Draft Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

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COVER SHEET

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Abstract:
This environmental impact statement (EIS) evaluates the environmental consequences of the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS) issuing incidental take permits associated with the Western Oregon State Forests Habitat Conservation Plan (HCP). The Oregon Department of Forestry (ODF) prepared the HCP in support of its permit applications. ODF is seeking take authorization from NMFS and FWS for the following species: Oregon Coast coho, Oregon Coast spring-run Chinook, Southern Oregon/Northern California Coast coho, Southern Oregon/Northern California Coast spring-run Chinook, Lower Columbia River coho, Upper Willamette River spring-run Chinook, Upper Willamette River steelhead, Columbia River chum, Lower Columbia River Chinook, eulachon, northern spotted owl, marbled murrelet, Oregon slender salamander, Columbia torrent salamander, Cascade torrent salamander, coastal marten, and red tree vole. The permits, if issued, would authorize take of the covered species that may occur incidental to ODF's forest and recreation management activities. The EIS presents effects of the proposed HCP and four alternatives on geology and soils, water resources, vegetation, fish and wildlife, air quality, aesthetics, recreation, cultural resources, tribal resources, socioeconomics, and environmental justice, and greenhouse gas emissions and carbon storage.

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Acronyms and Abbreviations

°C	degrees Celsius
APE	area of potential effects
BIA	Bureau of Indian Affairs
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO_2	carbon dioxide
CWA	Clean Water Act
DDE	Dichlorodiphenyldichloroethylene
EIS	Environmental Impact Statement
ERZ	Equipment Restriction Zone
ESA	Endangered Species Act
FMP	Forest Management Plan
FPA	Forest Practices Act
FR	Federal Register
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
HCA	habitat conservation area
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
ITP	incidental take permit
mg/L	milligrams per liter
MT CO_2e	metric tons carbon dioxide equivalent
N_2O	nitrous oxide
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRHP	National Register of Historic Places
O_3	ozone
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
OHV	off-highway vehicle
ORS	Oregon Revised Statues
PPZ	process protection zone
RCA	riparian conservation area
RMA	riparian management area
SR	State Route

the Services	NMFS and FWS
TMDL	total maximum daily load
U.S.C.	United States Code

ES.1 Introduction

The Oregon Department of Forestry (ODF) prepared the Western Oregon State Forests Habitat Conservation Plan (HCP) to support its applications for incidental take permits (ITPs) from the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) (collectively, the Services). The ITPs would authorize take of endangered and threatened species resulting from ODF's forest and recreation management activities on state-owned and managed forestlands in accordance with the requirements of the Endangered Species Act (ESA). Section 9 of the ESA and Federal regulations prohibit the taking of a species listed as endangered or threatened. The ESA defines "take" to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS and FWS may issue permits, under limited circumstances to take listed species incidental to, and not the purpose of, otherwise lawful activities. Section 10(a)(1)(B) of the ESA and implementing regulations provide for authorizing incidental take of listed species.

The proposed issuance of an ITP is considered a federal action under the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 et seq.). This environmental impact statement (EIS) was prepared to meet the Services' NEPA requirements. NMFS is the federal lead agency responsible for preparing the EIS, and FWS is a cooperating agency.

ES.2 Proposed Federal Action and Decisions to be Made

The Services are reviewing the ITP applications, received on February 9, 2022. The Services will base their decisions on the statutory and regulatory criteria of the ESA. Their decisions will also be informed by the data, analyses, and findings in this EIS and public comments received on the EIS and HCP. The Services will independently document their determinations in an ESA Section 10 findings document, ESA Section 7 biological opinion, and NEPA Record of Decision developed at the conclusion of the ESA and NEPA compliance processes. If the Services find that all requirements for issuance of the ITPs are met, they will issue the requested permits, subject to terms and conditions deemed necessary or appropriate to carry out the purposes of ESA Section 10.

ES.3 Purpose and Need for Federal Action

The purpose of ITP(s) issuance to ODF is to protect the covered species and their habitat while allowing the applicant to manage the permit area in compliance with the ESA. The need for the federal action is to respond to the applicant's request for ITPs for the covered species and covered activities as described in the HCP.

ES.4 Public Involvement

NMFS initiated the public scoping process for this EIS by publishing the Notice of Intent (NOI) to prepare an EIS in the *Federal Register* (FR) on March 8, 2021 (86 FR 13337). The NOI can be accessed at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat. The NOI announced NMFS' intent to prepare an EIS, provided information on the public scoping meeting, and requested comments from all interested parties on the scope of issues and alternatives to consider in preparing the EIS. The original comment period was from March 8, 2021, to April 7, 2021, which NMFS extended to April 21, 2021, in response to commenter requests (86 FR 18268). NMFS hosted a virtual scoping meeting on March 31, 2021. The *Scoping Report* (Appendix 1-C) summarizes comments received during the scoping period, which NMFS considered when developing this EIS.

The Draft EIS and HCP are concurrently released for public review. All comments must be submitted within the published comment period, which will close 60 days after the U.S. Environmental Protection Agency publishes a Notice of Availability of the Draft EIS in the FR. NMFS will consider all comments in preparing the Final EIS. A virtual public meeting will be held during the comment period, and attendees may give oral comments at this meeting. Written comments submitted via www.regulations.gov and oral comments received at the virtual public meeting will be considered and addressed in the Final EIS.

ES.5 Alternatives

NMFS analyzed five alternatives in detail in the Draft EIS, including the no action alternative and the proposed action (Western Oregon State Forests HCP). All alternatives include the forest and recreation management activities described in Section 2.1.2.2, *Covered Activities*. Chapter 2 and Appendix 2-A describe additional alternatives that NMFS considered but eliminated from detailed study.

ES.5.1 Alternative 1: No Action

Under the no action alternative, the applicant would not request and the Services would not issue ITPs for the proposed covered activities (i.e., forest and recreation management activities) described in Section 2.1.2.2. Current management practices would continue to guide management of ODF lands and the applicant would continue to conduct these activities in the absence of the HCP. ODF would manage riparian areas using the strategy delineated in the Northwest and Southwest Oregon State FMPs (ODF 2010a, 2010b) or in the most current FMP. These plans include riparian management areas (RMAs) based on stream classification and apply wider RMAs in areas designated as aquatic anchors, which are intended to provide additional riparian protections. ODF would manage lands outside of RMAs using the strategy delineated in its 2010 FMPs, which includes a structure-based management approach intended to develop a mosaic of stand types that shifts across the landscape. Species-related harvest constraints are based on the avoidance of sites occupied by listed species, specifically marbled murrelets and northern spotted owls. Harvest is not permitted in areas occupied by listed species but can occur after an area becomes unoccupied. No additional conservation measures would be implemented beyond what is required by the current Northwest and Southwest Oregon State FMPs and Oregon Forest Practices Act (FPA) (Oregon Revised Statues [ORS] 527 and Oregon Administrative Rules [OAR] 629).

ODF's forest and recreation management activities would continue to be subject to the Endangered Species Act (ESA). ODF currently manages state forests consistent with their FMPs with an intent to avoid and minimize the risk of take of any listed species (ODF 2010a, 2010b) and would continue to do so under the no action alternative.

The no action alternative is the baseline against which other alternatives are compared in the analysis of environmental consequences.

ES.5.2 Alternative 2: Proposed Action

Under the proposed action, the Services would approve the HCP and issue ITPs with 70-year permit terms to the applicant for incidental take of covered species from covered activities in the permit area. The proposed action is described in more detail in Section 2.1, *Alternatives Analyzed in Detail*.

Covered Activities

The covered activities are the forest and recreation management activities, as well as the activities needed to carry out the conservation strategy, projects, and activities for which ODF is requesting take authorization and include the following:

- Timber harvest activities
- Reforestation and young stand management
- Road system management activities
- Minor forest product harvest
- Quarries
- Fire management
- Recreation infrastructure and maintenance
- Conservation strategy implementation activities

Covered Species

The covered species include 17 species as listed in Table ES-1.

Table ES-1. Covered Species in the Western Oregon State Forests HCP

Species
NMFS
Oregon Coast coho (*Oncorhynchus kisutch*)
Oregon Coast spring Chinook (*O. tshawytscha*)
Southern Oregon/Northern California Coast coho (*O. kisutch*)
Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*)
Lower Columbia River coho (*O. kisutch*)
Upper Willamette River spring Chinook (*O. tshawytscha*)
Upper Willamette River steelhead (*O. mykiss*)
Columbia River chum (*O. keta*)
Lower Columbia River Chinook (*O. tshawytscha*)
Eulachon (*Thaleichthys pacificus*)
FWS
Northern spotted owl (*Strix occidentalis*)
Marbled murrelet (*Brachyramphus marmoratus*)
Oregon slender salamander (*Batrachoseps wrighti*)
Columbia torrent salamander (*Rhyacotriton kezeri*)
Cascade torrent salamander (*R. cascadae*)
Coastal marten (*Martes caurina*)
Red tree vole (*Arborimus longicaudus*)

NMFS = National Marine Fisheries Service; FWS = U.S. Fish and Wildlife Service

Conservation Strategy

The HCP's conservation strategy consists of a series of conservation actions that ODF would implement to achieve the biological goals and objectives for the covered species and to avoid, minimize, and mitigate impacts of take on listed species. The conservation strategy includes the following actions:

- Conservation Action 1, Establish Riparian Conservation Areas, establishes riparian conservation areas (RCAs) around streams, which would be intended to increase habitat complexity, channel stability, and channel form and function by maintaining or increasing large wood and gravel recruitment (including requiring ODF to leave trees in areas identified as high hazard for landslide initiation), stream shading, nutrient input, and streambank integrity.
- Conservation Action 2, Riparian Equipment Restriction Zones, limits covered activities near streams.
- Conservation Action 3, Stream Enhancement, commits ODF to completing in-stream improvement projects.
- Conservation Action 4, Remove or Modify Artificial Fish-Passage Barriers, commits ODF to repairing or replacing culverts that are barriers to fish passage.
- Conservation Action 5, Standards for Road Improvement and Vacating, sets standards for prioritizing and selecting road projects.

- Conservation Action 6, Establish Habitat Conservation Areas, establishes habitat conservation areas (HCAs) intended to support the persistence of northern spotted owl, marbled murrelet, red tree vole, Oregon slender salamander, and coastal marten by conserving, maintaining, and enhancing habitat in and adjacent to existing occupied habitat, as well as to increasing overall habitat values for covered species at the landscape level.
- Conservation Action 7, Manage Habitat Conservation Areas, limits and restricts management activities within HCAs.
- Conservation Action 8, Conservation Actions Outside Habitat Conservation Areas and Riparian Conservation Areas, commits ODF to management standards for areas outside of HCAs and RCAs, including landscape-wide requirements for dispersal habitat for northern spotted owl, legacy tree retention, and stand-level structure goals.
- Conservation Action 9, Strategic Terrestrial Species Conservation Actions, commits ODF to conducting certain strategic terrestrial conservation actions.
- Conservation Action 10, Operational Restrictions to Minimize Effects on Terrestrial Species, sets species-specific restrictions intended to minimize effects of the covered activities to covered species.
- Conservation Action 11, Road Construction and Management Measures, commits ODF to applying techniques and guidelines intended to minimize effects on covered species by reducing erosion and stream sedimentation during road construction and maintenance.
- Conservation Action 12, Restrictions on Recreational Facilities, limit development of new recreational facilities in HCAs and RCAs.

ES.5.3 Alternative 3: Increased Conservation

Under Alternative 3, the HCP would include the same covered activities, covered species, permit term, and monitoring and adaptive management program as the proposed action but Conservation Actions 1 and 5 would be modified to increase conservation. Under Conservation Action 1, RCA widths on certain stream types and protections related to landslide initiation sites would be expanded. Conservation Action 5 would include increased commitments related to prioritizing and selecting road projects.

ES.5.4 Alternative 4: Reduced Permit Term

Under Alternative 4, the HCP would include the same covered activities, covered species, conservation strategy, and monitoring and adaptive management program as the proposed action, but would have a shorter permit term, 50 instead of 70 years.

ES.5.5 Alternative 5: Increased Timber Harvest

Under Alternative 5, the HCP would include the same covered activities, covered species, permit term, and monitoring and adaptive management program as the proposed action but Conservation Actions 6 and 7 would be modified to increase harvest. Conservation Action 6 would include reduced acreage of HCAs. Conservation Action 7 would increase allowable harvest of Swiss needle cast stands in HCAs.

ES.6 Summary of Impact Analysis

Table ES-2 summarizes the impacts that could occur under the proposed action and alternatives for all environmental issues analyzed in the EIS. Chapter 3 provides a detailed analysis of potential effects.

Table ES-2. Summary of Potential Impacts

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Geology and Soils		
Timber harvest and road management could increase frequency of shallow-rapid landslide and debris flow/debris torrent, which have associated adverse effects (stream channel scour and delivery of fine sediment to streams) and beneficial effects (large wood recruitment and coarse sediment delivery to streams) on stream geomorphology and soil productivity. Riparian protections would encourage recruitment of large wood and coarse sediment to streams in the event of shallow-rapid landslide. In addition, use of heavy equipment near streams that removes vegetation and compacts soils would increase the delivery of fine sediment to streams. Continued implementation of the current practices would reduce these adverse effects and increase beneficial effects.	Types of effects would be the same as described for the no action alternative. Modeled increases in harvest and road activities could further increase the frequency of shallow-rapid landslide and associated events in the permit area. Expanded riparian protections would decrease adverse effects and increase beneficial effects on stream geomorphology in the event of landslide compared to the no action alternative.	**Alternative 3:** Effects would be the same as described for the proposed action, except that further expanded riparian protections would further decrease adverse effects and increase beneficial effects on stream geomorphology in the event of landslide. **Alternative 4:** Effects would be the same as described for the proposed action through year 50. **Alternative 5:** Effects would be the same as described for the proposed action, except that further increased harvest could result in greater potential to increase frequency of shallow-rapid landslide.
Water Resources		
Surface Water: Water Supply		
Timber harvest, young stand management, and road construction would result in increases in water yield at the local level. These effects of harvest would occur primarily in the first 15 years following harvest. The modeled increase in forest cover across the study area at three intervals over the analysis period showed slight average decreases in water supply, with varying localized effects depending on location and activity level.	Covered activities would affect water supply as described for the no action alternative. Because the timing and location of activities would differ from the no action alternative, localized effects would differ accordingly.	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Surface Water: Peak Flows and Channel Condition		
Based on modeling, harvest is not expected to increase peak flows at the subwatershed scale. However, in the absence of restrictions on level of harvest per subwatershed, adverse effects could occur at this scale. Where stream reaches drain areas with significant forest cover loss from harvest, road construction, and other activities, peak flows would increase and channel structure would be adversely affected at the local scale. Riparian buffers would be expected to increase wood recruitment to streams over the analysis period, mitigating some adverse effects.	As with the no action alternative, modeled harvest is not expected to increase peak flows at the subwatershed scale, but the potential for adverse effects would remain in the absence of restrictions on level of harvest per subwatershed. Modeled increases in harvest and road construction would result in increases in adverse effects at the local scale, described for the no action alternative. Expanded riparian protection under the proposed action would further mitigate some adverse effects.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protections would further mitigate some adverse effects. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action.
Surface Water: Low Flows		
Timber harvest may reduce low flows at the local stream scale, but because the change would be small relative to the study area and offset by effects of young and old growth, effects are not expected at the subwatershed scale. Road construction and controlled burns would increase low flows, while quarry development, road vacating, and water drafting would decrease low flows. Riparian buffers temper reductions in low summer flows.	Types of effects would be the same as described for the no action alternative. Modeled changes in stand distribution would result in increased reductions in low flows compared to the no action alternative but expanded riparian buffers would better mitigate these effects.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action but adverse effects would be greater (lower summer low flows) due to increased harvest.
Surface Water: Water Quality		
Timber harvest and stand management would increase stream temperature, sedimentation, and turbidity. Riparian buffers would reduce some of these adverse effects. Road construction and use would increase sedimentation, turbidity, and other contaminants; new roads near water bodies could increase public access and related	Types of effects would be the same as described for the no action alternative. Modeled increases in harvest compared to the no action alternative would result in greater potential adverse impacts on streams; however, expanded riparian buffers would further minimize adverse effects. Limits on salvage harvest in	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protections and more stringent road repair and vacating measures would further reduce adverse effects. **Alternative 4:** Effects compared to the no action alternative would be the same as

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
recreation activity impacts. Road closure and vacating would reduce some of these effects. Controlled burns would temporarily increase stream temperature, sedimentation, turbidity, pH levels, and other contaminants. Quarries can increase turbidity, sedimentation, oil and grease, mineral concentration, and pH of surface water. Water drafting would increase water temperature. The construction of recreation infrastructure could increase sediment delivery to streams, increase water temperature, and increase fecal bacteria. Stream enhancement and barrier removal could temporarily decrease water quality but result in long-term improvements. Maintenance activities would have a beneficial effect on water quality by repairing drainage features and addressing septic system issues but would have an adverse effect if herbicides or pesticides are used. Implementation of BMPs in compliance with CWA and state regulations would minimize and avoid water quality effects from quarries, water drafting, recreation infrastructure, and stream enhancement and barrier removal.	RCAs and HCAs would reduce associated effects compared to the no action alternative. The modeled increase in road construction under the proposed action would increase associated effects compared to the no action alternative, but increased equipment restriction zones would further mitigate these effects. Limitations on recreation infrastructure in RCAs would reduce associated effects compared to the no action alternative. Compliance with existing regulations would minimize and avoid water quality effects described for the no action alternative.	described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action; however, increased harvest would result in greater potential adverse effects on streams.
Groundwater		
Timber harvest, young stand management, and controlled burns would temporarily increase groundwater recharge. Road closing, vacating, maintaining, and drainage repair would increase groundwater recharge. Road construction and quarry and recreational development would decrease groundwater recharge. Overall effects on groundwater recharge would depend on location and timing	Types of effects would be the same as the no action alternative. However, lower average tree age and a larger road network compared to the no action alternative could reduce groundwater recharge compared to the no action alternative, while expanded riparian protections would increase groundwater recharge potential in certain locations.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that further expanded riparian protections and additional road system management standards could further increase groundwater recharge. **Alternative 4:** Effects compared to the no action alternative would be the same as

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
of management activities. Construction activities and some recreation infrastructure would pose some risk to groundwater quality; these effects would be minimized and mitigated through compliance with existing regulations.		described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, except that further increased harvest activity would further decrease groundwater recharge potential and increase the potential for groundwater contamination.
Flood Hazard		
Timber harvest, young stand management, controlled burns, and road construction could increase flood hazard by decreasing floodwater storage or conveyance capacity, redirecting floodwaters, increasing flood flow velocity, erosion and sedimentation potential. Road maintenance, road drainage repair, and closing or vacating roads in floodplains could reduce flood hazard by improving drainage and infiltration capacity, increasing floodwater storage capacity, and decreasing flood velocity.	Types of effects would be the same as described for the no action alternative. Modeled increase in harvest and road construction but could further increase flood hazard compared to the no action alternative. However, expanded riparian protections and commitments to road best management practices would better mitigate flood hazards under the proposed action.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action except that further expanded riparian protections and additional road system management requirements would reduce the magnitude of effects of flood hazards compared to the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action.
Vegetation		
Forest Structure and Type		
Modeled harvest and reforestation would change forest structure and type under the no action alternative over the analysis period in the following ways: • Greater average tree age and trunk diameter. • Greater understory complexity in late-seral forests • Less mid-seral forest and more late-seral forest.	Modeled harvest and reforestation under the proposed action shows the following differences in changes in forest structure and type compared to the no action alternative: • Age of trees harvested would be older on average over the permit term • More mid-seral forest and a less in late-seral forest	**Alternative 3:** Forest structure and type would be the same as the proposed action, with the following exceptions: • In riparian areas, more hardwood stands, higher average tree age, more green tree retention, and more understory complexity than under the proposed action

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
• Lower percent of Douglas-fir and hardwood stands and higher percent of western hemlock stands. In riparian areas, dominant forest types would remain conifer, mixed conifer, or hardwood forest Salvage following disturbance events could alter forest structure and type, likely reducing understory complexity, but specific effects are uncertain. Prescribed burns would result in nutrient release, fuels reduction, a more heterogeneous forest structure, and decreased understory structure.	• Higher percent of western hemlock stands and lower percent of mixed conifer stands • In riparian areas, increased hardwood stands, tree age, green tree retention, and understory complexity With restrictions on salvage harvest in HCAs and RCAs under the proposed action, less overall salvage harvest would occur, resulting in more standing dead matter, more understory organic matter, and more structural complexity. The potential for changes to forest structure and type would remain in areas outside of the RCAs and HCAs.	• Slightly less mid-seral forests and slightly more late-seral forest than the proposed action • Higher percent of mixed conifer and hardwood stands and slightly lower percent of Douglas-fir and Western hemlock stands than the proposed action **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Forest structure and type would be the same as the proposed action, with the following exceptions: • Lower average tree age and less structurally developed forest stands throughout the permit area • Less mid-seral forest • Less late-seral forests • More western hemlock stands
Permanent Removal of Vegetation		
Construction of roads, recreational infrastructure, and quarries would result in permanent removal of vegetation.	The modeled increase in road construction could result in increased vegetation removal while increased RCAs could reduce the removal of vegetation near streams compared to the no action alternative.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, but further increased RCAs could further reduce removal of vegetation near streams. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Invasives		
Ground disturbance could allow noxious weeds to establish in the study area but would be minimized using best management practices.	Based on modeling, ground disturbance would increase under the proposed action, which could result in increased potential for spread of noxious weeds compared to the no action alternative. This impact would be minimized using best management practices.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 5:** Ground disturbance would increase under Alternative 5 compared to the proposed action and no action alternative, which could result in increased potential for spread of noxious weeds. This impact would be minimized using best management practices.
Wetland Vegetation		
Timber harvest, salvage harvest, and prescribed burns in wetlands would reduce wetland function. Based on modeling, clearcut harvest and thinning would affect an annual average of 48 acres of documented wetlands over the analysis period. Salvage harvest could affect additional areas depending on the future disturbance. Effects of harvest and thinning on wetlands would be minimized through compliance with existing regulations and management practices.	Types of effects would be the same as described for the no action alternative. Based on modeling, clearcut harvest and thinning would affect an annual average of 88 acres of documented wetlands over the analysis period. Restrictions on salvage harvest in HCAs and RCAs would reduce potential for effects in these areas.	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as described for the proposed action.
Special-Status Plant Species		
Forest management activities have the potential to affect special-status plant species in the permit area through habitat degradation and removal. Best management practices would minimize the loss of special-status plant species.	Same as the no action alternative.	

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Fish and Wildlife		
Covered Salmonids		
Timber harvest, road construction and use, construction and operation of quarries and auxiliary facilities, water drafting, and recreation infrastructure development and maintenance would reduce the quality of salmonid habitat in the study area through effects on wood recruitment, sedimentation, stream temperature, peak and low flows, and habitat complexity, quantity, and connectivity. Timber harvest and equipment restrictions in riparian areas (RMAs), road vacating, and culvert removals would contribute to improved habitat quality for covered salmonids.	Types of effects would be the same as described for the no action alternative. Modeled increases in timber harvest and related activities (reforestation, road construction activities) compared to the no action alternative, would increase the effects of these activities. Wider riparian buffers (RCAs) and additional restrictions near streams would improve overall riparian health and reduce adverse effects from covered activities compared to the no action alternative. Commitments to stream enhancement and fish passage barrier removal would increase the likelihood of these projects and their beneficial effects on habitat quality and quantity. Monitoring and adaptive management commitments for fish and aquatic habitat as described for the proposed action would increase beneficial effects for covered salmonids.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protections and additional road vacating requirements would further improve habitat quality for covered salmonids. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, except that adverse effects from timber harvest would increase.
Eulachon (covered)		
Effects of forest and recreation management activities under the no action alternative would be the same as described for covered salmonids and would adversely affect eulachon habitat. Restrictions on these activities and riparian protections would reduce these effects, as described for covered salmonids.	Modeled increases in harvest and related activities would increase effects compared to the no action alternative. Wider riparian buffers (RCAs) and additional restrictions near streams would improve overall riparian health and reduce adverse effects from covered activities compared to the no action alternative. Commitments to stream enhancement and fish passage barrier removal would increase the likelihood of these projects and their beneficial effects on habitat quality and quantity. Monitoring and adaptive management commitments for fish and aquatic habitat would increase beneficial effects for eulachon.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, but expanded riparian protections and additional road system management requirements would further increase beneficial effects to habitat. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, except that

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
		adverse effects from timber harvest would increase.
Torrent Salamanders (covered)		
Timber harvest, road construction and use, construction and operation of quarries and auxiliary facilities, water drafting, and recreation infrastructure development and maintenance would reduce the quality of torrent salamander habitat in the study area through effects on wood recruitment, sedimentation, stream temperature, peak and low flows, and habitat complexity, quantity, and connectivity. These effects would be greatest in habitat with narrow or nonexistent riparian buffers (RMAs). Timber harvest and other activities could directly harm torrent salamanders through injury or mortality. Road construction, use, and maintenance would reduce habitat connectivity. Harvest and equipment restrictions in riparian areas (RMAs), road vacating, and culvert removals would reduce adverse effects on torrent salamanders.	Types of effects would be the same as described for the no action alternative. Modeled increases in timber harvest and related activities would increase adverse effects of these activities compared to the no action alternative. Wider riparian buffers (RCAs) and additional restrictions near streams would reduce adverse effects from covered activities compared to the no action alternative, but adverse effects would remain in seasonal, non-fish bearing streams that are not high energy or debris flow tracks. Monitoring and adaptive management plan for torrent salamanders would increase knowledge of torrent salamanders occurring in perennial streams and would increase beneficial effects on torrent salamanders.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protections would increase beneficial effects and reduce some adverse effects on habitat quality compared to the proposed action and additional road system management requirements would increase overland dispersal capacity for torrent salamanders. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, except that adverse effects from timber harvest would increase.
Noncovered Fish Species		
Effects on noncovered fish species would be similar to the effects described above for covered salmonids and eulachon; habitat quality would be reduced for a range of non-covered, native fish.	Modeled increases in activity levels would result in increased effects, while expanded riparian and aquatic protections would further minimize and mitigate effects compared to the no action alternative.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that further expanded riparian protections and additional road system management requirements would reduce adverse effects. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
		Alternative 5: Effects compared to the no action alternative would be the same as described for the proposed action but effects related to harvest would increase.
Noncovered Stream-Dependent Wildlife		
Effects on noncovered stream-dependent wildlife species that rely on fishless areas would be similar to the effects described above for torrent salamanders. Effects on noncovered stream-dependent wildlife species that may or may not coexist with fish would be similar to the effects described for covered salmonids and eulachon. The no action alternative would adversely affect species that rely more on fishless streams.	Effects on noncovered stream-dependent wildlife species under the proposed action that rely on fishless areas would be similar to those described above for torrent salamanders. Effects on noncovered stream-dependent wildlife species that may or may not coexist with fish would be similar to those described for covered salmonids and eulachon. Adverse effects would be reduced compared to the no action alternative in all but small, fishless seasonal streams that are not high energy or debris flow tracks.	**Alternative 3:** Effects compared to the no action alternative would be similar to those described for the proposed action, except that further-expanded riparian buffers and more stringent road-vacating requirements would increase beneficial effects. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest.
Oregon Slender Salamander (covered)		
Activities leading to injury or mortality of Oregon slender salamander would be prohibited when Oregon slender salamander becomes federally listed. Timber harvest, including salvage harvest, would modify Oregon slender salamander habitat and could reduce survival. Total modeled habitat decreases over the analysis period but highly suitable habitat increases. Assured habitat connectivity would be limited to riparian corridors. Road construction and quarry and recreational development could cause inadvertent direct injury or mortality and would result in potential habitat removal or modification. Avoidance of occupied habitat would shift if species distribution shifted following disturbance, but	Types of effects would be the same as described for the no action alternative. Unlike the no action alternative, take of Oregon slender salamander in the form of injury, mortality, or habitat modification would be permitted even when the species becomes listed during the permit term. This take would be minimized and mitigated by protection of habitat in HCAs (Conservation Action 6), increase in the quantity and quality of habitat over the permit term, inside HCAs (Conservation Action 7), and retention of legacy structure, including downed wood, in harvested stands outside of the HCAs (Conservation Action 8).	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action would be the same as the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as described for the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
restoration of disturbed areas would not be required and salvage in these areas would remove habitat. Monitoring would be limited to pre-harvest surveys to determine species presence.	Modeled habitat is similar to the no action alternative, but with slightly more overall modeled habitat and slightly less high-quality modeled habitat. Habitat connectivity would be greater. Effects of other activities would be the same as under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and access-related disturbance. The locations of conservation areas would not move if species move in response to disturbance, but restrictions of salvage in HCAs would promote restoration of disturbed areas in HCAs. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.	
Northern Spotted Owl (covered)		
Take of northern spotted owl would not be authorized and ODF would continue to avoid active spotted owl sites. Habitat removal or modification through timber harvest would be the primary effect on northern spotted owl. Nesting and roosting habitat would increase, while foraging and dispersal habitat would decrease over the analysis period. Assured habitat connectivity and dispersal habitat would be limited to riparian corridors. Road construction and quarry and recreational development would result in potential habitat removal or modification and increased access-related disturbance. Avoidance of occupied habitat would shift if species distribution shifted following disturbance, but restoration of	Types of effects would be the same as described for the no action alternative. Unlike the no action alternative, take of northern spotted owl would be authorized. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and protection of nest trees (Conservation Action 10). Most of the known active northern spotted owl sites in the permit area would be protected in HCAs and stand management activities in HCAs would increase habitat quality for northern spotted	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as under the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
disturbed areas would not be required and salvage in these areas would remove habitat. Monitoring would be limited to pre-harvest surveys to determine species presence.	owls over the permit term (Conservation Actions 6 and 7). Modeled nesting and roosting habitat increase over the permit term but less than projected under the no action alternative. Modeled foraging habitat decreases over the permit term, similar to the no action alternative. Modeled dispersal habitat decreases through year 25 and remains stable through the remainder of the permit term, resulting in more dispersal habitat by the end of the permit term and greater habitat connectivity than the no action alternative. Effects of other activities would be the same as under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and access-related disturbance. The locations of conservation areas would not move if species move in response to disturbance, but restrictions of salvage in HCAs would promote restoration of disturbed areas in HCAs. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.	
Marbled Murrelet (covered)		
Take of marbled murrelet would not be authorized and ODF would continue to avoid active marbled murrelet sites. Habitat removal or modification through timber harvest would be the primary effect on marbled murrelet. Total modeled habitat decreases over the analysis period. Assured habitat connectivity and dispersal habitat would be limited to riparian corridors. Road construction and	Types of effects would be the same as described for the no action alternative. Unlike the no action alternative, take of marbled murrelet would be authorized. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
quarry and recreational development would result in potential habitat removal or modification and increased access-related disturbance. Avoidance of occupied habitat would shift if species distribution shifted following disturbance, but restoration of disturbed areas would not be required and salvage in these areas would remove habitat. Monitoring would be limited to pre-harvest surveys to determine species presence.	(Conservation Action 8), and protection of nest trees (Conservation Action 10). The majority of the known occupied marbled murrelet sites in the permit area would be protected in HCAs. Modeled habitat increases over the permit term but less than projected under the no action alternative. Focusing management in contiguous areas of suitable habitat within HCAs would increase habitat connectivity. Effects of other activities would be the same as under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and access-related disturbance. The locations of conservation areas would not move if species move in response to disturbance, but restrictions of salvage in HCAs would promote restoration of disturbed areas in HCAs. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.	**Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action.
Coastal Marten (covered)		
ODF would continue to avoid management activities in occupied coastal marten habitat that could cause take. Harvest activities (especially clearcut harvest, retention cutting, and thinning) in unoccupied habitat would be the primary factor adversely affecting coastal marten habitat through reduction in habitat quality and quantity. Fragmentation of habitat would increase predation risk. Assured habitat connectivity and dispersal habitat would be limited to riparian corridors. Road construction and quarry and recreational development	The covered activities would have the same types of effects as described for the no action alternative. Unlike the no action alternative, take of coastal marten would be authorized. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and operational restrictions in occupied habitat outside HCAs (Conservation Action 10).	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as described for the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
would result in potential habitat removal or modification and increased access-related disturbance. Avoidance of occupied habitat would shift if species distribution shifted following disturbance, but restoration of disturbed areas would not be required and salvage in these areas would remove habitat. Monitoring would be limited to pre-harvest surveys to determine species presence.	The majority of the known occupied marbled murrelet sites in the permit area would be protected in HCAs. Modeled habitat increases over the permit term but less than projected under the no action alternative. Focusing management in contiguous areas of suitable habitat within HCAs would increase habitat connectivity. Effects of other activities would be the same as under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and access-related disturbance. The locations of conservation areas would not move if species move in response to disturbance, but restrictions of salvage in HCAs would promote restoration of disturbed areas in HCAs. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.	
Red Tree Vole (covered)		
Under the no action alternative, activities leading to injury or mortality of red tree vole would be prohibited when red tree vole becomes federally listed. Total modeled habitat increases over the analysis period with highly suitable habitat increasing substantially and suitable habitat decreasing slightly. Assured habitat connectivity would be limited to riparian corridors. Road construction and quarry and recreational development would result in potential habitat removal or modification and access-related disturbance. Avoidance of occupied habitat would shift if species distribution shifted following	The covered activities would have the same types of effects as described for the no action alternative. Unlike the no action alternative, take in the form of injury, mortality, or habitat modification would be permitted even if the species becomes listed during the permit term. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and protection of nest trees (Conservation Action 10).	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
disturbance, but restoration of disturbed areas would not be required and salvage in these areas would remove habitat. Monitoring would be limited to pre-harvest surveys to determine species presence.	Modeled habitat increases over the permit term but less than under the no action alternative. Focusing management in contiguous areas of suitable habitat within HCAs would increase habitat connectivity. Effects of other activities would be the same as under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and access-related disturbance. The locations of conservation areas would not move if species move in response to disturbance, but restrictions of salvage in HCAs would promote restoration of disturbed areas in HCAs. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.	
Noncovered Forest-Dependent Wildlife		
Timber harvest, reforestation, and young stand management would remove mid- and late-seral forest stands. Species occurring in these habitats could be injured or killed by equipment or tree felling. Removal of mid- and late-seral forest stands would adversely affect noncovered wildlife species that depend on this habitat type during at least part of their lifecycle, while benefiting wildlife species dependent on early-seral forest. The modeled increase in total late-seral forest over the analysis period (with the greatest changes occurring in the first 25 years of the analysis period) would benefit wildlife species dependent on this forest type, but could increase habitat for species dependent on early-	Types of effects would be the same as described for the no action alternative. Based on modeling, late-seral habitat would increase less and mid-seral habitat would decrease less compared to the no action alternative. As described for the no action alternative, the greatest changes occur in the first 25 years of the permit term. Habitat connectivity would increase compared to the no action alternative. The modeled increase in road miles compared with the no action alternative could reduce habitat connectivity and dispersal ability for some amphibian and invertebrate species that do not tend to cross roads.	**Alternative 3:** Effects compared to the no action alternative would be similar to the proposed action, but expanded riparian protections may provide more habitat and improved connectivity. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action but increased harvest would reduce overall forested habitat.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
seral forest and open forest structure. Habitat connectivity would decrease.		
Noncovered Species Dependent on Wetlands and Riparian		
Timber harvest could reduce riparian and wetland function through removal of vegetation and ground disturbance. Effects of other activities would be nominal due to existing regulatory guidance and practices.	The modeled acreage of potential habitat effects from timber harvest is greater under the proposed action than no action alternatives. Effects of other activities would be nominal due to existing regulatory guidance and practices	**Alternative 3:** Effects compared to the no action alternative would be the same as the proposed action, except that road vacating requirements under Alternative 3 would increase beneficial effects for wetland species by improving water quality. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as the proposed action.
Air Quality		
Forest and recreation management activities would result in emissions from the use of vehicles and equipment that emit air pollutants. Emissions would be distributed across the permit term and would not be likely to violate ambient air quality standards, cause an adverse effect on long-term air quality, or impair visibility.	Same as no action alternative.	Same as no action alternative.
Aesthetics		
Vegetation Patterns		
Forest and recreation management activities would affect forest structure and type, causing localized visual changes. ODF would continue to conduct management activities according to existing plans and policies and high-quality views and dynamic visual environments would continue to exist in the study area.	Same as no action alternative.	Same as no action alternative.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Visual Access		
Forest and recreation management activities would continue to preserve and protect visual access to recreational areas the quality of associated views. The modification of forest road systems would cause shifts in visual access for viewers using forest roadways for dispersed recreation. Increases in the road network to access harvest units could increase recreational access in the permit area. Some access may be removed due to road closure and vacating.	Types of effects would be the same as described for the no action alternative. The modeled increase in road construction compared to the no action alternative could further increase recreational access in the permit area.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for Same as the proposed action, but additional road system management requirements could decrease visual access compared to the proposed action in RCAs and HCAs. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action.
Wild and Scenic Rivers		
ODF would continue to protect views associated with Wild and Scenic Rivers through compliance with state restrictions and screening requirements.	Same as the no action alternative.	Same as the no action alternative.
Scenic Byways		
ODF would continue to implement scenic buffers along scenic corridors to protect immediate foreground views from these roadways.	Same as the no action alternative.	Same as the no action alternative.
Recreation		
Supply of Recreation		
ODF would continue to manage harvests to minimize impacts on developed recreation and would retain existing roads that facilitate recreation access. Harvest activities may temporarily restrict access to recreation sites. Increased spur roads for forest management over the analysis period could expand recreation access.	As under the no action alternative, ODF would continue to manage harvests to minimize impacts on developed recreation and retain existing roads that facilitate recreation access. Harvest activities may temporarily restrict access to recreation sites. The modeled increase in spur roads over the permit could further	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, but additional road system management requirements could reduce recreational access. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Development of new recreational facilities would increase the supply of recreation.	expand recreation access compared to the no action alternative. Restrictions on siting of recreational facilities in HCAs and RCAs would affect the location of certain facilities but is not expected to affect the overall supply compared to the no action alternative.	**Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, but a larger road network could further increase recreational access.
Quality or Value of Recreation		
Recreational views would be protected as described above for *Visual Access.* Access to all types of forest would be available across the permit area, but the change in spatial distribution over time would have varying effects on different recreation uses. Effects on fish and wildlife species and habitat could increase or decrease recreational value depending on the activity.	Recreational views would be protected as described above for *Visual Access.* Access to all types of forest would be available across the permit area. Because the change in spatial distribution over time would differ from the no action alternative, effects on different recreation uses would also vary. Effects on fish and wildlife species and habitat would have similar varying effects on recreational value as the no action alternative, though beneficial effects on fish habitat quality would benefit recreational anglers.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, but expanded riparian protections could improve riparian habitat quality, further improving some recreational opportunities. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 5:** Effects compared to the no action alternative would be similar to those described for the proposed action.
Cultural Resources		
Forest and recreation management activities under the no action alternative would cause ground disturbance or changes to the setting and have the potential to result in adverse effects on cultural resources. ODF will continue to comply with all policies and procedures and adhere to regulations relevant to cultural resources, which would minimize and mitigate for adverse effects on cultural resources.	Under the proposed action and Alternatives 3, 4, and 5, effects on cultural resources would be similar to the no action alternative, and ODF will continue to comply with applicable regulations, policies and procedures.	
Tribal Resources		
Fish and Wildlife Species		

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Timber harvest and reforestation activities would provide some habitat types for deer and elk but remove others and would reduce habitat connectivity. Forest and recreation management activities would reduce the quality of fish habitat in the study area. Restrictions in riparian areas, road vacating, and culvert removals would reduce these effects but would not fully protect the ecological function of the habitat. Expansion of the operational road network over the analysis period could increase access to fish and wildlife species valued by tribes.	Increased habitat connectivity would benefit deer and elk movement compared to the no action alternative but decreased edge could decrease forage habitat compared to the no action alternative. Modeled increases in timber harvest and related activities compared to the no action alternative would increase adverse effects of these activities on fish habitat; however, Conservation Actions 1, 2, 7, 8, and 12 would further reduce adverse effects of the covered activities and provide more protection to streams and riparian areas. The modeled increase in the road network compared to the no action alternative could increase access to fish and wildlife species valued by tribes.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protections and additional road system management requirements would contribute to increased habitat quality for fish and wildlife species valued by tribes. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action but with greater adverse effects related to harvest.
Availability of or Access to Plants		
Forest management activities would reduce availability of or access to some plants valued by the tribes. Availability of certain plants valued by tribes, specifically that rely on late-seral forest, would increase over the permit term in areas where harvest is restricted.	Forest management activities would reduce availability of or access to some plants valued by the tribes. Availability of certain plants valued by tribes, specifically that rely on late-seral forest, would increase over the permit term but less than under the no action alternative based on model projections. Availability of riparian and wetland plants would increase compared to the no action alternative.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, but expanded riparian protections would further increase availability of riparian and wetland plants. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, but increased harvest would reduce availability of plants valued by the tribes compared to the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Timber Harvest and Available Forest Products		
Activities in the permit area generate various forms of economic activity, some of which could contribute to employment and income for tribal groups. The distribution of employment impacts on tribal groups (like other specific groups) depends on contractual relationships over space and time and cannot necessarily be inferred from aggregate economic effects. Additional detail on these effects for each alternative is included under Socioeconomics.	See explanation under no action alternative.	
Minor Forest Products		
Modeled increases in late-seral stage forests over the analysis period would favor plant species that occur in older, more diverse forests. Timber harvest sites would continue to provide opportunities for firewood collection although access may change over the analysis period. Construction of spur roads may improve access for collection of minor forest products.	Effects would be the same as described for the no action alternative, but increased forest diversity compared to the no action alternative could increase the variety of plant species and opportunities for harvest and the availability of timber suitable for processing as firewood. The increased road network could improve access to minor forest products.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, but increased harvest could increase availability of timber suitable for processing as firewood.
Socioeconomics		
Income or Employment Levels		
Forest management activities would provide direct jobs and labor income and support non-forestry jobs, labor income, value added, and output through indirect and induced effects. Based on modeling, total direct jobs would support approximately $3.4 billion in employee compensation, including wages and benefits, over the analysis period.	Based on modeling, employee compensation would increase compared to the no action alternative over the permit term with compensation from direct jobs increasing by 29.5 percent.	**Alternative 3:** Based on modeling, employee compensation would increase compared to the no action alternative over the permit term with compensation from direct jobs increasing by 28.3 percent. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
		Alternative 5: Based on modeling, employee compensation would increase compared to the no action alternative over the permit term with compensation from direct jobs increasing by 33.7 percent.
Government Revenue		
Forest management activities would generate timber sale revenues for state agencies, and local county governments, and taxing districts. Based on modeling, most entities would see revenue from timber sales decrease over the analysis period compared to existing conditions.	Based on modeling, timber sale revenues would increase overall compared to the no action alternative. Generally, timber sale revenue distributions would increase for all counties (and associated taxing districts) with Board of Forestry lands except Marion County.	**Alternative 3:** Effects compared to the no action alternative would be similar to the proposed action but slightly lower overall. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be similar to the proposed action but slightly higher overall.
Value of Ecosystem Services		
There would be mixed effects on the value of special forest products depending on changes to forest structure and type. Effects on fish and wildlife habitat would depend on the location and intensity of forest management activities, so the value of ecosystem services like fishing, hunting, and the existence of sensitive, threatened, and endangered species would vary. The value of carbon sequestration would increase over the analysis period. There would be minimal change to the value of ecosystem service related to surface water quality regulation. The value of cultural services from old-growth forests would increase slightly. The value of forest-based educational services would not change.	The modeled difference in stage age distribution compared to the no action alternative would change the availability of certain forest products. Continued availability of all habitat types in the permit area would limit impacts on value of hunting. Riparian protections could increase the value of fishing compared to the no action alternative. The modeled value of carbon sequestration is lower than the no action alternative. The value of sensitive, threatened, and endangered species would be similar to the no action alternative. Other effects would be the same as the no action alternative.	**Alternative 3:** Effects compared to the no action alternative would be the same or nearly the same as described for the proposed action. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same or nearly the same as described for the proposed action.

Alternative 1: No Action	Alternative 2: Proposed Action	Alternatives 3 through 5
Environmental Justice		
Potential disproportionately high and adverse effects were identified for socioeconomics (income and employment, government revenue, and the value of ecosystem services).	Potential disproportionately high and adverse effects were identified for recreation and socioeconomics (income and employment, government revenue, and the value of ecosystem services). Potential disproportionately high and adverse effects related to income and employment and government revenue and would be less adverse than the no action alternative.	**Alternative 3:** Effects compared to the no action alternative would be the same as described for the proposed action, except potential disproportionately high and adverse effects related to government revenue and value of ecosystem services would be lower. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be the same as described for the proposed action, with slightly reduced adverse effects related to government revenue.
Greenhouse Gas Emissions and Carbon Storage		
Forest management activities would result in greenhouse gas emissions, but modeled carbon stored in the forest continues to increase. The study area would sequester more carbon than covered activities would emit; therefore, the no action alternative would not affect climate change.	Based on modeling, increased harvest activity compared to the no action alternative would result in increased emissions and decreased carbon storage. However, the study area would sequester more carbon than covered activities would emit; therefore, the proposed action would not affect climate change.	**Alternative 3:** Effects compared to the no action alternative would be nearly the same as under the proposed action, with slightly decreased emission and increased carbon sequestration. **Alternative 4:** Effects compared to the no action alternative would be the same as described for the proposed action through year 50. **Alternative 5:** Effects compared to the no action alternative would be nearly the same as described for the proposed action, with slightly increased emission and slightly less carbon sequestration.

Chapter 1
Purpose and Need

1.1 Introduction

The Oregon Department of Forestry (ODF) prepared the Western Oregon State Forests Habitat Conservation Plan (HCP) to support its applications for incidental take permits (ITPs) from the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) (collectively, the Services). The ITPs would authorize take[1] of endangered and threatened species resulting from ODF's forest and recreation management activities on state-owned and managed forestlands in accordance with the requirements of the Endangered Species Act (ESA). Section 9 of the ESA and federal regulations prohibit the taking of a species listed as endangered or threatened. The ESA defines "take" to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS and FWS may issue permits, under limited circumstances to take listed species incidental to, and not the purpose of, otherwise lawful activities. Section 10(a)(1)(B) of the ESA and implementing regulations provide for authorizing incidental take of listed species.

The proposed issuance of an ITP is considered a federal action under the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 *et seq*.). This environmental impact statement (EIS) was prepared to meet the Services' NEPA requirements. NMFS is the federal lead agency responsible for preparing the EIS, and FWS is a cooperating agency.

1.2 Proposed Federal Action and Decisions to be Made

The Services are reviewing the ITP applications, received on February 9, 2022. The Services will base their decisions on the statutory and regulatory criteria of the ESA. Their decisions will also be informed by the data, analyses, and findings in this EIS and public comments received on the EIS and HCP. The Services will independently document their determinations in an ESA Section 10 findings document, ESA Section 7 biological opinion, and NEPA Record of Decision developed at the conclusion of the ESA and NEPA compliance processes. If the Services find that all requirements for issuance of the ITPs are met, they will issue the requested permits, subject to terms and conditions deemed necessary or appropriate to carry out the purposes of ESA Section 10.

1.3 Purpose and Need for Federal Action

The purpose of ITP(s) issuance to ODF is to protect the covered species and their habitat while allowing the applicant to manage the permit area in compliance with the ESA. The need for the federal action is to respond to the applicant's request for ITPs for the covered species and covered activities as described in the HCP.

[1] Take is defined in the ESA Section 3(19) as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Appendix 1-A, *Glossary*, presents definitions of terms used in the EIS.

1.4 Scoping and Public Engagement

NMFS initiated the public scoping process for this EIS by publishing the Notice of Intent (NOI) to prepare an EIS in the *Federal Register* (FR) on March 8, 2021 (86 FR 13337). The NOI can be accessed at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat. The NOI announced NMFS' intent to prepare an EIS, provided information on the public scoping meeting, and requested comments from all interested parties on the scope of issues and alternatives to consider in preparing the EIS. The original comment period was from March 8, 2021, to April 7, 2021, which NMFS extended to April 21, 2021, in response to commenter requests (86 FR 18268). NMFS hosted a virtual scoping meeting on March 31, 2021. The *Scoping Report* (Appendix 1-C, *Scoping Report*) summarizes comments received during the scoping period.

1.5 Draft EIS Public Comment Period

The Draft EIS and HCP are concurrently released for public review and comment. All comments must be submitted within the published comment period, which will close 60 days after the U.S. Environmental Protection Agency publishes a Notice of Availability of the Draft EIS in the FR. NMFS will consider all comments in preparing the Final EIS.

Comments can be submitted as follows:

- Written comments can be submitted electronically via www.regulations.gov. Follow instructions for submitting comments on Docket NOAA-NMFS-2021-0019-0001.
- Oral comments can be given during the virtual public meeting during the comment period. The link to the virtual meeting and instructions for registering to give oral comments are posted at https://www.fisheries.noaa.gov/action/western-oregon-state-forests-habitat-conservation-plan.

Chapter 2
Proposed Action and Alternatives

This chapter describes the alternatives analyzed in detail in this EIS and alternatives considered but eliminated from further consideration. NMFS identified a reasonable range of alternatives to consider for detailed study in the EIS through a structured screening process. Appendix 2-A, *Alternatives Screening*, describes the alternatives screening process and outcomes.

2.1 Alternatives Analyzed in Detail

NMFS analyzed five alternatives in detail in the EIS, including the no action alternative and the proposed action (Western Oregon State Forests HCP). All alternatives include the forest and recreation management activities described in Section 2.1.2.2, *Covered Activities;* the specific implementation of these activities would vary as described for each alternative below.

This section provides a description of the five alternatives analyzed in detail in this EIS.

- Alternative 1: No Action
- Alternative 2: Proposed Action
- Alternative 3: Increased Conservation
- Alternative 4: Reduced Permit Term
- Alternative 5: Increased Timber Harvest

2.1.1 Alternative 1: No Action

Under the no action alternative, NMFS and the U.S. Fish and Wildlife Service (FWS) (referred to collectively as the Services) would not issue incidental take permits (ITPs) to ODF for the proposed covered activities. ODF would continue to implement these activities in the absence of the HCP and would continue to be subject to the Endangered Species Act (ESA).

ODF currently manages state forests consistent with the Northwest and Southwest Oregon State Forest Management Plans[1] (FMPs) (ODF 2010a, 2010b) and the Oregon Forest Practices Act (Oregon Revised Statutes [ORS] Chapter 527) with an intent to avoid and minimize the risk of take of any listed species. According to the HCP, this management approach has been increasingly costly and disruptive to ODF planning and operations, given the uncertain legal and regulatory landscape, shifting or expanding species distribution, and potential for new listed species. Although this approach is not practical over the long-term for these reasons, it provides a baseline against which to compare the proposed action and alternatives in the analysis of environmental consequences and, therefore, was used as the no action alternative.

For purposes of this analysis, the no action alternative assumed continuation of current management practices, which are summarized below. Further assumptions regarding current

[1] ODF implements harvest activities using the guidance in the Northwest and Southwest Oregon FMPs and the district implementation plans. Additionally, timber harvest activities follow the Oregon FPA, specifically ORS 629–630.

management practices are identified as appropriate in Chapter 3, *Affected Environment and Environmental Consequences*.

ODF would manage riparian areas per the strategy delineated in its 2010 FMPs. These plans include riparian management areas (RMAs) based on stream classification (Table 2-1) that are divided into three zones with distinct management restrictions. Management is most restricted in the streambank zone, where harvest cannot occur and vegetative disturbance and equipment use are limited. The FMPs allow harvest in the inner and outer zones. ODF is not currently conducting harvest activities in these areas (Wilson pers. comm.). The FMPs apply wider RMAs in areas designated as aquatic anchors on certain stream types, which are intended to provide additional riparian protections.

Table 2-1. Average Riparian Management Area Widths by Stream Type, No Action Alternative

Fish-Bearing Streams	Non-Fish-Bearing Streams			
All Stream Types[a]	Large and Medium Perennial Streams[a]	Small Perennial Streams	Seasonal Debris Flow/ High-Energy Streams[b]	Other Seasonal Streams
115 feet	115 feet	30–50 feet[c]	30–50 feet[c]	0

[a] These distances are estimated average RMA widths applied over the length of a management site. Actual width may vary based on site-specific conditions. RMAs may be extended beyond the standard widths for each stream type to encompass certain sensitive sites (e.g., inner gorge areas).

[b] This category includes non-fish-bearing, seasonal reaches that are potential debris flow tracks and non-fish-bearing, seasonal, high-energy reaches that may deliver sediment and large wood to fish-bearing streams.

[c] In aquatic anchor reaches, the wider, 50-foot riparian management area applies. In all other reaches, the 30-foot RMA applies.

ODF would retain trees on high-hazard upland slopes likely to deliver debris to fish-bearing streams. No additional conservation measures would be implemented beyond what is required by the current Northwest and Southwest Oregon State FMPs and Oregon Forest Practices Act (FPA) (ORS 527 and Oregon Administrative Rules [OAR] 629).

ODF would manage lands outside of RMAs using the strategy delineated in its 2010 FMPs. The intent of this structure-based management approach is to develop a mosaic of stand types that shifts across the landscape, but with relatively stable quantities of each. Additional restrictions on harvest are applied in areas designated as terrestrial anchors, which comprise approximately 10 percent of ODF's land base and are intended to protect habitat for species unsuited to younger forests or particularly sensitive to fragmentation. These areas would be released and available for harvest after approximately 30 years but are maintained until the species concerned is colonizing and persisting in new areas of habitat.

Species-related harvest constraints are based on the avoidance of sites occupied by listed species, specifically marbled murrelets and northern spotted owls. ODF conducts surveys in areas planned for harvest per the requirements outlined in the Northern Spotted Owl Operational Policy (ODF 2017) and the Marbled Murrelet Operation Policy (ODF 2013) to identify where species occur on the landscape. Harvest is not permitted in areas occupied by listed species but can occur after an area becomes unoccupied. ODF has not conducted harvest activity in areas within the coastal marten's range since the species' listing in October 2020, so ODF has not conducted field surveys or developed a specific management protocol for coastal marten.

2.1.2 Alternative 2: Proposed Action

Under the proposed action, the Services would approve the HCP and issue ITPs with 70-year permit terms to ODF for incidental take of covered species from covered activities in the permit area.

2.1.2.1 Permit Area and Plan Area

The permit area consists of the lands ODF currently manages. The permit area is where the ITPs would provide take coverage for covered activities and where the conservation strategy would apply (Figure 2-1). These lands include lands owned by the Board of Forestry and Common School Forest Lands owned by the State Land Board. The permit area currently totals 639,489 acres; however, the acreage of the permit area may change during the permit term based on changes in land management and ownership.

To allow for possible future changes in ODF's land ownership, the plan area includes the permit area and an additional 94,206 acres to encompass lands where acquisition would most likely occur over the permit term. If and when land transfers, land sales, or land purchases bring any of these lands under ODF management, they would become part of the permit area. When lands are removed or added to the permit area ODF will demonstrate that the level of take authorized by the ITP and the mitigation provided by the conservation strategy for each covered species, as described in HCP Chapter 4, *Conservation Strategy*, remain intact. Conversely, land removed from state ownership during the permit term would no longer be included in the permit area. HCP Chapter 8, *Implementation*, describes this process in more detail.

2.1.2.2 Covered Activities

The covered activities are the projects and activities for which the applicant is requesting take authorization. The covered activities include the applicant's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These activities are summarized below. HCP Chapter 3, *Covered Activities,* provides detailed descriptions of the covered activities.

Timber Harvest Activities

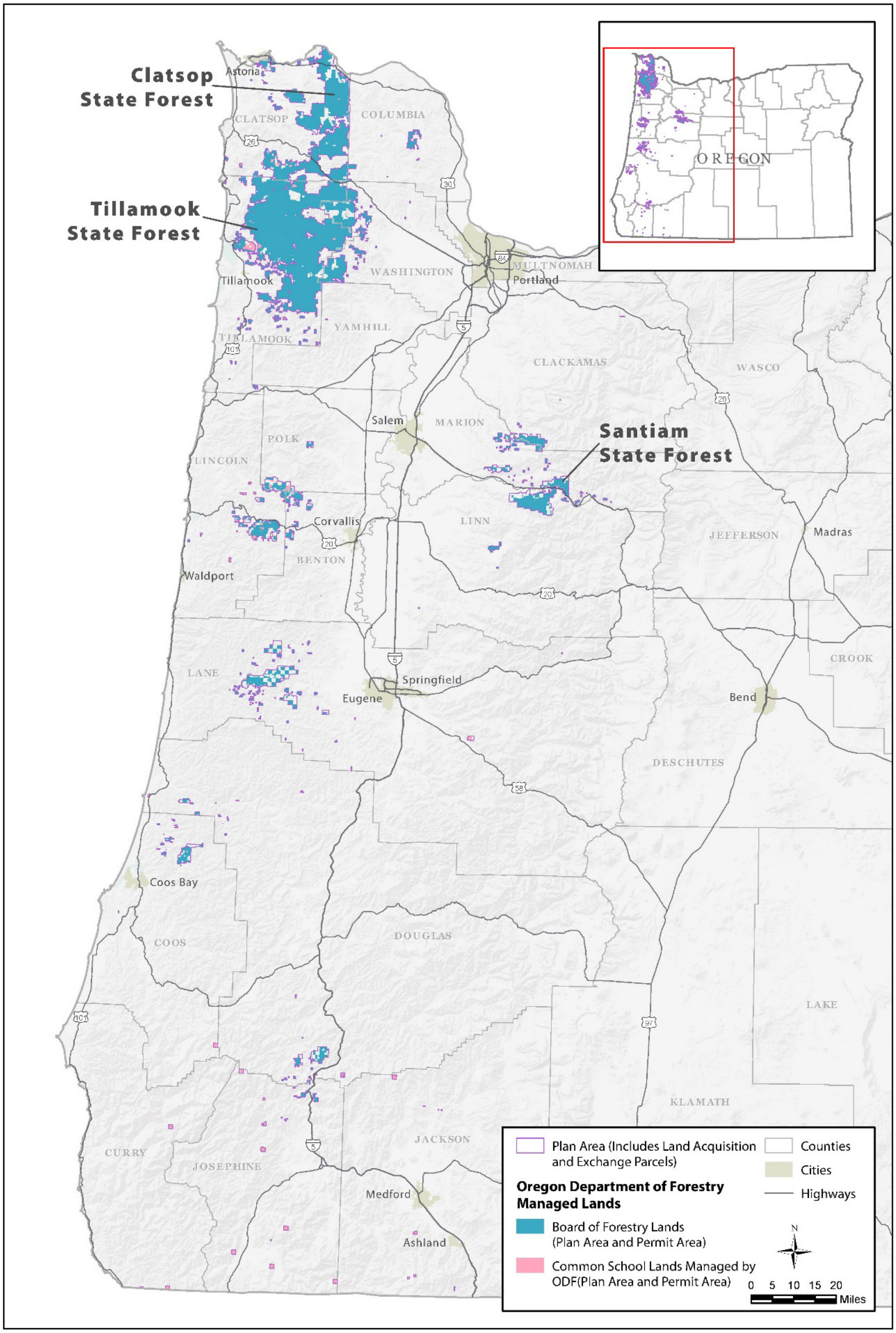
Harvest activities include the harvesting of timber and other forest products. Under the HCP, ODF would implement timber harvest activities according to a new FMP that is being developed as a companion document to the HCP. The companion FMP would guide ODF's forest management activities in accordance with the HCP.

Harvest methods include felling (cutting down trees), bucking (cutting felled trees in the field), yarding or skidding (moving felled trees to a cleared area for storage), processing (cutting felled trees into logs), and loading (moving logs from the landing area to a truck for transport).

ODF conducts several types of harvest. Clearcuts and retention cuts[2] are intended to develop new stands and remove most trees in a given area. Partial-cut harvest (i.e., heavy, moderate, light, and variable density thinning) are intended to manage the growth and density of an existing stand and retain more vegetation than clearcuts and retention cuts.

[2] The HCP refers to clearcuts and retention cuts as regeneration harvest.

Figure 2-1. Permit Area and Plan Area



Reforestation and Young Stand Management

Reforestation and stand management activities are performed between harvests, as needed, to manage stand development. Specific reforestation and stand management activities include site preparation, tree planting, manual release treatments, control measures for ungulates and beavers, precommercial thinning and pruning, salvage, and other techniques to control the establishment, composition, growth, health, and quality of stands. Salvage harvest is conducted following disturbance events and can range from limited removal of trees to clearcuts and removal of downed wood for commercial harvest. Additionally, ODF and other agencies, such as the Oregon Department of Transportation, may remove trees for emergency and safety hazards.

Road System Management Activities

Road system management activities are associated with the construction, use, maintenance, and vacating of forest roads and associated facilities. Within the permit area, ODF maintains approximately 4,151 miles of roads, which provide access for management, recreation, and fire protection. Most new road construction consists of short spurs for accessing individual harvest units or reroutes to better locations when roads are vacated. Road vacating consists of making roads undriveable, stabilizing cuts and fills, removing culverts, and ensuring natural drainage. ODF also conducts road closures, which consists of limiting access to the road while keeping the road in a useable condition (e.g., installing gates or barricades at road entry points). ODF manages its road system consistent with the FMPs and other ODF implementation guidance, the Oregon FPA (OAR 629), and other applicable statutes described in the *Forest Roads Manual* (ODF 2000) or the most recent version of this guidance. This covered activity also includes water drafting and storage to provide water for road system management, chemical mixing, controlled burning, and firefighting.

Minor Forest-Product Harvest

ODF issues permits for collecting or harvesting a variety of products other than timber (e.g., Christmas trees, cones, ferns, firewood, mushrooms), in the permit area, for commercial income or personal use.

Quarries, Borrow Sites, and Stockpile Sites

Development, operation, and maintenance of quarries and auxiliary facilities (borrow sites and stockpile sites) would be covered activities under the HCP. ODF obtains rock and other materials from quarries and borrow sites to use on roads and for slope protection. Quarry and borrow site development includes the use of drills, explosives, bulldozers, loading equipment, and trucks. Quarries typically remain active for several years, and borrow sites are typically single-use sites or sites where small quantities of material are removed over a longer period. Stockpile sites are locations where rock is stored for future use; they are generally permanent parts of the transportation network and would be re-used over the course of the permit term. All quarries and auxiliary facilities would be hydrologically disconnected from aquatic resources, compliant with requirements of the Oregon FPA rules (OAR 629-625-0500) and other applicable statutes.

Fire Management

ODF and its state agency partners conduct controlled burning for stand management and other objectives. Types of controlled burns include prescribed burns to improve seedling survival and growth, underburns to remove fuels and improve forest health, and pile burns to remove slash.[3]

[3] Slash is debris generated during timber harvest.

Burns are limited to certain times of year and conducted under controlled conditions with little or no risk of catastrophic fire damage. ODF traditionally employs manual fuels management techniques, piling and burning smaller fuels. As a result, ODF has not traditionally conducted underburns in the permit area. Changing conditions due to drought and climate change may necessitate increased underburning in the future. The average size of prescribed burns is 80 acres and the average size of pile burns is 20 acres.

Recreation Infrastructure and Maintenance

Management of recreation facilities in the permit area, including maintaining and improving existing facilities and developing certain new facilities is a covered activity. Recreation facilities include campgrounds, day-use facilities, parking areas, trailheads, motorized and nonmotorized trails, boat launches, designated shooting lanes, restrooms, target shooting lanes, interpretive centers, and administrative buildings.

Conservation Strategy Implementation Activities

Conservation strategy implementation activities are required as part of the HCP's conservation strategy. These activities include aquatic habitat restoration, upland restoration, and barred owl removal.

2.1.2.3 Covered Species

The Services would issue ITPs to the applicant for the 17 species listed in Table 2-2. These species are collectively referred to as the *covered specie*s. Non-listed species covered in the HCP are treated as if they are listed and all conservation measures described in the HCP for that species would be fully implemented (FWS and NMFS 2016).

Table 2-2. Covered Species in the Western Oregon State Forests HCP

Species	Listing Status (Federal/State)
National Marine Fisheries Service	
Oregon Coast coho (*Oncorhynchus kisutch*)	FT/--
Oregon Coast spring-run Chinook (*O. tshawytscha*)	UR/--
Southern Oregon/Northern California Coast coho (*O. kisutch*)	FT/--
Southern Oregon/Northern California Coast spring-run Chinook (*O. tshawytscha*)	UR/--
Lower Columbia River coho (*O. kisutch*)	FT/SE
Upper Willamette River spring-run Chinook (*O. tshawytscha*)	FT/--
Upper Willamette River steelhead (*O. mykiss*)	FT/--
Columbia River chum (*O. keta*)	FT/--
Lower Columbia River Chinook (*O. tshawytscha*)	FT/--
Eulachon (*Thaleichthys pacificus*)	FT/--

Species	Listing Status (Federal/State)
U.S. Fish and Wildlife Service	
Northern spotted owl (*Strix occidentalis*)	FT/ST
Marbled murrelet (*Brachyramphus marmoratus*)	FT/ST
Oregon slender salamander (*Batrachoseps wrighti*)	--/ST
Columbia torrent salamander (*Rhyacotriton kezeri*)	UR/ST
Cascade torrent salamander (*R. cascadae*)	UR/--
Coastal marten (*Martes caurina*)	FT/--
Red tree vole (*Arborimus longicaudus*)	--/--

SE = State Endangered; ST = State Threatened; FT = Federal Threatened; UR = Under Review

2.1.2.4 Conservation Strategy

Under the proposed action, ODF would implement the conservation strategy (a series of conservation actions) to avoid, minimize, and mitigate impacts of take on listed species. The conservation actions are summarized below. HCP Chapter 4 provides detailed descriptions of the actions, the rationale for the actions, and the biological goals and objectives the actions are intended to achieve.

Conservation Action 1: Establish Riparian Conservation Areas

Upon ITP issuance, ODF would establish riparian conservation areas (RCAs) next to streams in the permit area where commercial harvest and stand management activities would not occur. Management activities in RCAs would be further limited within 35 feet of streams as described in Conservation Action 2. The intent of RCAs is to increase habitat complexity, channel stability, and channel form and function by maintaining or increasing large wood and gravel recruitment, stream shading, nutrient input, and streambank integrity.

Activities that would be permitted to occur in RCAs include the following.

- Activities related to stream enhancement or restoration
- Construction of boat ramps and trails and maintenance of existing recreational facilities
- Maintenance, closure, vacating, or improvement of existing roads, with a focus on hydrologic disconnection
- Limited construction of new roads (including temporary roads and stream crossings), only in situations where upland road placement options do not exist or are infeasible or cost prohibitive
- Felling trees that pose a safety risk[4]
- Construction of borrow sites[5]

RCA width would be based on the presence of fish, stream size (determined by annual flow), flow period (perennial versus seasonal), and the potential for landslides (potential debris flow tracks) or debris transport during high-energy seasonal flow events (high-energy reaches). RCA widths would be applied horizontally, regardless of slope, at the widths listed in Table 2-3.

[4] Any trees felled in RCAs would be retained in the RCA and not salvaged.

[5] Borrow sites may only be located in RCAs following consultation with an Aquatic and Riparian Specialist. Quarries and stockpile sites would only be located outside of RCAs.

HCP Chapter 4, Figures 4-11 through 4-13, illustrate how the RCAs are applied by stream type.

Table 2-3. Minimum Riparian Conservation Area Width by Stream Type, Proposed Action

Fish-Bearing Streams	Non-Fish-Bearing Streams			
All Stream Types	Large and Medium Streams Perennial	Small Streams, Perennial	Seasonal Debris Flow/ High-Energy Streams[a]	Other Seasonal Streams
120 feet	120 feet	35–120 feet[b]	35–50 feet[b]	0

[a] This category includes non-fish-bearing, seasonal reaches that are potential debris flow tracks and non-fish-bearing, seasonal high-energy reaches that may deliver sediment and large wood to fish-bearing streams.

[b] The higher value is applied within the process protection zone (the first 500 feet from the end of fish use on perennial fish-bearing streams); the lower value is applied above this zone (beyond the first 500 feet from the end of fish use on perennial fish-bearing streams).

Seep or springs connected to perennial streams would be included in the RCA width for that stream. Where a seep or spring is not fully included in the RCA for the associated stream, the RCA would be extended to encompass it with a 35-foot RCA. ODF would also expand RCA widths up to 170 feet, if necessary, to include nearby unstable slopes (i.e., inner gorges and aquatic adjacent unstable areas) so landslides and other soil movement (e.g., sloughing) would function to benefit the aquatic system. ODF would retain trees on high-hazard upland slopes likely to deliver debris to fish-bearing streams.

Conservation Action 2: Riparian Equipment Restriction Zones

ODF would establish 35-foot equipment restriction zones (ERZs) on either side of all streams that would apply to covered activities taking place in the RCAs. Vegetation removal, ground disturbance, yarding activities, and tree-canopy removal would be minimized and conducted according to the specific limitations for each stream type and best management practices followed within ERZs. ODF would restrict machinery entering streams to occur only for activities related to stream enhancement and restoration work and, in those cases, would choose locations to minimize the loss of riparian trees or bank erosion. Activities that require work in the aquatic environment would follow the established *Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife* (ODFW 2008).

Conservation Action 3: Stream Enhancement

Throughout the permit term, ODF would complete 440 in-stream improvement projects, with an average of 60 projects being constructed per decade.[6] Stream enhancement projects would range from simple projects like installation of large woody material to more complex floodplain reconnections or channel restoration projects. This conservation action identifies factors that would be considered when planning and designing stream enhancement projects. ODF would target stream reaches in the permit area with the potential to provide high-quality habitat.

[6] While ODF implements stream enhancement projects under current management and may continue at a comparable rate, the HCP includes a commitment not assumed under the no action alternative.

Conservation Action 4: Remove or Modify Artificial Fish Passage Barriers

Over the permit term, ODF commits to repairing or replacing at least 50 percent of the culverts (at least 167 culverts) in the permit area that do not currently meet fish passage requirements and have been identified[7] as either complete barriers or a partial blockage, including at least three ODFW priority barriers over the course of the permit term.[8] All new and replaced stream crossings would meet NMFS criteria for upstream and downstream passage for salmonids. ODF would select barriers in the permit area for removal based on the implementation planning process, which occurs every 10 years as part of ODF's regular forest management planning process.

ODF would remove priority fish passage barriers in the permit area when they occur in a proposed harvest unit and may remove them outside of harvest units to maximize benefit to the covered species. ODF would identify and assess new priority barriers as a part of its 10-year implementation planning and annual operation planning processes.

Conservation Action 5: Standards for Road Improvement and Vacating

ODF would adhere to the guidelines for prioritizing and selecting road projects outlined in this conservation action, which also apply under current management practices. Selection of large road repair projects would occur during the 10-year implementation planning process or annual operations planning process and would use the best available data (i.e., historic inventories and watershed assessments) to identify areas needing repair.

Roads in the permit area that were not built to current design standards may require repair or vacating. Road projects would occur at sites determined to be a risk for covered species. The purpose of road repair projects and best management practices is to disconnect the road system hydrologically from stream channels. Potential reasons for road vacating could include proximity to a fish-bearing stream, high erosion potential, or landslide hazards that could affect covered species.

Conservation Action 6: Establish Habitat Conservation Areas

Upon ITP issuance, ODF would designate 275,000 acres of habitat conservation areas (HCAs) to support the persistence of northern spotted owl, marbled murrelet, red tree vole, Oregon slender salamander, and coastal marten. HCAs comprise 43 percent of the permit area. HCP Appendix F, *Habitat Conservation Area Maps*, includes maps of the HCAs. Management activities in HCAs would be limited to those that contribute to achieving habitat objectives, as described in Conservation Action 7.

The primary purpose of HCAs is to conserve, maintain, and enhance habitat in and adjacent to existing occupied habitat, as well as to increase overall habitat values for covered species at the landscape level. ODF located the HCAs based on current and potential future occupation by covered species (northern spotted owl and marbled murrelet activity centers), suitability of habitat, patch size, proximity and connectivity to other HCAs and existing habitat, and distribution across the permit area.

[7] Fish-passage barriers in Oregon, which reduce or block access for salmon to their habitat, are identified, categorized, and prioritized by the Oregon Department of Fish and Wildlife.

[8] While ODF implements fish passage barrier removal and repair projects under current management and may continue at a comparable rate, the HCP includes a commitment not assumed under the no action alternative.

Conservation Action 7: Manage Habitat Conservation Areas

ODF would manage HCAs according to standards outlined in this conservation action to achieve or not preclude the objective of increased habitat quality and quantity for terrestrial covered species. Management in HCAs would occur in a limited number of younger stands, stands that have been used for timber harvest, and conifer-dominated stands. ODF would manage these stands to achieve habitat objectives for mature, diverse forests, primarily through thinning in young, healthy conifer forests to promote forest development and clearcuts or retention harvest and replanting in hardwood dominant or Swiss needle cast stands (up to 15,000 acres in each stand type). Timber management activities conducted within HCAs would occur during the first 30 years of the permit term and generally decrease over time.

Conservation Action 8: Conservation Actions Outside Habitat Conservation Areas and Riparian Conservation Areas

ODF would adhere to management standards for landscape-level and stand-level forest structure. The landscape-level standards focus on maintaining dispersal habitat across the permit area for northern spotted owls. Stand-level standards focus on retaining and improving the existing forest structure in managed stands. ODF would commit to standards that improve landscape-level forest structure through multiple measures, including retaining the oldest, largest trees on the landscape during clearcuts or retention harvest, per the Forest Ecosystem Management Assessment Team's definition of old-growth trees, patches, and stands (Thomas et al. 1993). Old-growth trees would be identified before harvest to ensure no old growth is harvested.

Conservation Action 9: Strategic Terrestrial Species Conservation Actions

ODF would conduct strategic terrestrial conservation actions, including barred owl removal and covered species reintroduction, to address factors limiting the ability of covered terrestrial species to take advantage of the new habitat and to increase populations. The anticipated focus of activities would be to address known stressors on species survival, research covered species' response to management actions in HCAs, boost species populations, and improve understanding of species ecology or habitat use that could influence how management actions are used in HCAs. Other actions would emerge throughout the permit term as opportunities for addressing limiting factors to covered species arise.

Conservation Action 10: Operational Restrictions to Minimize Effects on Covered Species

ODF would adhere to restrictions on covered activities intended to limit noise and other disturbance that may significantly interfere with essential behaviors of covered species. Operational restrictions described in this conservation action may apply inside or outside HCAs or both.

ODF would apply operational restrictions inside and outside HCAs for northern spotted owls, marbled murrelets, red tree voles, and coastal martens. Restrictions are based on seasonality and distance from known occurrences. ODF would also apply restrictions on fuels reduction in HCAs and restrictions on water drafting related to water quality and aquatic species protection.

ODF would provide limited exceptions to these restrictions in cases where the safety of ODF staff, contractors, or the public is compromised or where a more limited restriction is justified based on site conditions.

Conservation Action 11: Road and Trail Construction and Management Measures

ODF would apply techniques and guidelines, implemented under current management practices, to minimize effects on covered species by reducing erosion and stream sedimentation during road and trail construction and maintenance. ODF would use and update existing GIS resources to track and plan maintenance to the permit area's road and trail network. ODF would solicit input from geotechnical specialists in designing roads and trails to minimize management-induced soil movement and protect the aquatic covered species. Additionally, ODF would implement design measures from the *Forest Roads Manual* (ODF 2000) and Roni et al. (2002), or the most current versions of these materials, to minimize potential effects on covered species. Road and trail design and management techniques that can restore stream processes to benefit covered species would be considered when designing and managing road and trail systems in the permit area.

Conservation Action 12: Restrictions on Recreational Facilities

ODF would adhere to the guidelines outlined in this conservation measure for the development of new recreation facilities and maintenance of existing recreation facilities in HCAs and RCAs. Development of new recreation facilities in HCAs is expected to include all development types described in HCP Chapter 3, Section 3.8, *Recreation Infrastructure and Maintenance,* except shooting lanes, and would adhere to the operational restrictions outlined in Conservation Action 10. Development of new trails in HCAs would avoid specific nesting sites as described in Conservation Actions 6, 7, and 10. Development of new facilities in RCAs would be limited to boat ramps and trail segments, consistent with current management practices. Motorized trails would be limited to stream crossings in RCAs. The maintenance of existing recreation facilities would follow the measures and timing restrictions described in Conservation Action 2 and Conservation Action 10.

2.1.2.5 Monitoring and Adaptive Management

HCP Chapter 6, *Monitoring and Adaptive Management*, includes guidelines and recommendations for a monitoring and adaptive management program, which would be developed during the initial years of HCP implementation. The purpose of this framework and the final monitoring program is to ensure compliance with the HCP, assess the response of covered species habitat conditions to conservation actions, and evaluate the effects of management actions such that the successful implementation of the conservation strategy can be assessed.

2.1.3 Alternative 3: Increased Conservation

Under Alternative 3, the HCP would include the same permit area, covered activities, covered species, permit term, and monitoring and adaptive management program as the proposed action; however, the conservation strategy would be modified to expand the RCAs and include additional requirements for risk inventory and evaluation of roads and motorized trails. Under Conservation Action 1, the RCA width on small perennial non-fish-bearing streams and seasonal non-fish-bearing streams that have potential to deliver wood to fish-bearing streams (potential debris flow tracks and high-energy streams) would be increased from 35 to 50 feet above the process protection zone (Table 2-4). RCA widths on other stream types would be the same as described for the proposed action. ODF would leave trees on moderate hazard landslide initiation sites likely to deliver debris to a fish-bearing stream, as well as high-hazard sites.

Table 2-4. Minimum Riparian Conservation Area Width by Stream Type, Alternative 3

Fish-Bearing Streams	Non-Fish-Bearing Streams			
All Stream Types	Large and Medium Streams, Perennial	Small Streams, Perennial	Seasonal Debris Flow/ High-Energy Streams[a]	Other Seasonal Streams
120 feet	120 feet	50–120 feet[b]	50 feet	0

[a] This category includes non-fish-bearing, seasonal reaches that are potential debris flow tracks and non-fish-bearing, seasonal high-energy reaches that may deliver sediment and large wood to fish-bearing streams.

[b] The higher value is applied within the process protection zone (the first 500 feet from the end of fish use on perennial fish-bearing streams); the lower value is applied above this zone (beyond the first 500 feet from the end of fish use on perennial fish-bearing streams).

In addition, Conservation Action 5 would include a requirement for ODF to adopt a risk inventory and evaluation program that includes motorized roads and trails in RCAs. The program would support road drainage improvement and vacating-related target setting, project-level prioritization and decision-making, and reporting for compliance. ODF would select the road risk inventory, evaluation methods and protocols collaboratively with NMFS and the Oregon Department of Environmental Quality. The protocol would systematically identify road/trail-related risks that threaten water quality and aquatic habitat, including road surface sediment production and delivery, mass wasting risk from road-related gullies and landslides, risks of stream diversion and crossing failures, and road hydrologic connectivity. Once a protocol is agreed to, ODF would perform preliminary inventory and analysis and set risk-reduction targets in collaboration with NMFS and the Oregon Department of Environmental Quality, such that the targets align with ESA and Clean Water Act compliance efforts and with a goal of vacating an equivalent number of new roads constructed in HCAs and within 120 feet of water by the end of the permit term. Methods, protocols, and targets would be reviewed by NMFS by the end of year 1 of the permit term. Inventory and an action plan would be complete by the end of year 3 of the permit term.

2.1.4 Alternative 4: Reduced Permit Term

Under Alternative 4, the HCP would include the same covered activities, covered species, conservation strategy, and monitoring and adaptive management program as the proposed action, but would have a shorter permit term, 50 instead of 70 years.

2.1.5 Alternative 5: Increased Timber Harvest

Under Alternative 5, the HCP would include the same covered activities, covered species, permit term, and monitoring and adaptive management program as the proposed action but would modify the conservation strategy to allow increased timber harvest volume. Conservation Action 6 would be modified to remove from the HCAs approximately 23,500 acres identified as having high production value and low or marginal northern spotted owl and marbled murrelet habitat quality, while still avoiding northern spotted owl and marbled murrelet activity centers, and add to the HCAs approximately 8,000 acres identified as having low production value. Areas would be removed and added along the outer boundary of the HCAs to minimize increase in edge and reduction in habitat connectivity. Conservation Action 7 would be modified to increase allowable harvest of Swiss needle cast stands in HCAs from 15,000 to 21,000 acres.

2.2 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to evaluate a reasonable range of alternatives to the proposed action and, for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination (40 CFR 1502.14). Alternatives, information, and analyses submitted during scoping are summarized in Chapter 4, *Summary of Submitted Alternatives, Information, and Analyses*, and further described in Appendix 1-C, *Scoping Report,* per 40 CFR 1502.17(a). Alternatives B, O, and Q were moved forward for further development and detailed analysis and are therefore not described in this section. The alternatives described below were considered but dismissed from detailed analysis for reasons summarized below and described further in Appendix 2-A.

The following alternatives were considered but dismissed from detailed analysis because they did not meet the purpose and need for the proposed action.

- **Alternative C, Reduced Covered Species—Exclude Non-Listed Fish Species.** This alternative, which would exclude non-listed fish species from ITP coverage, does not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- **Alternative D, Reduced Covered Species—Exclude Non-Listed Amphibian Species.** This alternative, which would exclude non-listed amphibian species from ITP coverage, does not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- **Alternative E, Reduced Covered Species—Exclude Eulachon.** This alternative, which would exclude eulachon from ITP coverage, does not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- **Alternative F, Reduced Covered Species—Exclude Coastal Marten.** This alternative, which would exclude coastal marten from ITP coverage, does not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- **Alternative G, Reduced Covered Species—Exclude Red Tree Vole (Non-Listed).** This alternative, which would exclude red tree vole from ITP coverage, does not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- **Alternative L, Modified Aquatic Conservation Strategy—Increased Management in Riparian Conservation Areas.** This alternative, which would modify the aquatic conservation strategy to increase management in RCAs to increase production of fish biomass, would rely on primary productivity and would not increase or improve natural functions and processes of habitat in riparian areas for aquatic covered species.
- **Alternative N, Modified Terrestrial Conservation Strategy—Reduced Habitat Conservation Areas and Increased Predator/Competitor Control.** This alternative would reduce HCAs and compensate for that reduction in conservation by increasing control or removal of barred owls and other non-native species. Reduced HCAs were considered in Alternative 5, which was moved forward for detailed analysis in the EIS. Control or removal of species that prey on or compete with covered species may occur under the proposed action as part of Conservation Action 9, which addresses factors that limit the ability of covered species to take advantage of the new habitat and for populations to increase. While barred owl control experiments have indicated positive response by northern spotted owls, not all treatment areas observed significant responses. An alternative further reliant on this form of management

would not adequately address the covered terrestrial species' reliance on availability of suitable habitat.

The following alternatives passed the screening for purpose and need but were eliminated from detailed analysis based on screening against additional criteria questions, as summarized below and described in more detail in Appendix 2-A.

- **Alternative A, Reduced Permit Term of 30 Years.** This alternative, which would reduce the permit term to 30 years, was eliminated because it did not provide for long-term assurances to provide for the conservation of listed species. The shorter permit term does not provide the time needed to develop habitat to meet the biological goals and objectives and would provide fewer long-term conservation benefits to the covered species.
- **Alternative H, Modified Aquatic Conservation Strategy—Western Oregon Bureau of Land Management Riparian Strategy.** This alternative, which would model the riparian conservation strategy on the Western Oregon Bureau of Land Management Resource Management Plan riparian strategy, was eliminated because it would not meet the goals of the applicant regarding economic feasibility.
- **Alternative I, Modified Aquatic Conservation Strategy—Increased Temperature Protections.** This alternative, which would increase the length of the process protection zone and increase the RCAs above this zone on small perennial non-fish-bearing streams, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. Elements of this alternative were incorporated into Alternative Q, which was moved forward for detailed analysis in the EIS as Alternative 3.
- **Alternative J, Modified Aquatic Conservation Strategy—Increased Protection of Landslide Initiation Sites.** This alternative, which would retain trees at all landslide initiation sites, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. Elements of this alternative were incorporated into Alternative Q, which was moved forward for detailed analysis in the EIS as Alternative 3.
- **Alternative K, Modified Aquatic Conservation Strategy—Aquatic Reserves.** This alternative would revise the conservation strategy based on designation of key watersheds as aquatic reserves and would manage them for the primary purpose of aquatic conservation. It was eliminated because it would not meet the goals of the applicant regarding economic feasibility.
- **Alternative M, Modified Terrestrial Conservation Strategy—Increased Protections.** This alternative would increase protections for terrestrial species. It was eliminated because it would not meet the goals of the applicant regarding economic feasibility. Some elements of the alternative are already part of the proposed action.
- **Alternative P, Modified Terrestrial Conservation Strategy—Increased Management in Habitat Conservation Areas.** This alternative, which would apply disturbance-based management principles in HCAs, such as partial-harvest forestry and commercial thinning, was eliminated because it is largely similar to the proposed action, which would implement these principles in HCAs.

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter presents the existing conditions and potential environmental effects of the proposed action and alternatives.

3.1.1 Scope of Analysis

Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* describes reasonably foreseeable environmental trends and planned actions with potential to have impacts on the resources affected by the proposed action and alternatives.

The remaining sections of this chapter analyze the effects of the proposed action and alternatives on the following resources: geology and soils (Section 3.3), water resources (Section 3.4), vegetation (Section 3.5), fish and wildlife (Section 3.6), air quality (Section 3.7), aesthetics and visual resources (Section 3.8), recreation (Section 3.9), cultural resources (Section 3.10), tribal resources (Section 3.11), socioeconomics (Section 3.12), environmental justice (Section 3.13), and greenhouse gas emissions and carbon storage (Section 3.14). Each resource section consists of a description of the study area, methods, affected environment, and potential effects. Appendix 3.1-A, *Regulatory Environment*, provides the regulatory context for each resource.

3.1.2 Modeling

Differences in effects of the proposed action and alternatives on the human environment are primarily driven by differences in constraints on timber harvest (Chapter 2, *Proposed Action and Alternatives*). Timber harvest constraints affect the timing and location of activities, which in turn affect timber harvest volumes, revenues, and costs, as well as forest attributes (e.g., structure, type). The forest management model (forest model) projects these outcomes under the proposed action and alternatives over the analysis period. The resource analyses in this chapter used model outputs to evaluate the effects of the proposed action and alternatives on the human environment.

The forest model uses data inputs from ODF's inventory of forest stands in the permit area (stand-level inventory),[1] ODF data representing forest growth and yield, management prescriptions, and financial considerations. Forest model results are not meant to be interpreted as specific harvest targets or to predict precisely how activities will occur in reality but, rather, are used to compare alternatives based on representative policy-level information. Because the no action model assumptions are dependent on site-specific future species occurrence, which is unknown, the no action model has less certainty than the models for the proposed action and alternatives, which are based on the designation of protected areas for the length of the permit term. Appendix 3.1-B, *Forest Management Modeling*, provides a detailed description of the model assumptions and constraints for all alternatives.

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[1] The model's land base reflects past disturbance events and post-disturbance management through 2018; it does not reflect recent (post-2018) events or project these factors into the future. Future disturbance and post-disturbance forest management activities could substantially affect actual harvest values and forest attributes.

The following tables provide an overview of the harvest model outputs under the alternatives. Table 3.1-1 presents average annual modeled harvest volumes by alternative over the analysis period. Tables 3.1-2 and 3.1-3 present the modeled acreage of clearcut harvest and thinning, respectively.

Table 3.1-1. Modeled Average Annual Harvest Volume (MMBF/year) by Alternative[a]

Year	No Action	Proposed Action	Alt. 3	Alt. 4	Alt. 5
1–25	179.3	247.0	246.1	247.0	258.0
26–50	174.8	221.7	220.8	221.7	227.0
51–70	169.3	204.3	203.3	--[b]	212.2

Source: Forest model

[a] Includes clearcut harvest and thinning.

[b] Alternative 4 would have a 50-year permit term.

MMBF = million board feet

Table 3.1-2. Modeled Average Annual Clearcut Harvest Acreage by Alternative

Years	No Action	Proposed Action	Alt. 3	Alt. 4	Alt. 5
1–25	4,159	5,727	5,703	5,727	6,026
26–50	4,339	4,100	4,103	4,100	4,258
51–70	4,136	4,045	4,043	--[a]	4,254

Source: Forest model

[a] Alternative 4 would have a 50-year permit term.

Table 3.1-3. Modeled Average Annual Thinning Acreage by Alternative

Year	No Action	Proposed Action	Alt. 3	Alt. 4	Alt. 5
1–25	1,662	891	886	891	882
26–50	1,594	2,488	2,435	2,488	2,457
51–70	1,765	3,471	3,447	--[a]	3,467

Source: Forest model

[a] Alternative 4 would have a 50-year permit term.

The forest model results were used in combination with ODF's road network data to estimate the amount of road miles that would be used for timber harvest and related activities, the amount of road miles that would need to be constructed to access harvested areas over the analysis period, and the costs associated with timber harvest, including the costs to maintain the road network. The forest model does not estimate miles of roads that would be vacated; potential road vacating and associated effects were assessed qualitatively. Table 3.1-4 presents estimated miles of roads constructed by alternative. Table 3.1-5 presents estimated miles of roads used for harvest by alternative.

Table 3.1-4. Modeled Miles of New Roads Constructed by Alternative

Years	No Action	Proposed Action	Alt. 3	Alt. 4	Alt. 5
1–25	196.5	214.0	215.3	214.0	213.9
26–50	29.0	27.2	26.3	27.2	27.4
51–70	2.2	2.2	1.8	--[a]	1.5

Source: Forest model and ODF (2021) road network data
[a] Alternative 4 would have a 50-year permit term.

Table 3.1-5. Modeled Miles of Roads Used[a] for Harvest by Alternative

Years	No Action	Proposed Action	Alt. 3	Alt. 4	Alt. 5
1–25	2,520.3	2,601.5	2,598.2	2,601.5	2,618.4
26–50	2,390.7	2,444.7	2,436.4	2,444.7	2,501.1
51–70	2,379.8	2,287.7	2,288.6	--[b]	2,335.9

Source: Forest model and ODF (2021) road network data
[a] Includes new and existing roads. Does not reflect potential road vacating.
[b] Alternative 4 would have a 50-year permit term.

3.2 Reasonably Foreseeable Trends and Planned Actions

This section provides a program-level review of reasonably foreseeable trends or planned actions with potential to affect the resources affected by the proposed action and alternatives (40 CFR 1502.15). This section examines trends and planned actions occurring in and adjacent to the plan area. The analysis takes a qualitative approach because impacts from these trends and planned actions may occur over different timeframes, cover different footprints, or occur over widely different locations within the plan area, making a quantification of impacts infeasible.

Table 3.2-1 summarizes reasonably foreseeable trends and planned actions identified as relevant to this analysis and their potential effects. The subsequent sections of Chapter 3, *Affected Environment and Environmental Consequences*, discuss the potential for combined effects on resources.

Table 3.2-1. Summary of Reasonably Foreseeable Trends and Planned Actions

Trend or Planned Action	Potential Effects
Climate Change Climate change will continue to affect western Oregon through the analysis period. The projected effects of climate change on western Oregon include increased temperatures, significantly drier summers, somewhat wetter winters, elevated sea-surface temperatures off the Oregon coast, and reduced snowpack. There is projected to be a general shift in the timing and availability of water. Climate change is also projected to cause increased frequency, intensity, and duration of drought and disturbance events (i.e., severe storm events, wildfires, and invasive species). Appendix 3.2, *Disturbance and Climate Change*, describes projected climate change effects in western Oregon in more detail.	• Reduced summer streamflow • Increased summer stream temperatures • Slower vegetation growth and increased tree mortality • Increased disturbance by insects or pathogens • Increased invasive species effects • Increased competition and predation related to greater prevalence of warm water fish species and fish pathogens
Increase in Disturbance Event Frequency, Intensity, and Duration Major disturbance events, particularly storms, wildfires, and invasive species threats, are expected to increase in frequency, intensity, and duration due to climate change. Under current conditions, storms affecting a large fraction of the plan area and causing extensive destruction in the form of blowdown, landslides, and flooding occur approximately once per decade. Storms having such effects within one region of the plan area occur approximately once every 2 years. By the end of the analysis period, due to forecasted increases in storm severity associated with climate change, the record will likely contain the most severe storms ever recorded in the plan area. Once-per-decade and once-every-2-year storms are projected to be substantially more severe and will affect similarly extensive or perhaps slightly larger areas. Major fires have burned a long-term average of about 0.5 percent of western Oregon per year since records have been kept. The actual burned acreage varies greatly from year to year, with severe fires occurring on average less than once per decade. Continuation of current conditions (0.5 percent burn probability per acre per year) would suggest 35 percent of the plan area is likely to burn over the analysis period. Given the increased severity of fires predicted with climate change, the actual extent is anticipated to be significantly larger. Under current conditions, many invasive species have been introduced to the plan area, with severe adverse biological consequences. Although regulations and programs exist to discourage further invasive species introductions, such introductions continue to occur. Many existing invasive species have been introduced recently enough that they are continuing to actively spread. Accordingly, it is expected that many existing invasive species will continue to spread, and an appreciable number of new invasive species will be introduced, during the analysis period. Appendix 3.2 describes historical and projected ecological disturbances in western Oregon in more detail.	• Habitat loss or alteration of habitat distribution • Species mortality • Tree mortality • Increase in frequency, duration and intensity of flooding • Sedimentation and debris flow • Decreased revenue from forest industries, recreation

Trend or Planned Action	Potential Effects
Forest Management Forestland borders most of the plan area. Forestland in western Oregon is owned and managed by federal and state agencies and private landowners and has a variety of uses including, but not limited to, timber production, vegetation management, management for habitat conditions, fire management, water development, recreational use, conservation, and grazing. These types of forest management activities are expected to continue throughout the analysis period.	• Changes in forest composition and health • Changes in water yield • Changes in the timing and magnitude of seasonal flows • Changes in soil moisture
Barred Owl Population Expansion Barred owls are an invasive species in western Oregon that pose a significant threat to the northern spotted owl due to competition for resources and habitat. They are slightly larger and more aggressive than northern spotted owls and compete for the same habitat. Barred owls have spread throughout western Oregon and are expected to continue spreading across the plan area during the analysis period.	• Increased competition with northern spotted owl for habitat and resources • Further population decline of NSO in the plan area
Agricultural Activities Land designated for exclusive farm use, which is intended to preserve farmland, rangeland, and related uses, borders a small portion of the plan area in southern Marion County and northern Linn County, as well as isolated patches of the plan area in Lane and Coos Counties. Agricultural activities on these lands are anticipated to continue in these areas through the analysis period.	• Increase in sedimentation and pollutants that may affect surface waters and wetland ecosystems • Decrease in low flows • Increase in use of ground water to supplement diminishing summer low flows
Development Development adjacent to the plan area will continue to occur throughout the analysis period. Development is expected to include residential and commercial development, linear infrastructure projects like roadways or utility lines, and energy development. The relevant effects of development projects would generally be consistent from project to project but would vary in magnitude depending on project size and location relative to the plan area.	• Habitat fragmentation or loss of connectivity due to conversion of forested areas • Wildlife disturbance impacts • Increased peak flows and channel degradation • Water quality impairments • Increased air pollution • Change in regional socioeconomic productivity • Increase in recreation pressures and effects

Trend or Planned Action	Potential Effects
Recreation Activities Recreational activities, such as hiking, hunting, fishing, camping, boating, target shooting, equestrian activities, and off-road vehicle use occur in the plan area and on adjacent forestland. Recently, Oregon has seen increased participation in hiking, equestrian use, visiting interpretive sites, and off-highway vehicle use, and declining demand for hunting and fishing licenses in Oregon (ODFW 2020:3; Lindberg and Bertone-Riggs 2015:2–4). Over the analysis period, general demand for recreation in western Oregon is projected to continue to increase. Development of recreational facilities and infrastructure includes campgrounds, day-use facilities (e.g., picnicking), parking, trailhead facilities, motorized and non-motorized trails (equestrian, mountain bike, foot), boat launches, designated shooting lanes, restroom facilities, target shooting lanes, interpretive centers, and administrative buildings in areas adjacent to the plan area. This development could have overlapping effects with the covered activities. Included in this category are facilities that would require reconstruction or modification because of damage from disturbance events. It is reasonably foreseeable that recreational facilities would require expansion and improvement as the demand for recreation in Oregon continues to increase and as wildfires damage existing recreational facilities.	• Vegetation disturbance or removal • Sedimentation • Altered hydrology • Effects on water quality • Species disturbance (e.g., from noise disturbance, habitat impacts, or physical damage to species) • Increase in human-caused fires • Increase in garbage and increase in competitors to listed species (Corvid and marbled murrelet)
Changes in Revenue Distribution Policy Changes in revenue distribution policy could affect how timber revenue streams are distributed through public agencies and taxing districts. These policy changes could overlap with the effects of the proposed action and alternatives on revenue from timber harvest.	• Changes in socioeconomic productivity • Changes in revenue and funding
Resource Protection, Enhancement, and Restoration Activities Species protection and habitat protection or restoration efforts within or adjacent to the plan area (e.g., federal, state, or tribal species recovery plans, barred owl removal projects, other invasive species removal efforts) may have overlapping effects with the proposed action and alternatives.	• Beneficial effects on species and habitat • Decrease in flood hazard • Water quality improvement • Summer low flow improvement
Active Incidental Take Permits for Covered Species Projects with incidental take permits for the covered species may result in overlapping impacts with the proposed action and alternatives by enabling additional take of the covered species. Active incidental take permits for the covered species in Oregon currently include the following: • City of the Dalles HCP (northern spotted owl) • Weyerhaeuser-Millicoma Tree Farm HCP (northern spotted owl)	• Increased potential for the total amount of incidental take of northern spotted owl; however, take is minimized and mitigated through each HCP's conservation measures.

NSO = northern spotted owl; HCP = habitat conservation plan

3.3 Geology and Soils

3.3.1 Methods

The study area for geology and soils consists of the plan area and landslide initiation sites outside the plan area that affect slopes and streams within the plan area.

This analysis evaluates the potential for forest and recreation management activities under the proposed action and alternatives to increase the frequency of landslides and associated events (debris flow/torrent). It also considers how differences in restrictions on management practices affect the potential for adverse effects (e.g., stream channel scour and delivery of fine sediment to streams, which lead to aquatic habitat simplification) and beneficial effects (i.e., large wood recruitment and coarse sediment delivery to streams, which lead to more diverse aquatic habitat) related to these events. TerrainWorks (2021) modeling was considered in evaluating wood recruitment potential under the proposed action and alternatives.[1]

The analysis also evaluates potential changes in soil productivity resulting from changes in shallow-rapid landslide and erosion with respect to forestry activities such as felling, bucking, yarding, processing, and loading of timber.

3.3.2 Affected Environment

3.3.2.1 Regional Geology and Soils

The study area is large, with the plan area encompassing 733,695 acres in four ecoregions[2] (Figure 3.3-1), as defined by the U.S. Environmental Protection Agency (2013): Coast Range, West Cascades, Klamath Mountains, and Willamette Valley. The geology, soils, and climate vary by ecoregion. These factors affect forest productivity, stream geomorphology, and geologic processes. These processes include shallow-rapid landslide, debris flow/debris torrent, changes in stream geomorphology, and erosion, all of which can affect human safety, habitat, and forest productivity. Table 1 in Appendix 3.3, *Geology and Soils Technical Supplement*, summarizes the geologic origin, topography, soils, and climate of the four ecoregions in the study area. Appendix 3.3 provides detailed descriptions of bedrock and soils hazards and other geology and soils characteristics.

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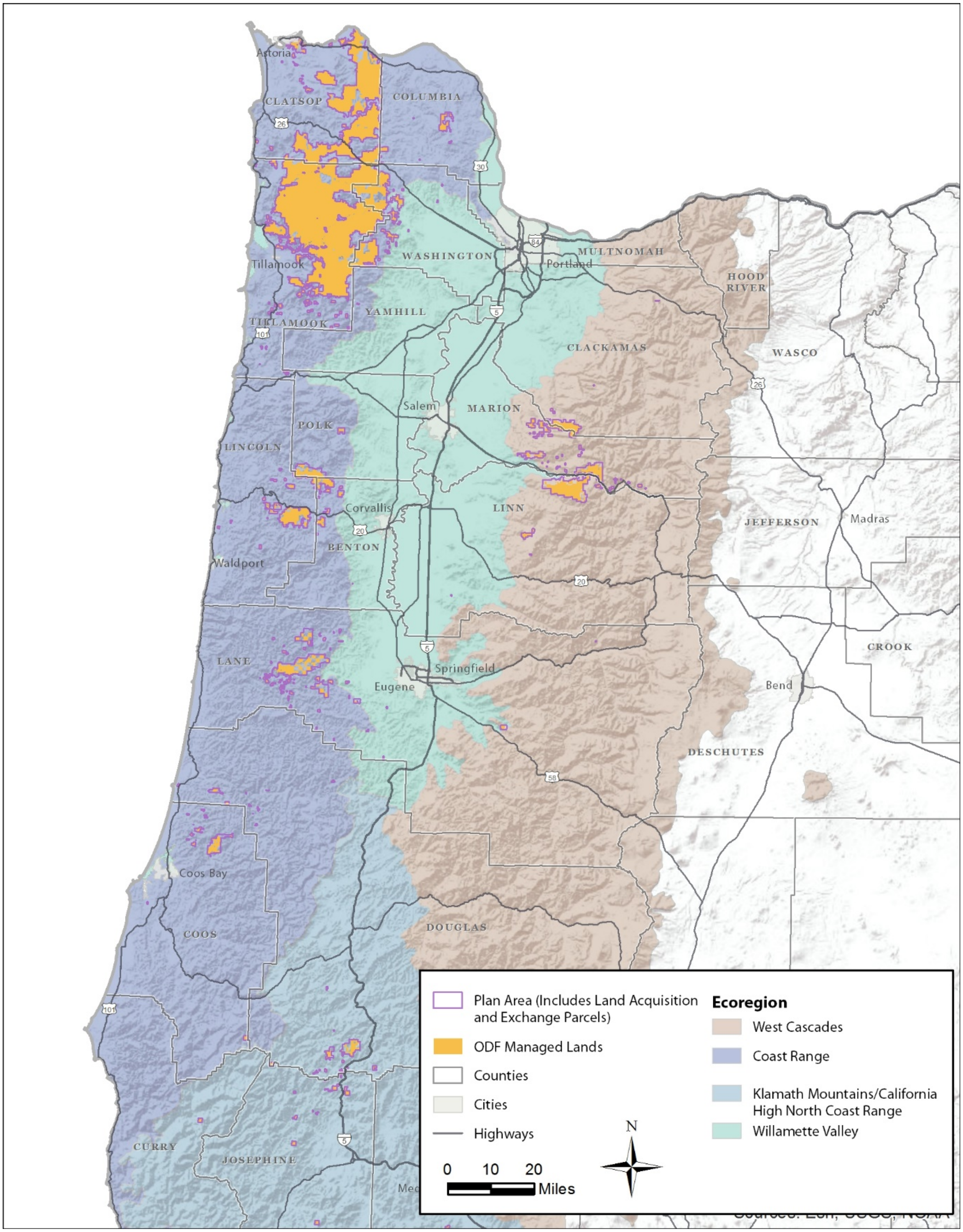
[1] The wood recruitment model calculates the estimated proportion of available wood from different recruitment processes and different source areas that is recruited to streams, including riparian buffers specified under each alternative, based on estimated frequencies of riparian tree fall, landslides, and debris flows. The size, location, and number of trees available for recruitment are based on forest growth data from the forest model. The locations and runout extent of landslides and debris flows are estimated using an empirical model calibrated to landslide and debris flow events in the Oregon Coast Range.

[2] This section references Level III ecoregions (EPA 2013).

Figure 3.3-1. Geology and Soils Study Area



3.3.2.2 Shallow-Rapid Landslide,[3] Debris Flow, and Debris Torrent

The study area's steep mountainous terrain is susceptible to shallow-rapid landslide and associated debris flow and debris torrent under both natural and forestry management conditions (Benda in prep.:2; ODF 2020:70). Shallow-rapid landslides occur within the forest rooting zone, generally less than 10 feet deep (Cohen and Schwarz 2017:452; Hairiah et al. 2020:256). Such landslides are typically initiated by intense rainfall or rapid snowmelt. Debris flow occurs when the landslide is saturated and travels across open slopes (ODF 2003a:2). Debris torrent occurs when a landslide enters a stream channel, particularly one that is flowing, and the landslide materials mix with water (Robison et al. 1999:vi, 44, 58; ODF 2003a:2; Miller and Burnett 2007:1). Debris torrents can travel thousands of feet depending on stream channel geomorphology (Robison et al. 1999:105). Shallow-rapid landslide and debris flows and torrents affect stream geomorphology and soil productivity through sediment supply and channel disturbance (Miller and Burnett 2008:184).

Past forestry management activities in the study area have resulted in shallow-rapid landslide and associated effects (i.e., debris flow and debris torrent). The Oregon Forest Practices Act (Oregon FPA) was enacted and amended to reduce these effects of forestry practices. Although the influence of forest management activities on shallow-rapid landslide and associated effects has been reduced since enactment of the FPA, forestry management activities still increase the frequency of shallow-rapid landslide and associated effects. Harvest and root decomposition remove the vegetative structure that holds soil in place. Use of heavy equipment, construction of roads and yarding areas, timber processing, and hauling compact the soil, increasing potential for runoff, which in turn increases frequency of shallow-rapid landslide. Other causes that increase frequency of shallow-rapid landslide are heavy precipitation (from rainstorms and snowmelt) and ground conditions, including soil particle size, underlying geology, and slope.

Landslide initiation sites have physical characteristics (e.g., slope, soil type) that create higher potential for shallow-rapid landslide. The highest frequency of shallow-rapid landslide occurs on slopes of over 70 to 80 percent steepness, depending on landform[4] and underlying soils and geology (Robison et al. 1999:iii; TerrainWorks 2014), especially the presence of thick, saturated soils (Department of Oregon Geology and Mineral Industries 2008). Moderate frequency occurs on slopes between 50 and 70 percent. Conditions in the study area are favorable to initiation of shallow-rapid landslide, namely steep slopes and high precipitation rates (Appendix 3.3, Table 1).

Shallow-rapid landslides that become debris torrents generally initiate in very steep landscapes or adjacent to stream channels, including in inner gorge regions (areas next to a stream where the adjacent slope is significantly steeper than the gradient of the surrounding hillsides). Even landslides that begin as relatively small slides can mobilize large volumes of material through scour and move up to thousands of feet once they enter a stream (Robison et al. 1999:58:105). The wood and water content as well as stream channel geometry affect how far debris torrents travel in stream channels (ODF 2003a:2; Robison et al. 1999:107; Benda et al. 2004:3).

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[3] This analysis does not consider deep-seated landslide. Within the study area, most deep-seated landslides are ancient, naturally caused, and not currently moving (ODF 2020:71). Some forest management activities can affect a deep-seated landslide, in particular those that make large-scale modifications to topography, including quarrying, aggregate stockpiling, placement of large fill, and construction of large road cuts, especially at the base along the toe of the landslide. However, shallow-rapid landslide and associated debris torrent are the predominant ground failure characteristics that shape the landscape.

[4] Landform refers to the shape of the ground surface.

The permit area has been mapped using light detection and ranging (LiDAR) for multiple characteristics, including slope steepness, landform, and landslide density (TerrainWorks 2014). Results of landslide modeling are presented in Appendix 3.3. The Coast Range and Klamath Mountains have similar landslide densities, slightly higher than the landslide density of the West Cascades and Willamette Valley.

The potential for destabilizing events to increase the frequency of shallow-rapid landslide varies according to local conditions and is not evenly distributed across the landscape (Robison et al. 1999:44; Cover et al. 2010:1596–1597; Burnett and Miller 2007:2), either within or across ecologic regions (Cover et al. 2010:1605). Increased frequency of shallow-rapid landslide as a result of root decomposition is higher in the 3 to 15 years after tree harvest, known as the window of vulnerability (Phillips et al. 2012:6). The landslide recurrence interval (i.e., average time between landslides at a particular location) during the window of vulnerability at clearcut sites in the Coast Range in Oregon was determined to be approximately three times that of the landslide recurrence interval in undisturbed forest (Benda in prep.:7).

In addition, roads constructed before the Oregon FPA may have been constructed on slopes greater than 50 percent (ODF 2001:4-4), on unsuitable geologic parent material (Rice and Lewis 1986:245), or with inadequate drainage, among other poor construction techniques. Poorly constructed roads dating from before the Oregon FPA in the study area have caused shallow-rapid landslide and associated effects, in particular on steep slopes (ODF 2000a:23, 2010a:2-50, 2010b:2-24 to 2-25). Landslides associated with roads were larger in volume than landslides not associated with roads by a factor of four in the Oregon Coast Range (Robison et al. 1999:v). Roads on steep slopes were associated with the majority of landslides. However, road construction and subsequent use that adhere to current best management practices (e.g., Nunamaker et al. 2007:1), requirements of the Oregon FPA (OAR 629-625), and ODF guidance (ODF 2001, 2000b, 2003c) is less likely to increase frequency of shallow-rapid landslide and associated effects.

Landslide, debris flow, and debris torrent can cause changes that can persist over thousands of years. These include changes to stream hydrology and geomorphology through sediment deposition that can dam streams and rivers or scour streambeds (Geertsema et al. 2009:589–593). There can also be potential benefits such as deposition of large wood and coarse gravels and boulders and associated creation of more diverse aquatic habitat (Geertsema et al. 2009:593–598; Miller and Scurlock 2018:2).

3.3.2.3 Stream Geomorphology

Stream geomorphology describes stream systems, including physical shape, water and sediment transport processes, and the landforms that the streams create and alter. It encompasses processes that create, alter, and maintain structure across whole watersheds (Independent Multidisciplinary Science Team 1999:11). These processes create aquatic habitat.

Debris torrents can cause both stream geomorphology simplification through scour and deposition of channel sediment (Burnett and Miller 2007:239; Robison et al. 1999:v–vi), as well as creation of complex geomorphic structures through deposition of large wood and boulders (Burnett and Miller 2007:239; Miller and Scurlock 2018:2; May and Gresswell 2003:1352–1353).

Study area stream channels have been greatly altered post-European settlement, through practices, such as removal of large wood to accommodate both boat passage and log transport, and sediment deposition and scour as a result of shallow-rapid landslide.

3.3.2.4 Soils

As described in Table 1 of Appendix 3.3, soils in the study area vary considerably with respect to parent material and productivity, depending on ecoregion. Parent material affects soil characteristics, including susceptibility to erosion and associated changes in soil productivity. Appendix 3.3 describes soils and soil hazards in the plan area. Forestry activities can decrease soil productivity through vegetation removal, soil compaction, and associated erosion. When vegetation is removed through forestry activities, such as use of heavy equipment and road construction, surface erosion can increase over natural rates until vegetation is re-established. Removing vegetation allows precipitation (i.e., rainfall and snowmelt) to mobilize particles and move them downhill (Curran et al. 2005:4–7; Picchio et al. 2020:116; Nunamaker et al. 2017:1).

3.3.3 Environmental Consequences

3.3.3.1 Shallow-Rapid Landslide and Related Events, and Changes to Stream Geomorphology

Alternative 1: No Action

Shallow-Rapid Landslide and Related Events

Continuation of forest and recreation management activities under current management practices would continue to have the potential to increase frequency of landslide and associated debris flow/torrent.

Timber harvest activities would increase frequency of shallow-rapid landslide and associated events by removing vegetation and compacting soils with use of heavy equipment. Because clearcut harvest removes the greatest number of trees, this harvest type creates conditions most conducive to shallow-rapid landslide. To address slope stability risks near areas with human uses (e.g., roads, homes), all harvest activities are prohibited near High Landslide Hazard Locations (HLHL) with substantial downslope public safety risk,[5] except for removal of dead or diseased trees, trees on sites that have already failed, and trees that have been blown over (ODF 2003b:9). In HLHL areas with intermediate downslope public safety risk, limited clearcut harvest and thinning are allowed to the extent that a healthy canopy is maintained during and after harvest. By restricting harvest activities in HLHL areas, ODF minimizes the likelihood of increasing the frequency of landslide in these areas. Harvest, including clearcut harvest, not near human uses can proceed even when it is proposed near a high-risk landslide initiation site.

New roads would be constructed under the no action alternative to access new harvest areas. Although no roads are projected to be built on steep slopes, new roads would still have the potential to increase frequency of shallow-rapid landslide and associated events. Road development in riparian buffers (riparian management areas [RMAs]) would occur only when other options are not

[5] This HLHL areas are identified via a database based on slope and landform information. In general, areas with 70 percent or greater slope are considered HLHL areas, and areas with 50 to 70 percent slopes are considered to have moderate hazard. If the area planned for forest management activities is in an HLHL area, in accordance with the Oregon FPA, a professional experienced with analyzing landslide risk on the ground inspects and evaluates the site to make recommendations regarding avoidance.

operationally or economically feasible, but where they do occur would increase the potential for near-stream landslide.

The use of roads built before the Oregon FPA would continue to cause increased potential for landslide and associated events under the no action alternative. Continued repair and vacating of these roads over the analysis period, informed by the Forest Road Hazard Inventory and prioritized by individual forest districts (ODF 2010a:2-59), would reduce these effects.

All road construction and vacating would continue to be performed in accordance with the Oregon FPA (Oregon Administrative Rules [OAR] 629) and other applicable statutes and described in the *Forest Roads Manual: Forest Engineering Roads Manual* (ODF 2000b) and additional guidance including *Avoiding Roads in Critical Locations* (ODF 2003c). Adherence to this guidance, which includes avoiding the physical steepening of slopes, avoiding directing water to steep or hazardous slopes, and maintaining canopy and roots in steep areas (Oregon Board of Forestry 2001:33), would minimize the potential for road management activities to increase the frequency of landslide.

Prohibition of ground-based equipment within 25 feet of the stream bank would minimize the potential for activities near streams to initiated landslide and associated events.

Construction of quarries and auxiliary facilities, if near a landslide initiation site, could increase frequency of shallow-rapid landslide and related events through use of explosives and bulldozers. Standard practices, including slope stability evaluation of potential quarry sites and removal of overlying soil, as well as compliance with the Oregon FPA,[6] would reduce these effects.

Changes to Stream Geomorphology

Shallow-rapid landslide and associated events would continue to cause both adverse and beneficial changes to stream geomorphology over the analysis period. These changes include stream channel scour and delivery of fine sediment to streams, which adversely affect aquatic habitat through simplification and large wood recruitment and coarse sediment delivery to streams, which beneficially affect aquatic habitat through diversification. In addition, use of heavy equipment near streams that removes vegetation and compacts soils would increase the delivery of fine sediment to streams. Continued implementation of the current practices described above would reduce these adverse effects and increase beneficial effects.

ODF would continue to constrain harvest activities in riparian areas based on stream type and distance from the stream channel as described in Chapter 2, Section 2.1.1, *Alternative 1: No Action*, and Table 2-1. These riparian buffers (RMAs), which are wider than required under the Oregon FPA, would continue to support recruitment of large wood and coarse sediment to streams in case of shallow-rapid landslide and related events. Wood recruitment to streams is projected to increase over the analysis period as trees in the riparian buffers mature (TerrainWorks 2021). In addition, if ODF continues its current practice of not harvesting in RMAs, this would continue to minimize delivery of fine sediment (Rachels et al. 2020:8). In addition, adherence with the Oregon FPA requirement to replant clearcut areas within 2 years of harvest (OAR 629-610-0040) would minimize risk of erosion after the plants are established.

[6] The Oregon FPA requires that development, use, and abandonment of rock pits or quarries on forestland and used for forest management must be conducted using practices that maintain stable slopes and protect water quality. Further, quarry operators must stabilize banks, headwalls, and other quarry surfaces to prevent surface erosion or landslide.

For harvest near high-risk landslide initiation sites, trees surrounding the site to a horizontal distance that equates to the canopy height would be left standing (leave trees). In the event of landslide, these trees could be delivered to stream channels along with coarse sediment via debris torrent, contributing positively to aquatic habitat.

Other activities near streams, including constructing roads, recreation infrastructure, and quarries and auxiliary facilities; establishing yarding corridors; and conducting stream enhancement activities would remove vegetation and increase fine sediment to streams. Prohibition of ground-based equipment within 25 feet of the stream bank would minimize the potential for activities near streams to deliver fine sediment.

Alternative 2: Proposed Action

Under the proposed action, types of effects would generally be the same as described for the no action alternative, except for the effects described below.

Shallow-Rapid Landslide and Related Events

Based on modeling, clearcut acreage would be greater under the proposed action than the no action alternative, which would result in greater overall potential to increase frequency of shallow-rapid landslide. Establishment of habitat conservation areas (HCAs) for the duration of the permit term would alter the distribution of harvest across the permit area compared to the no action alternative. In the HCAs, where clearcut harvest would be limited to 30,000 acres within the first 30 years of the permit term (no clearcut harvest after), the potential for these activities to increase frequency of landslide would be reduced. Outside of the HCAs, where harvest would increase, the potential would be greater.

Road system management methods, practices, planning, and associated types of effects would be the same as under the no action alternative. Modeled new road miles estimated under the proposed action are somewhat greater than under the no action alternative (Table 3.1-4), which would increase the potential for landslide frequency and associated events.

Impacts of quarry development and the standard procedures and Oregon FPA requirements to reduce effects would be the same as the no action alternative, but the prohibition of quarry development in RCAs (Conservation Action 11) would reduce the potential of quarries to increase the frequency of shallow-rapid landslide and associated events originating within RCAs.

Changes to Stream Geomorphology

Expanded riparian buffers (RCAs) under the proposed action (Conservation Action 1) and the added commitment to no harvest would increase potential for recruitment of large wood[7] and coarse sediment to streams in the event of landslides and associated events compared to the no action alternative.

Restrictions on siting of recreation infrastructure (Conservation Action 12), prohibition of quarry siting in RCAs, and increased widths of equipment restriction zones adjacent to stream banks (Conservation Action 2) compared to the no action alternative would further minimize the potential for activities near streams to deliver fine sediment.

[7] Based on the wood recruitment model, estimated average recruitment of wood to streams over the permit term would be 96.7 percent compared to 96.3 percent under the no-action alternative.

Alternative 3: Increased Conservation

Effects under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that increased aquatic protections (Conservation Action 1) would increase potential for recruitment of large wood[8] and coarse sediment to streams in the event of landslides and associated events, and additional requirements related to road vacating in HCAs and RCAs (Conservation Action 5) would further reduce adverse effects related to existing forest roads.

Alternative 4: Reduced Permit Term

Effects under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term. Estimated wood recruitment would increase compared to the proposed action.[9]

Alternative 5: Increased Timber Harvest

Effects under Alternative 5 compared to the no action alternative would be the same as described for the proposed action, except that the approximately 3 percent increase in modeled acreage of clearcut harvest over the permit term would increase the potential frequency of landslide and associated events.

3.3.3.2 Soil Productivity

While forestry activities can decrease soil productivity by increasing soil erosion through removal of vegetative cover and soil compaction, surface erosion rates associated with forestry activities and prescribed fire are generally minimal with current forest management practices (Elliot 2013:563; Heninger et al. 2011:28-31). These best management practices include conducting a detailed soil inventory, following harvest strategies to meet soil disturbance standards based on local soil susceptibility to disturbance, considerations of climate constraints, monitoring the resulting soil disturbance, and restoring soils that are over prescribed disturbance limits (Curran et al. 2005:8). Under all alternatives, best management practices would minimize effects on soil productivity (ODF 2010a:4-108 to 4-109, 2010b:4-100 to 4-101).

3.3.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions*, that would overlap with impacts of the proposed action and alternatives on geology and soils. With climate change, increased precipitation will cause soil saturation, increasing the frequency of soil failure, erosion, and sedimentation. More frequent disturbance events, including wildfires, will decrease soil permeability and increase the frequency of shallow-rapid landslide. Wildfires will remove vegetation, leading to more runoff and increased frequency of shallow-rapid landslide. Forest management and road construction adjacent to the plan area would have the same effects described for the proposed action and alternatives, increasing frequency of shallow-rapid landslide. Depending on forest practices, potential for delivery of large wood to streams in the plan area in case of landslide in these areas would vary.

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[8] Estimated average wood recruitment would be 98.8 percent.

[9] Estimated average wood recruitment would be 97.1 percent.

3.4 Water Resources

3.4.1 Methods

The study area for water resources consists of waters that could be affected under the proposed action and alternatives. For surface water and water quality this includes the plan area and the subwatersheds (hydrologic unit code [HUC]12) overlapping with plan area, which in part surround the plan area. For groundwater, the study area includes the regional groundwater system. The flood hazard study area includes areas prone to flooding within the subwatersheds (HUC12) that overlap with the plan area.

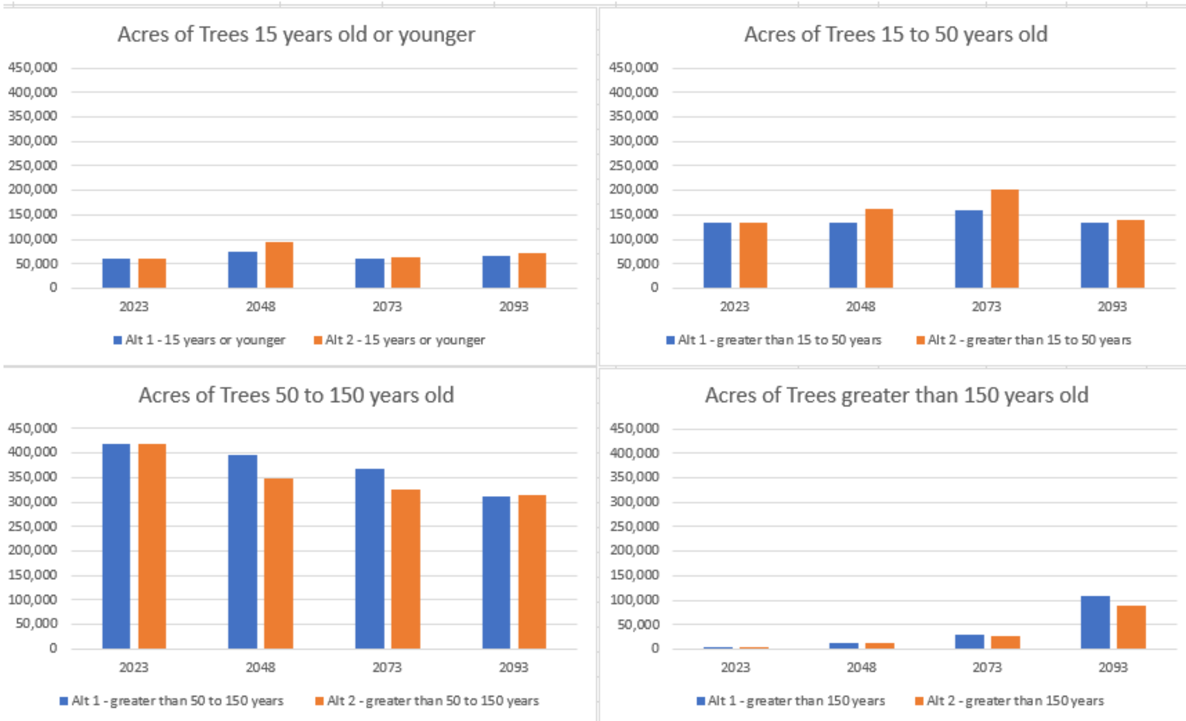
The analysis evaluated all covered activities with potential to affect water resources through changes in surface water (i.e., water supply, peak and low flows, drainage patterns, and water quality); groundwater supply, recharge, upwelling, and quality; and flood hazard (i.e., floodwater storage, conveyance, erosion, sedimentation of floodplains). The analysis based the evaluation of these changes on the review of scientific literature and relevant studies pertaining to general effects of forestry and recreation infrastructure and maintenance activities on water resources, the forest model outputs, and analysis results in Section 3.3, *Geology and Soils*, and Section 3.5, *Vegetation*.

The analysis of effects related to evapotranspiration, water yield, peak and low flows, and channel condition was based, in part, on how forest cover would change over the analysis period. Changes in forest cover were estimated based on forest model projections of basal area, which is a measure of the average amount of area occupied by tree stems. Appendix 3.4, *Water Resources Technical Supplement*, Tables 11 and 12 present the average percent changes in modeled basal area across subwatersheds by basin and maximum decrease in any one subwatershed in each basin, respectively. The analysis of effects on peak and low flows was based on forest model projections of forest age class over the analysis period. Figure 3.4-1 presents modeled forest age class under the proposed action and no action alternative. Age classes under Alternative 3 and Alternative 5 would align closely with the proposed action. The analysis also considers the effects of road construction and use on water resources. Table 3.4-1 shows the modeled length of new and existing roads and their proximity to water resources under each alternative. Effects of covered activities that were not modeled are addressed qualitatively.

3.4.2 Affected Environment

The study area includes 226 subwatersheds distributed across six surface water basins, as delineated by the U.S. Geologic Survey Hydrologic Unit (HU) 6: the Lower Columbia, Northern Oregon Coastal, Willamette, Southern Oregon Coastal, Northern California Coastal, and Klamath basins (USGS 2021a). Most of the study area is concentrated in the Northern Oregon Coastal basin. Table 3.4-2 shows the acreage distribution of study area and plan area across the basins. Figure 3.4-2 illustrates the distribution of study area across the basins.

Figure 3.4-1. Modeled Acres of Forest Age Classes in the Permit Area under the No Action Alternative and Proposed Action



Source: Forest model

Table 3.4-1. Modeled Miles of Roads Used and Constructed in Permit Area and near Water

	No Action Alternative	Proposed Action	Alternative 3	Alternative 4	Alternative 5
Roads used					
In permit area	2,785	2,819	2,817	2,816	2,854
Within 120 feet of water	632	647	646	647	652
Roads constructed					
In permit area	228	243	243	241	243
Within 120 feet of water	44	50	50	50	50

Source: Forest model and ODF (2021) road network data

Table 3.4-2. Study Area and Plan Area by Basin

Basin (HU6)	Study Area (acres)	Plan Area (acres)
Lower Columbia	400,696	50,950
Northern Oregon Coastal	1,565,963	532,634
Southern Oregon Coastal	1,102,107	33,803
Willamette	1,163,067	104,623
Klamath	11,969	108
Northern California Coastal	35,539	557

Source: USGS 2021a

3.4.2.1 Surface Water

Surface Water Hydrology

Table 3.4-3 summarizes the waterbodies and streams in the study area according to U.S. Geological Survey National Hydrography Dataset. Waterbodies in the study area include lakes, ponds, reservoirs, inlets, sloughs, bays, and estuaries. Section 3.5.2.2, *Wetland Areas*, describes wetlands in the plan area.

Table 3.4-3. Waterbodies and Streams in the Study Area

Basin	Study Area Waterbodies (acres)	Study Area Streams (miles)
Lower Columbia	1,046	4,999
Northern Oregon Coastal	14,425	24,544
Southern Oregon Coastal	11,788	15,848
Willamette	19,378	15,779
Klamath	1	218
Northern California Coastal	0	633

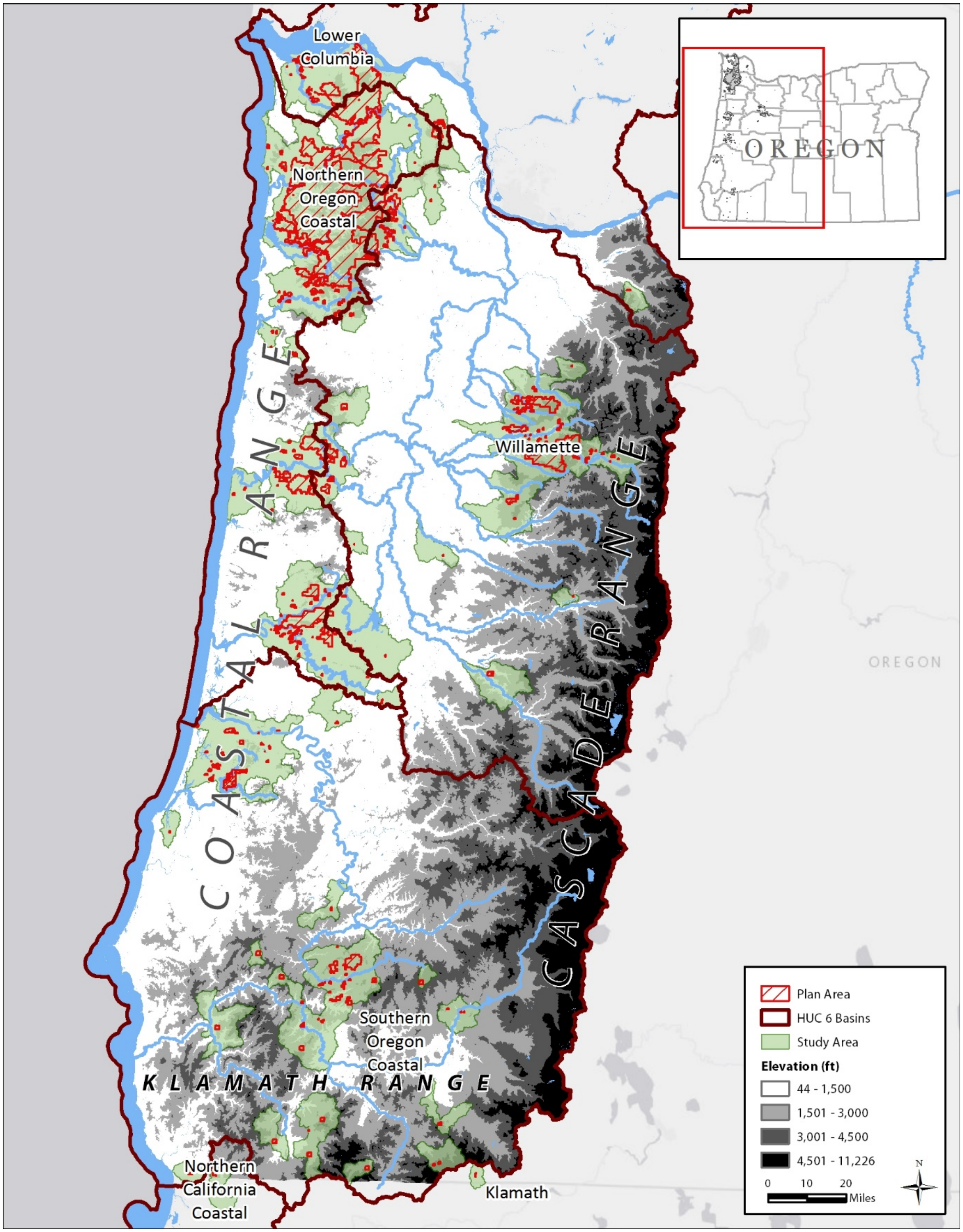
Source: USGS 2021a

Almost all precipitation in western Oregon falls in winter when water demand is at its lowest. Most precipitation falls in the coastal areas (50–200 inches per year) and the least in southern areas (45–60 inches per year) (Cooper 2005). Most of the snowfall occurs above 3,000 feet (Cooper 2005). In the study area, only nine subwatersheds, or 4 percent, have an average elevation over 3,000 feet (USGS 2021b). Most of the study area is made up of soils that have moderate infiltration and runoff potential, except for the Klamath basin, which has soils capable of higher infiltration rates (NRCS 2019).

In the coastal range watersheds, soil permeability and soil storage capacity are governing factors of peak flows (Cooper 2005). In all parts of the study area, rainfall intensity is a major factor governing peak flows. With climate change, expected increased rainfall intensity will result in increased peak flows across the study area (Easterling et al. 2017; Cooper 2005). For the small portion of the study area above 3,000 feet, peak flow increases would be compounded by rising winter temperatures with climate change, which is forecasted to increase incidents of rain-on-snow events and cause snow to melt faster (Vose et al. 2017). Appendix 3.4 describes the factors driving peak flows across the study area, statistics of physiographic characteristics, and hydrologic soil distribution across the study area.

A small portion of the study area is currently snow-dominated; the extent of this area will likely diminish with climate change, and its seasonal flows will shift from spring to fall-winter, driving summer low flows even lower (Liebowitz et al. 2014; Dalton and Fleishman 2021). Rain-dominated areas likely will also experience a decrease in summer flows to a lesser extent (Liebowitz et al. 2014). Appendix 3.4 discusses rain-versus snow-dominated hydrographs. Appendix 3.2, *Disturbance and Climate Change*, and Section 3.5 discuss projected change to vegetation with climate change.

Figure 3.4-2. Distribution of Plan Area and Study Area across Basins



Source: USGS 2021a

Surface Water Quality

The Oregon Department of Environmental Quality (ODEQ) has identified 12 beneficial uses of waters of the state: fish and aquatic life, water contact recreation, fishing, domestic water supply, industrial water supply, boating, irrigation, livestock watering, aesthetic quality, wildlife and hunting, hydropower, and commercial navigation and transportation. Water uses in the study area are impaired by water quality in all basins, except for Northern California Coastal and Klamath basins (ODEQ 2019, 2020). For a summary of impaired waterbody extents, refer to Table 6 in Appendix 3.4. The primary causes of water quality impairment in the study area streams/rivers are temperature, fecal bacteria, and dissolved oxygen. The primary causes of impairments in study area waterbodies include temperature and fecal bacteria, as well as harmful algal blooms (Willamette basin), arsenic (Northern Oregon Coastal basin), and dichlorodiphenyldichloroethylene (DDE)[1] (Lower Columbia basin). Sediment did not rank in the top three impairment causes for any basin. Stream and waterbody temperature will likely increase across the study area with climate change. Stream temperature increases are projected to be minimal in groundwater-fed streams at high elevations in the Cascade Range and greatest in low-elevation streams that are fed by surface water (Dalton and Fleishman 2021). Appendix 3.4*,* Tables 7 and 8 list miles and acres of impaired uses and causes in the study area by basin.

Surface Water Supply

State forests occupy 1 percent of lands in surface drinking water source areas statewide (ODEQ and Oregon Health Authority 2017). Most of this overlapping area is in the Willamette basin, on the west slope of the Cascades and the eastern slope of the Coast Range. The top contaminant risks statewide are managed forests, irrigated crops, livestock, above ground tanks, auto repair, wastewater treatment plants, and heavy recreation (ODEQ 2005).

Surface water in the study area is allocated for agricultural, municipal, domestic, industrial, or instream use. During the driest 20 percent of summers on record, all streamflow in most of the study area has been allocated for use. Not all water allocated is consumed; instream allocations remain in the stream, and some water diverted for consumptive use is returned to the stream (Cooper 2002). Demand for irrigation, municipal, and industrial use will likely increase with demographic changes and climate change. In the study area, increased demand will likely be greatest in Washington, Lane, Columbia, and Clatsop Counties (OWRD 2015, 2017). Appendix 3.4, Figures 2 through 4 show forecasted changes in water demand.

3.4.2.2 Groundwater

Aquifers and Recharge Areas

Only 1 percent of the plan area overlaps with a major regional aquifer system (USGS 2020). However, there is substantial groundwater use outside of the major system and many streams depend on groundwater upwelling in dry summer months when flows are critically low (ODEQ and Oregon Health Authority 2017; USGS 1994). There are four minor aquifers in the study area made up of unconsolidated-deposit aquifers, volcanic and sedimentary-rock aquifers, Miocene basaltic-

[1] DDE is a breakdown product of the pesticide DDT. DDE exposure is a probable cause of human cancer and a known toxicant to certain bird species. Because DDE is soluble in fat, it is rarely excreted, and concentrations tend to increase throughout exposed organisms' life. DDT and DDE persist in the environment for decades.

rock aquifers, and aquifers in pre-Miocene rocks (USGS 1994). Unconsolidated aquifers have higher recharge potential, are more important water sources for human use, and are more susceptible to contamination because of their higher recharge potential. Approximately 4 percent of the plan area overlaps with unconsolidated aquifers, including the 1 percent overlap with the Willamette Trough Regional Aquifer System. Most of the plan area in the Northern and Southern Oregon Coastal basins (84 percent) overlaps with aquifers in pre-Miocene rocks, which generally do not allow much recharge. Most of the study area in the Cascade Range, portions of the Willamette, and Southern Oregon Coastal basins overlaps with Miocene basaltic-rocks, where recharge zones are limited to high elevations (Moore and Wondzell 2005), mostly outside the study area, and along fault lines (USGS 1994). Appendix 3.4, Table 9 provides the distribution of aquifer types in Oregon; Table 10 in the appendix describes principal human groundwater use and well yields.

Groundwater Quality and Special Management Areas

Total dissolved solids (minerals) provide a measure of groundwater quality. The recommended value for drinking water is less than 500 milligrams per liter (mg/L), and groundwater that contains more than 1,000 mg/L is generally unsuitable for most uses. Known measured dissolved solids exceed 1,000 mg/L in very small portions of the study area (USGS 1994). ODEQ beneficial uses for groundwater are public and private drinking water, irrigation and livestock, and rural businesses. The top five groundwater contaminant sources are high density housing, highways and high use roads, above-ground tanks, irrigated crops, and underground storage tanks (ODEQ 2004). The study area does not overlap with any groundwater management areas (ODEQ 2004:7).

Groundwater Supply

According to the Oregon Health Authority, groundwater accounts for approximately 30 percent of all water used in the state, with 70 percent of Oregon residents relying on groundwater for all or part of their drinking water and 90 percent of the state's public drinking water systems relying on groundwater (ODEQ and Oregon Health Authority 2017). Statewide, ODF-managed lands occupy approximately 2 percent of land within drinking water source areas for public water systems using groundwater (ODEQ and Oregon Health Authority 2017). Some of these areas lie within the study area (ODEQ 2019). One of these areas is under direct influence of surface water, meaning the drinking water is more susceptible to contamination from surface water infiltrating into groundwater. The area is located along the Little North Santiam River in the Willamette Basin.

3.4.2.3 Flood Hazard

Most of the study area subwatersheds (222 of 226) are included in the Federal Emergency Management Agency (FEMA) flood hazard map (FEMA 2021). Of those subwatersheds, 27 percent of their area, or 1,744 square miles, is classified as Zone D, which indicates that the areas have a potentially moderate to high risk of flooding, but the probability has not been determined. Of the remainder, approximately 5 percent, or 349 square miles, is classified as 100-year floodplain, and 0.10 percent, or 6 square miles, is classified as 500-year floodplain.

Some of the largest flood events in western Oregon recorded history occurred in 1964 and 1996. The 100-year flood level was exceeded in the Clackamas River at Estacada in both floods and the Nehalem River at Foss and the Wilson River at Tillamook in the 1996 flood. The 50-year flood level was exceeded in the Sandy River at Bull Run in both floods (NOAA 2021a) and in tributaries to the Umpqua River in the 1996 flood. Between 1996 and June 2021, the National Weather Service estimated over 21 flood related deaths, 9 injuries, $700 million in property damage, and $10 million in crop damage in counties overlapping the plan area (NOAA 2021b). For a discussion of landslides caused by the 1996 flood, see Appendix 3.2.

3.4.3 Environmental Consequences

3.4.3.1 Surface Water

Alternative 1: No Action

This section discusses the effects of management activities on surface water supply, timing and duration of peak and low flows, and water quality. For a discussion of effects on soil moisture, see Appendix 3.4.

Timber harvest, associated stand and road management activities, and controlled burns would have the most extensive effects on all aspects of surface water because they affect vegetation cover at the landscape scale. Restrictions on these activities in riparian buffers (RMAs), under the no action alternative, would reduce these effects. Other management activities would affect surface water but to a lesser and more localized extent. Although controlled burns may reduce the likelihood of severe fire, which can severely affect surface water, the effects analysis only discusses the direct effects of controlled burns.

Water Supply

Water yield, the annual average water discharged from an area, is a measure of water supply. Generally, reducing forest cover through timber harvest decreases evapotranspiration and increasing soil compaction through timber harvest and road building decreases infiltration to groundwater. Both of these increase water yield, particularly during the wet season and in rain-dominated drainages, which account for most of the plan area (Goeking and Tarboton 2020; Moore and Wondzell 2005). Increased water yield can benefit water users downstream. As forest cover regrows or areas are reforested, water yield decreases. Most of the increase diminishes over the first 15 years of regrowth (Moore and Wondzell 2005).

Young stand management and salvage harvest to address insect infestations and disease would have similar but smaller effects as timber harvest. Salvage harvest following disturbance events may have more pronounced effects than timber harvest because soils are more sensitive to compaction after wildfire. The magnitude of effect would depend on the extent of the disturbance and associated salvage harvest, both of which are likely to increase over the analysis period due to climate change (Appendix 3.2).

Under the no action alternative, the average modeled change in forest cover at the subwatershed level would fluctuate throughout the analysis period. Change in forest cover is projected to range from less than a 2.5 percent *increase* to less than a 1 percent *decrease* at each 25-year time interval sampled over the analysis period (Appendix 3.4, Table 11). On average, modeled forest cover would increase over the study area, so average surface water supply would not increase due to timber harvest over the analysis period and may actually decrease. However, some areas would experience short-term increases in water yield at the local level where harvest is occurring. In the subwatershed with the greatest reduction in forest cover, water yield would increase by approximately 170 acre-feet per year (roughly equivalent to supplying water for 17 households per year) for the first few years after harvest. Appendix 3.4 provides a detailed discussion on methods.

Construction of new roads would result in permanent removal of vegetation and increased soil compaction, which can increase water yield. However, based on modeled miles of road construction and assuming road vacating at historical rates, road network expansion would account for less than 0.05 percent[2] of the study area and would not be expected to affect water yield.

Road maintenance, minor forest product harvest, quarries and auxiliary facilities, recreation infrastructure construction, and stream enhancement and barrier removal activities would likely have an undetectable effect on water yield at the subwatershed scale, because change to vegetation and compaction would likely be less than 1 percent of any subwatershed. Water drafting decreases water yield by increasing water storage and drawing water, but its effect would be local and small relative to other water storage systems (e.g., municipal, industrial, agricultural) in the study area.

Peak Flows and Channel Condition

Increases in peak flow can adversely affect channels by increasing erosion and sedimentation, which can increase sediment yield and drainage density and drain groundwater. Figures 5 through 7 in Appendix 3.4 depict the relationship between watershed conditions, management considerations, and percentage area harvested on peak flow. Changes in peak stream flows are not detectable at the subwatershed scale unless at least 20 percent of forest cover is lost (Grant et al. 2008). The sensitivity of a watershed to changes in forest cover is related to its size, climate, and road density. For large rain-dominant watersheds, the limit of detection may be as high as 45 percent cover loss (Grant 2008 et al.). Table 12 in Appendix 3.4 shows the modeled maximum decrease in forest cover in any subwatershed by basin between three time intervals. Under the no action alternative, the only subwatershed showing greater than 20 percent decrease in forest cover over the time periods sampled, due to modeled harvest activities, is a large, rain-dominated watershed that would have 23 percent less forest cover in 2048 than in 2023. Therefore, based on modeled results, harvest activities are not expected to increase peak flows at the subwatershed scale across the time periods sampled by more than the detectable limit. The *Model Results* section in Appendix 3.4 provides model results tables and a detailed discussion regarding factors affecting peak flows.

Although modeled estimates do not exceed the detection limits, the no action alternative does not set explicit rules limiting harvest below a percentage of a subwatershed. Actual harvest could result in removal of forest cover exceeding these limits of detection and result in adverse effects. Furthermore, where stream reaches drain areas with significant forest cover loss, peak flows would increase, and channel structure would be adversely affected at the local scale (Reid et al. 2010). Southern Oregon Coastal, Northern Oregon Coastal, and Klamath basins are more susceptible to changes in peak flows from timber harvest and road work. Appendix 3.4 provides details on factors affecting peak flows.

The estimated maximum area of modeled new road construction over the analysis period would be far below detection levels in any subwatershed (0.03 percent on average, 0.37 percent maximum). Timber harvest reduces the quantity of large wood available for recruitment into streams, which can increase peak flow velocity and exacerbate channel erosion and sedimentation (Ryan et al. 2014; Dixon et al. 2016). Under the no action alternative, wood recruitment potential is

[2] Assuming the average width of an affected area is 45 feet from top of cut slope to toe of fill slope.

expected to increase as forests in protected riparian buffers (RMAs) mature over the analysis period. The increase in large wood recruitment would result in a decrease in peak flow velocity.

Salvage harvest can also adversely affect peak flows and channel condition by removing forest cover and compacting sensitive burned soils. The no action alternative does not place any limits on the percent watershed area that can be salvage logged. The extent of salvage logging is expected to increase with climate change.

Controlled burns can also adversely affect peak flows and channel condition through removal of forest cover. The effect would be lower than timber harvest on a per unit area basis, because controlled burns leave overstory forest cover intact and do not cause increased soil compaction, and because new spur roads, connector roads, and skid trails are not required for controlled burns. Effects of all other management activities on peak flows would be localized and, therefore, minimal relative to timber harvest and road system management.

Because changes in peak flows can cause increased channel erosion, which can impair water quality, compliance with the Clean Water Act (CWA) may result in limitations on the percent watershed area harvested. Individual projects must comply with the CWA, which includes complying with the antidegradation rule for non-impaired streams and compliance with any restoration plans that ODEQ imposes to manage total maximum daily loads (TMDLs) on impaired streams.

Low Flows

In most areas, harvest activities would cause low flows to increase temporarily (for the first 5 to 15 years after harvest in rain-dominated parts of the study area) by temporarily decreasing evapotranspiration (Goeking and Tarboton 2020; Moore and Wondzell 2005). Low flows tend to drop as the stand regrows and reaches peak evapotranspiration, which occurs when stands are around 15 to 50 years in age (Perry and Jones 2017). At peak evapotranspiration age, low flows can be up to 50 percent lower during summer months relative to old forest (Segura et al. 2020). Appendix 3.4 provides some additional details.

Under the no action alternative, modeled forest cover by trees aged 15 to 50 years would increase by 24,000 acres (0.56 percent of the study area) by 2073 before declining again to 2023 levels (Figure 3.4-1). Summer low flows would be even lower in the study area streams where this age class is expanding. Trees over 150 years old and younger than 15 years old would have the opposite effect on low flows in the study area streams where they occur, mitigating the adverse effect of harvest on low flows.

Flows tend to be more sensitive to changes in vegetation in the riparian zone than in the rest of the watershed (Moore and Wondzell 2005). Under the no action alternative, 72,810 acres would be protected in riparian buffers, which would temper reductions in low summer flows. Increases in large wood recruitment described in the discussion of peak flow effects could also enhance low flows (Ryan et al. 2014). In summary, harvest may reduce low flows at the local stream scale, but because the change would be small relative to the study area and offset by effects of young and old growth, effects are not expected at the subwatershed scale.

Controlled burning would increase water yield by reducing understory vegetation and slash material. Because these burns are used for younger understory plants (Allen et al. 2019), the effect may last approximately 10 years and could mitigate local negative effects of young trees on low flows. These effects would be of substantially lower magnitude than the effects of timber harvest.

Road construction could supplement low flows by decreasing forest cover, increasing compaction, and diverting groundwater from hillsides to streams. Road vacating would have the opposite effects.

Quarries and auxiliary facilities have the potential to draw down the water table and thereby reduce low flows. By storing water year-round, water developments may sustain higher low flows downstream of the impoundment. Water drafting for road system management, controlled burns, and wildfire suppression would reduce streamflow. Water drafting for wildfire suppression may increase in response to increased disturbance with climate change over the analysis period. Change in vegetation due to recreation construction likely would not be extensive enough to cause detectable changes in low flows.

Water Quality

Timber harvest and young stand management can adversely affect water temperature by decreasing shading. Segments of streams that have less than a 120-foot-wide riparian buffer (Table 2-1) are shown to experience increase in water temperature due to timber harvest (Leinenbach 2016). Studies have shown that increased stream temperature, ranging from 0.5 to 7 degrees Celsius (°C), can persist for 150 to 3,000 feet downstream of a harvest unit where there are narrow or nonexistent riparian buffers (Keith et al. 1998; MacDonald et al. 1998; Wilkerson et al. 2006; Zwieniecki and Newton 1999). Appendix 3.4 contains additional details. The minimum riparian buffer under the no action alternative does not exceed 115 feet. Therefore, water temperature would increase in all streams flowing through harvest units and streams receiving waters from harvest units that are not otherwise shaded by topography, large wood, or additional riparian buffer requirements such as those for inner gorges and high landslide hazard areas. Moreover, the no action alternative does not prohibit timber thinning in riparian buffer areas, which can also reduce shade and increase stream temperature (Leinenbach 2016).

Where streams already exceed CWA standards, ODEQ may require ODF to implement additional, project-specific best management practices to comply with plans that manage TMDL allocations as set by ODEQ and authorized by state regulation Oregon Revised Statutes (ORS) 527.

Timber harvest and young stand management can also adversely affect water quality by increasing fine sediment delivery to streams. Riparian buffers of 50 feet have been found to be effective at preventing sediment from entering streams from hillslope surface erosion (Lakel et al. 2010) Under the no action alternative, these activities would have an adverse effect on sediment delivery to most small perennial and seasonal streams where buffers (RMAs) are below this. In addition, these activities can increase turbidity and sedimentation by increasing gully erosion of the channels themselves (Reid et al. 2010). ODEQ (2014) did not reach any conclusions about whether rules governing harvest on landslide-prone areas are protective of water quality.

Forest road failure and chronic surface erosion cause adverse effects on water quality through the delivery of sediment (Boston 2016; Kastridis 2020). Forest road use also causes adverse effects on water quality by spreading noxious weeds and thereby increasing related herbicide use. Road maintenance decreases sediment delivery to streams. Road drainage repair decreases adverse effects on water quality by addressing drainage issues. Under the no action alternative, 632 miles of roads within 120 feet of water would be used for harvest and 44 miles of new roads would be constructed within 120 feet of water. The forest roads manual describes how ODF manages roads to mitigate sediment delivery to streams (ODF 2020). ODEQ (2014) found a lack of information on upgrades to roads that predate the latest forest roads manual and what risk remains on the landscape. ODEQ also found that current cross-drain spacing and wet-weather hauling rules are insufficient to meet turbidity and sediment standards. Based on ODEQ findings, water quality near haul routes and new roads would be adversely affected under the no action alternative.

Vacating or closing roads were not modeled but would decreases these adverse effects. Vacating roads has a greater beneficial effect than closing roads, because vacating increases infiltration and vegetation and removes fill from flood-prone areas, whereas road closure slows drainage feature degradation by reducing traffic.

Salvage logging can adversely affect water quality by increasing stream temperature and sedimentation by removing stream shade and increasing surface and channel erosion. The no action alternative poses no limit on salvage logging, and salvage logging opportunities are expected to increase under climate change.

Depending on their extent and burn severity, prescribed burns in riparian areas can temporarily increase stream temperature, nutrients, sediment, and reduce dissolved oxygen (Ice et al. 2004; Stednick 2010); streams already impaired by these contaminants would be most vulnerable to this activity. Appendix 3.4 contains additional details.

The recruitment of large wood to streams would likely increase over the analysis period from continued implementation of riparian buffers (RMAs) that are wider than under historical practices. This increased wood recruitment would mitigate the adverse effects of harvest on water quality, including water temperature, nutrients, and dissolved oxygen.

Quarries and auxiliary facilities can increase turbidity, sedimentation, oil and grease, mineral concentration, and pH of surface water by permanently changing the drainage patterns in the local area, decreasing vegetative cover, increasing compaction, and exposing mineral soil. Areas most sensitive to potential effects are waters impaired by temperature, sediment, and naturally occurring minerals, such as iron and arsenic. Under the no action alternative, development of quarries and auxiliary facilities in riparian areas would be allowed, which would increase the risk of water quality impacts. Development and operation of quarries and auxiliary facilities must comply with OAR 629-625-0500, which requires that these facilities be developed and used in such a way that maintains stable slopes and protects water quality.

Water drafting adversely affects water temperature and dissolved oxygen by increasing exposure to solar irradiance, collecting sediment, and increasing stagnation. Under the no action alternative, unrestricted water drafting would be allowed, which would increase water temperature. Streams already impaired by temperature and dissolved oxygen would be most sensitive to water drafting.

New recreation infrastructure located near waterbodies would negatively affect water quality by increasing sediment delivery to streams, increasing water temperature by decreasing riparian shading, and increasing fecal bacteria via increased sewage. the no action alternative would not restrict building new recreation infrastructure in the riparian zone. Maintenance activities would have a beneficial effect on water quality by repairing drainage features and addressing septic system issues but would have an adverse effect on water quality if herbicides or pesticides are used. If the increased roads near water bodies increase public access, recreation activity impacts would also increase. Minor forest product harvest is expected to have no effect on water quality. Appendix 3.4 contains additional details. Effects of stream enhancement and barrier removal on water quality include temporarily increased turbidity, sedimentation, and delivery of other contaminants to the stream. In the long-term, enhancement and barrier removal would improve water quality by restoring channel and floodplain functions and riparian vegetation. Compliance with CWA and state regulations (e.g., CWA permitting processes, TMDL requirements, and ODEQ regulations) requires implementation of BMPs that are effective in meeting water quality standards or TMDL restoration plans that would minimize and avoid water quality effects from quarries and auxiliary facilities, water drafting, recreation infrastructure, and stream enhancement and barrier removal.

Alternative 2: Proposed Action

Water Supply

The types of effects on water supply under the proposed action would be the same as described for the no action alternative. The average modeled change in subwatershed forest cover would range from approximately -1.5 to 3.5 percent at the time intervals sampled, which is similar to the modeled change in forest cover under the no action alternative (Appendix 3.4, Table 11). In the subwatershed with the greatest reduction in forest cover over the time periods sampled, water yield would increase by approximately 350 acre-feet per year (roughly equivalent to supplying water for 35 households per year) for the first few years after harvest. The estimated maximum area of modeled new road construction is slightly greater under the proposed action than the no action alternative over the permit term (0.04 percent on average, 0.47 percent maximum); therefore, effects on water supply would be similar to the no action alternative.

Effects of other activities would be the same as described for the no action alternative.

Peak Flows and Channel Condition

The types of effects on peak flow and channel condition under the proposed action would be the same as described for the no action alternative. Based on modeling, harvest would increase; however, the modeled maximum decrease in forest cover did not exceed 20 percent in any transition subwatershed or 45 percent in any rain-dominated watershed between the three intervals (Appendix 3.4 provides the modeling results). Therefore, effects of harvest on peak flows are not expected to be detectable at the subwatershed level over these time periods. However, like the no action alternative, the proposed action does not set explicit rules for limiting harvest below a percentage of a subwatershed. Therefore, adverse effects on peak flows could occur. Moreover, wherever stream reaches drain areas that are significantly harvested, channel erosion is likely to occur (Reid et al. 2010).

The estimated maximum area of modeled new road construction is slightly greater under the proposed action than the no action alternative over the permit term but would remain far below detection levels in any subwatershed (0.04 percent on average, 0.47 percent maximum).

Factors that may mitigate the effects of peak flows on channel condition, such as increased large wood[3] and reduced compaction in the riparian area, would increase under the proposed action. Conservation Action 1 (expanded and more protective riparian buffers, cover 3,356 more acres than under the no action alternative, Table 2-3). Conservation Actions 2, 5, and 11 would ensure minimum ground disturbance in riparian areas and that road standards are followed. Therefore, the proposed action would better mitigate effects on local peak flows and channel condition than the no action alternative.

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[3] Based on the wood recruitment model, estimated average recruitment of wood to streams over the permit term would be 96.7 percent compared to 96.3 percent under the no-action alternative.

Under the proposed action, salvage logging would be limited in riparian conservation areas (RCAs) and HCAs to hazard tree removal only. This would reduce the potential for adverse effects to peak flows and channel condition relative to the no action alternative, which poses no limit on salvage logging. Use of prescribed fire and associated effects would the same as described under the no action alternative. Effects of all other management activities on peak flows would be localized and, therefore, minimal relative to timber harvest and road system management.

Low Flows

The types of effects on low flows under the proposed action would be the same as described for the no action alternative. Modeled changes in stand age distribution show the proposed action would result in more adverse effects on low flows than the no action alternative (Figure 3.4-1) and would have the potential for greater localized adverse effects on low flows. Modeled acres of high transpiration age class (15 to 50 years) increase by approximately 30 percent more than the no action alternative (Figure 3.4-1, Table 3.4-4), which would result in lower summer low flows. Modeled increase in old growth would be about 40 percent less than no action increase, and would therefore not mitigate for adverse effects on low flows as well. Riparian buffers (RCAs) would be wider and longer than under the no action alternative (Conservation Action 1), and fully protected from thinning and prescribed fire, which would better mitigate for adverse effects on low flows (Segura et al. 2020). Conservation Action 2 would reduce adverse effects of disturbance from harvest in riparian areas on low flows relative to the no action alternative, and Conservation Actions 3 and 4 could improve low flows by restoring surface-groundwater interaction and storage.

Table 3.4-4. Modeled Percent Change in Acres Covered by Age Class from 2023 to 2073

Alternative	0 to 15 Years	15 to 50 Years[a]	50 to 150 Years	Greater than 150 Years
No action	2.0%	17.7%	-11.8%	435.5%
Proposed action	7.4%	49.9%	-22.2%	394.7%
Alternative 3	7.7%	48.7%	-21.9%	394.8%
Alternative 4	7.4%	49.9%	-22.2%	394.7%
Alternative 5	12.0%	56.5%	-25.0%	392.5%

Source: Forest model

[a] Highest transpiration age class

Increased large wood recruitment potential compared to the no action alternative, as described for peak flows and channel condition, would better mitigate adverse effects on low flows.

The modeled increase in the miles of road construction (Table 3.4-1) could result in greater water drafting than the no action alternative, which would increase adverse effects on low flows in some years. In drier years, adverse effects of water drafting on low flows may be tempered, relative to the no action alternative, because of limitations on the percent decrease in water depth caused by drafting. Restrictions on new quarries in the riparian area under Conservation Action 11 would reduce potentially adverse effects on low flows.

Water Quality

The types of effects on water quality under the proposed action would be the same as described for the no action alternative, and the same regulatory requirements for CWA and ODEQ compliance would apply.

Expanded riparian buffers would reduce the magnitude and duration of adverse effects of harvest and young stand management on sedimentation and stream temperature relative to the no action alternative (Leinenbach 2016). A process protection zone (PPZ) would be implemented on the first 500 feet upstream of fish use and up small, perennial non-fish-bearing streams that connect to fish-bearing streams to further protect fish bearing streams from increased water temperature flowing downstream from areas protected by less than 120-foot buffers (Table 2-3). Although the PPZ would reduce adverse effects on fish-bearing streams, relative to the no action alternative, the PPZ would not eliminate adverse temperature effects flowing into fish-bearing streams (Leinenbach 2021; Groom et al. 2018). Some streams would avoid the residual adverse effect due to site conditions, including streams surrounded by steep hillsides, on north- and east-facing slopes, streams fed by groundwater seeps, streams with higher percent large wood, streams that feed into larger tributaries, and streams downstream of high-energy tributaries which have wider buffers. The potential for residual temperature effects on these streams would remain, but would be reduced compared to the no action alternative. Adverse effects on temperature for all small perennial and seasonal non-fish bearing streams would be the same as the no action alternative. Prohibited thinning in RCAs and limits on riparian area disturbance (Conservation Actions 1 and 2) would mitigate adverse effects compared to the no action alternative.

Modeled miles of roads used for harvest and new roads built within 120 feet of water increase relative to the no action alternative (Table 3.1-4) and road best management practices would not differ. This would increase potential adverse effects on sediment delivery to streams and on water quality.

Adverse effects on water quality from salvage logging would be lower than the no action alternative by limiting tree removal in HCAs and RCAs to hazard trees only. Increased recruitment of large wood to streams compared to the no action alternative would better mitigate adverse effects on water quality. Based on the increased modeled road network, compared to the no action alternative, adverse effects of water drafting on water temperature would increase but would be mitigated by restrictions related to siting and change in stream depth (Conservation Action 10).

Effects of recreation infrastructure development, and potentially maintenance, would be reduced under the proposed action due to restrictions on development in RCAs and increased equipment restriction zones (Conservation Actions 12 and 2). If the increased roads near waterbodies increase public access, recreation activity impacts would also increase.

The modeled increase in road construction under the proposed action would increase traffic around quarries and material removal and related effects on water quality. However, increased equipment restriction zones and prohibition of quarry development in RCAs (Conservation Actions 2 and 11) would mitigate the adverse effects on water quality compared the no action alternative. As described for the no action alternative, minor forest product harvest is expected to have no effect on water quality.

Under the proposed action, individual projects must still comply with the CWA. Therefore, individual projects may have stricter limitations, based on site-specific conditions, to protect water quality from degrading or to comply with water quality restoration plans.

Alternative 3: Increased Conservation

Effects on surface water under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that expanded RCAs (Conservation Action 1) would further minimize temperature effects and road system management requirements (Conservation Action 5) would further mitigate adverse effects on water quality.

Expanding RCAs from 35 to 50 feet above the PPZ for all small perennial and seasonal non-fish-bearing streams that are high energy or in potential debris flow tracks would exceed the estimated minimum 41 feet required to attenuate temperature effects to less than 0.3°C at the outlet of the PPZ (Leinenbach 2021; Groom et al. 2018).

Adverse effects of road system management would be mitigated by targeting an equal number of road miles vacated to road miles constructed within 120 feet of water and in HCAs. Prioritizing road drainage improvement and vacating projects based on a systematic evaluation of risk to water quality would increase beneficial effects of these activities. Adverse effects of recreation infrastructure would be further mitigated by establishing a risk-based inventory and evaluation of motorized trails for improved maintenance and coordination with ODEQ. Refer to Table 3.4-1 and Appendix 3.4, Tables 11 and 12, for details.

Alternative 4: Reduced Permit Term

Effects on surface water under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on surface water under Alterative 5 compared to the no action alternative would be similar to the proposed action, but adverse effects on low flows would be of greater magnitude because of increased harvest. Based on modeling changes in stand age distribution, acres of high transpiration age class would increase by 7 percent beyond proposed action increases, resulting in lower summer low flows. Acres of old growth would be 2 percent less, which would not mitigate for adverse effects on low flows, as well (Figure 3.4-1, Table 3.4-4).

3.4.3.2 Groundwater

Alternative 1: No Action

Timber harvest, young stand management, and controlled burns temporarily increase groundwater recharge at the shallow level (Smerdon et al. 2009), which can increase upwelling (Waswa and Lorentz 2019). Reforestation may increase recharge by increasing roughness and then decrease water table levels as evapotranspiration peaks around 15 to 50 years. Riparian buffers (RMAs) and wood recruitment increase the potential for infiltration to groundwater in and around stream channels.

Management activities would increase the potential for fuel spills from equipment and herbicides, which can infiltrate to shallow groundwater. However, most of the study area is covered by lower infiltration soils and rocks that are less likely to allow contaminants to penetrate groundwater. The Chemical and Other Petroleum Product Rules and Water Protection Rules of the Forest Practices Act (OAR 629) would further minimize and avoid effects on groundwater quality.

New road construction would decrease recharge by increasing compaction and decreasing roughness. New roads can also increase groundwater discharge, where road cuts intercept subsurface flow zones and redirect discharge to streams (Goeking and Tarboton 2020). Locations in the plan area where seeps and springs are more common are more susceptible to this effect. Catchments that are already heavily roaded, have steep slopes, and have shallower soils are more susceptible to decreases in recharge, because they are more efficient at draining any intercepted groundwater (Grant et al. 2008). Appendix 3.4, Tables 1 and 2 provide details regarding road density, slopes, and depth to bedrock.

Road drainage repairs would increase recharge by distributing drainage across the hillside where it can recharge the shallow groundwater. Closing and vacating roads would increase infiltration by decreasing compaction and increasing cover and roughness on the road surface. Maintaining roads would increase shallow groundwater recharge by restoring proper drainage.

Even in the heaviest harvest years, minor forest product harvest effects on recharge and groundwater quality would not be detectable and would be further mitigated via the ODF minor forest product harvest permitting process; there would be no effect on groundwater recharge, supply, or quality.

In and around quarries and auxiliary facilities, recharge to groundwater decreases due to increased ground compaction and removal of soil. Quarries and auxiliary facilities can encounter subsurface flow zones, altering subsurface pathways and rates. Quarries and auxiliary facilities located in riparian areas, unconsolidated materials, and on steep hillsides near fault lines are most susceptible to this effect. Operations of these facilities involve heavy equipment fuel and oils that may be transported into groundwater and their development in riparian areas would have an adverse effect on local groundwater recharge and quality.

In low withdrawal years, water drafting, particularly those in unconsolidated aquifers, could increase groundwater recharge by increasing residence time and inundation area. In high withdrawal years, where streamflow is drafted from reaches where groundwater is upwelling, groundwater could be withdrawn from the shallow aquifer.

New recreation infrastructure may permanently decrease recharge locally by increasing impervious surfaces near waterbodies. Maintenance would periodically increase groundwater recharge locally by improving drainage features that facilitate groundwater infiltration. New recreation infrastructure could cause an increase in fecal bacteria in shallow groundwater, as new restrooms, dispersed camping, and hiking access increase waste. The Northern Oregon Coastal basin, where fecal bacteria is already a concern, is most susceptible to this effect. Maintenance activities would mitigate this effect by ensuring restrooms are in functioning condition. Maintenance could increase herbicides in shallow groundwater, as parking lots and campgrounds may be treated for weeds. CWA permitting and Oregon Groundwater Protection Act compliance would ensure that impacts are avoided or minimized.

During construction, stream enhancement and barrier removal may temporarily decrease groundwater recharge around streams and would involve heavy equipment that could leak or spill fuels, which could seep into shallow groundwater. Best management practices would minimize this risk and should mitigate the potential risk of spills during construction and stream channel downcutting after barrier removal.

Alternative 2: Proposed Action

The types of effects on groundwater under the proposed action would be the same as described for the no action alternative; however, the magnitude and duration of effects from timber harvest, reforestation, and young stand management; riparian protections; and new road construction would differ.

On average, timber harvest, reforestation, and young stand management effects on recharge and upwelling would be similar to the no action alternative (Appendix 3.4, Table 13). The modeled acres of old trees would increase less and acres of young trees would increase more relative to the no action alternative (Figure 3.4-1), which may result in less of an increase in recharge to groundwater. Expanded riparian buffers (RCAs) (Conservation Action 1) would capture more runoff and increase beneficial effects on recharge and upwelling. Increased equipment restriction zones (Conservation Action 2) would reduce ground disturbance and further limit adverse effects on recharge around streams relative to the no action alternative.

Based on modeling, construction of new roads would increase relative to the no action alternative (Table 3.4-1). This would result in increased adverse effects on groundwater recharge.

Alternative 3: Increased Conservation

Effects on groundwater under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that further expanded RCAs (Conservation Action 1) would further reduce adverse effects and increase beneficial effects of all covered activities and increased commitments under Conservation Action 5 would further reduce road-related effects. Specifically, adverse effects of road system management would be mitigated by targeting an equal number of road miles vacated to road miles constructed within 120 feet of water and in HCAs. Furthermore, the beneficial effects of road drainage improvement and road vacating projects would be more beneficial, because they would be prioritized based on a systematic evaluation of risk to water quality, which would involve identifying roads that are intercepting and diverting groundwater.

Alternative 4: Reduced Permit Term

Effects on groundwater under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on groundwater under Alternative 5 compared to the no action alternative would be the same as described for the proposed action, except that greater modeled acres of clearcut harvest would further decrease recharge potential and increase the potential for groundwater contamination.

3.4.3.3 Flood Hazard

Alternative 1: No Action

By disturbing land and removing vegetation, timber harvest, young stand management, and controlled burns could affect floodplain functions, such as floodwater storage and conveyance capacity, erosion and sedimentation potential, and available aquatic habitat. Reforestation and riparian buffers (RMAs) would likely cover most of the floodplains, which account for less than 1 percent of the plan area (NRCS 2019). Large wood recruitment would decrease flood velocities and control erosion.

Construction of roads or trails could interfere with the storage and passage of floodwater. A decrease in floodwater storage capacity may increase floodwater levels downstream. Road or trail construction may also result in the redirection of floodwaters, potentially causing erosion in adjacent areas. Road maintenance, road drainage repair, and closing or vacating roads in floodplains can reduce the adverse effects on flood hazards by improving drainage features and increasing infiltration, which can decrease velocities, scour, and flood surface elevation.

Based on modeling, 44 miles of new roads would be built and 632 miles would be used within 120 feet of surface water and, therefore, maintained or repaired. Some of these roads may be in floodplains. Compliance with the state and federal regulations governing development in floodplains would mitigate the effect of road system management on flood hazard.

Minor forest product harvest is not expected to affect flood hazards on a widespread scale, even in high harvest years. Quarries and auxiliary facilities built in floodplains would increase flood hazards by placing and removing fill in floodplains. State and federal floodplain regulations would minimize adverse effects. Placement of fill associated with new recreation infrastructure in floodplains could increase flood hazards by raising water elevations. Compliance with state and federal floodplain regulations would minimize this adverse effect. Stream enhancements and barrier removals could result in placement or removal of fill in floodplains. However, these projects would likely be designed to attenuate flood flows and protect the channel from erosion in the long term by restoring floodplain functions. Compliance with state and federal floodplain regulations would minimize any adverse effects.

Alternative 2: Proposed Action

The types of effects on flood hazard under the proposed action would be the same as described for the no action alternative. Modeling estimated that there would be 6 more miles of new road and 15 more miles of road used for timber hauling within 120 feet of a surface water compared to the no action alterative (Table 3.4-1). Some of these roads may be in floodplains and therefore could increase flood hazard.

The following conservation actions are designed to mitigate flood hazards under the proposed action. Conservation Actions 11 and 12 would prohibit new quarries and recreation facilities, other than boat ramps and trails, in RCAs and would limit extent of trails in RCAs. Conservation Action 2, which expands the distance from streams where equipment use is restricted, could reduce the removal or placement of fill in floodplains. Conservation Actions 5 and 11 would make road best management practices into legal requirements and thereby improve the likelihood that roads are designed to pass flood flows.

Alternative 3: Increased Conservation

Effects on flood hazard under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that further expanded RCA widths (Conservation Action 1) would further reduce adverse effects and increase beneficial effects from all covered activities and increased commitments under Conservation Action 5 would further reduce road-related effects as described for groundwater (Section 3.4.3.2, *Groundwater*).

Alternative 4: Reduced Permit Term

Effects on flood hazard under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on flood hazard under Alternative 5 compared to the no action alternative would be the same as described for the proposed action.

3.4.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* that would overlap with impacts of the proposed action and alternatives on water resources.

Climate change will alter air temperature, humidity, wind, cloud cover, and precipitation patterns, lowering low flows, increasing flood frequency, changing peak flow timing and duration, reducing extent of snow-dominated areas, increasing water temperature, and increasing incidence of drought.

Intensified rainstorms and increased storm event frequency and related flooding will increase sedimentation, channel erosion, and debris flows impair water quality and exacerbate downstream flood hazards. These effects can also reduce low flows. More frequent, more intense, and larger wildfires will remove vegetation and cause soils to become hydrophobic and more sensitive to compaction from management activities, resulting in increased water yield, peak flows, sedimentation, channel erosion, debris flows, water temperature, and flood hazards.

Forest management adjacent to the plan area would have the same effects described for the proposed action and alternatives, including changes to water yield, timing, magnitude, and duration of seasonal flows, soil moisture, water temperature, channel erosion, and sedimentation.

Agricultural activities adjacent to the plan area would increase water withdrawals from streams, decreasing low flows, thereby increasing water temperature. Agriculture also results in runoff, which increases sedimentation, turbidity, nutrients, herbicides, water temperature, and fecal indicator bacteria; decreases dissolved oxygen; and potentially increases the concentration of other water quality contaminants.

Development adjacent to the plan area would increase impervious surface area, increasing runoff and consequently increasing peak flows and associated channel erosion and water quality impairments. Development would also increase municipal and industrial water demand, which increases water withdrawals, thereby decreasing low flows and degrading water quality (Figures 2 and 4 in Appendix 3.4). Development can also result in new construction of major surface water infrastructure, such as reservoirs, to meet the increased demand for water, which would change sediment transport and flow regimes and decrease water quality.

Recreational activities within or adjacent to the plan area would increase compacted and impervious areas, spread weeds, and increase sewage waste, which would increase runoff and require expanded herbicide application, thereby decreasing water quality.

Restoration activities adjacent to the plan area could improve connection between channels and floodplains, restore flood conveyance capacity and riparian vegetation, which would decrease flood hazards, improve water quality, increase groundwater recharge, and improve summer low flows.

3.5 Vegetation

3.5.1 Methods

The study area for vegetation consists of the plan area, where vegetation could be affected by forest and recreation management activities under the proposed action and alternatives.

The vegetation analysis evaluates changes in forest structure and type in the permit area under the proposed action and alternatives based on the forest model outputs at four timesteps (0, 25, 50, and 70 years). The forest model included timber harvest (except salvage), reforestation, young stand management, and road construction. Effects of other activities on forest structure and types are addressed qualitatively. The analysis also compares the extent and timing of activities by evaluating the loss of vegetation and potential for spread of invasive weeds from ground-disturbing covered activities. To evaluate impacts on wetlands, the analysis overlayed modeled clearcut and thinning activities on mapped wetlands. To evaluate impacts on special-status plant species, the analysis involved identifying documented species occurrences at the county level and the species potential habitat in the study area.

3.5.2 Affected Environment

3.5.2.1 Vegetation Cover

The study area overlaps with four ecoregions:[1] the Coast Range, Klamath, Cascades, and Willamette Valley (Figure 3.3-1) (Thorson et al. 2003). Most (87.6 percent) of the study area is in the Coast Range, with 8.5 percent in the West Cascades, 2.9 percent in the Klamath Mountains, and 1 percent in the Willamette Valley. The Coast Range ecoregion is dominated by coniferous forests and has a dense stream network with distinct deciduous riparian vegetation communities. The West Cascades ecoregion is almost entirely forested by conifers. The Klamath Mountains ecoregion contains diverse elevation, topography, geology, and climate, enabling it to support a range of vegetation communities. The Willamette Valley ecoregion was historically dominated by grasslands, oak savannas, and wet prairies but is now Oregon's most productive agricultural region (ODFW 2016).

There are four dominant stand types in the study area: Douglas-fir (*Pseudotsuga menziesii*), mixed conifer, hardwood, and western hemlock (*Tsuga heterophylla*). Mixed conifer stands typically include a combination of western hemlock, Douglas-fir, western redcedar (*Thuja plicata*), with a lesser amount of Sitka spruce (*Picea sitchensis*) and noble fir (*Abies procera*). Hardwood dominant stands are usually dominated by either red alder (*Alnus rubra*) or bigleaf maple (*Acer macrophyllum*). Approximately 45 percent of the study area is dominated[2] by Douglas-fir.

Seral stages describe forest development based on age and structure. Stand age generally refers to the time since the last clearcut harvest or natural disturbance event and post-disturbance salvage logging that eliminated much of the previous forest in an area. Forest stands in the 50- to 79-year-old range are the most abundant across the study area and account for half of the total acreage and

[1] Ecoregions are defined by ecosystem components, useful for understanding the physical and biological settings in different parts of the study area.

[2] Greater than 80 percent of trees within the stand are Douglas-fir trees.

more than 60 percent of the standing volume.[3] Forest structure comprises the vertical and horizontal distribution of trees, presence of snags (standing dead) and logs (downed dead), structural diversity and distribution of small vegetation in the understory, and structural complexity of trees. Structural complexity includes the presence of secondary limbs, cavities, and other features. Forest structure within a single seral stage can range from simple to complex. Appendix 3.5, *Vegetation Technical Supplement,* provides further details on forest age and structure across different seral forests.

Disturbance events, primarily fires and windstorms, have historically shaped the forest landscape in Oregon. These events have intensified with climate change and are projected to continue to intensify. Timber harvest, dating back to the 19th century, is also a primary force in shaping the landscape in the study area. Disturbance and timber harvest both affect vegetative cover by clearing vegetation and removing diversity and complexity. Appendix 3.2, *Disturbance and Climate Change,* describes historical ecological disturbances and effects.

Responses to disturbance events, primarily salvage harvest and replanting, have also shaped the forest landscape. Salvage harvest removes organic matter from the forest floor, which can limit what species can be supported and thereby reduce diversity of structural complexity within the forest stand (Thorn et al. 2018).

As a result of historical timber harvest and fires, most of the study area is second growth or third growth forest with isolated patches of old-growth forest, usually more than 175 years old (see Appendix 3.5 for further discussion).

3.5.2.2 Wetland Areas

Wetlands make up approximately 1.3 percent of the total study area. Riverine systems are the most common wetland type (approximately 73 percent of total wetland acreage) in the study area; freshwater forested/shrub wetlands are the second most common (14 percent). Riverine systems include wetlands and deepwater habitats contained within a defined channel; freshwater forested/shrub wetlands are areas dominated by woody vegetation, including shrubs, saplings, or trees such as willows (Cowardin et al. 1979).

3.5.2.3 Invasive Plant Species

Roughly 190 invasive plant species or species groups occur in the study area. Invasive species affect the forest structure by outcompeting native species and reducing the biological diversity in the shrub and herbaceous layers. English holly (*Ilex aquifolium*) and ivy (*Hedera helix*) have invaded intact native forests (Stokes et al. 2014). Within forest habitat the most common invasive plant species include Japanese knotweed (*Fallopia japonica*), giant hogweed (*Heracleum mantegazzianum*), Himalayan blackberry (*Rubus armeniacus*), yellow archangel (*Lamium galeobdolon*) and English ivy (Seybold et al. 2021:352–377). Invasive species likely found in riparian or aquatic areas include flowering rush (*Butomus umbellatus*), waterthyme (*Hydrilla verticillata*), water primrose (*Ludwigia grandiflora*), yellow floating heart (*Nymphoides peltata*), reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), giant salvinia (*Salvinia molesta*), and water chestnut (*Trapa natans*) (Seybold et al. 2021:352–377).

[3] Standing volume refers to standing trees, dead or alive.

3.5.2.4 Special-Status Plant Species

Twenty-two plant species identified as federal or state listed threatened, endangered, or species of concern have been documented within counties in the study area (Oregon Biodiversity Information Center 2019). Appendix 3.5, Tables 3 and 4, list and describe these plants and their likelihood of occurring in the study area.

3.5.3 Environmental Consequences

3.5.3.1 Forest Structure and Type

Alternative 1: No Action

Of the forest and recreation management activities, ongoing timber harvest, reforestation, and young stand management would be the primary drivers of changes in forest structure and type under the no action alternative. Based on modeling, clearcut harvests would occur on an average 0.65 percent of the permit area per year over the analysis period. Clearcut harvests would occur primarily outside of the riparian areas in a mosaic pattern throughout the permit area. The majority of clearcut harvests would occur in the Tillamook and Astoria Districts, and to a lesser extent, Forest Grove District during the analysis period.

After clearcut harvesting, reforestation and young stand management would occur. Reforestation or replanting helps forest develop more quickly than would happen naturally and determines the future forest type. Within the first 30 years after replanting, forest stands develop into dense early-seral forests with closed canopies and little to no or simple understory structures.

Timber harvest also includes thinning and tree selection to allow certain trees to become larger while removing others. For example, during hardwood release practices, red alders are removed to ensure conifer dominance. These practices tend to reduce understory biodiversity through spraying of herbicides, mechanical removal, or other activities destructive to vegetation. Based on modeling, thinning would occur on an average 0.26 percent of the permit area annually over the analysis period.

Based on modeling, these activities would result in the following changes in forest structure and type over the analysis period (Figures 3.5-1 and 3.5-2). Appendix 3.5, Table 1, provides the overall modeled changes in extent of dominant forest structure during the analysis period.

- Trees would generally become older and wider in trunk diameter over time with a 4 percent increase in old-growth forest by end of the analysis period.
- Understory structure within late-seral forests would be more complex as stands age and develop gaps in the canopy from natural disturbance or management activities. Gaps create opportunity for horizontal growth, such as vine maple and other shrubs, or vertical growth, such as western hemlock or Sitka spruce seedlings in the Coast Range.
- Between Year 1 and Year 25, mid-seral forest would decrease by 30 percent and late-seral forest would increase by 30 percent. These trends would continue to a lesser extent over the remainder of the analysis period.
- Early-seral forest would remain just under 20 percent over the analysis period.

- Douglas-fir and hardwood stands would decrease while western hemlock would increase during the analysis period. Mixed conifer would remain consistent over the analysis period.

Salvage harvest would continue in response to disturbance events in the study area, which can result in harvest plan adjustments and implementation plan revisions. The timing, location, and size of future disturbance events cannot be predicted. However, given the projected increased frequency, duration, and extent of related disturbance events with climate change (Section 3.2, *Reasonably Foreseeable Trends and Planned Actions*), post-disturbance salvage harvest could substantially alter the distribution of forest type and structure described above. Salvage harvest typically focuses on those areas most heavily damaged while leaving surviving green trees on the landscape as part of the rehabilitation effort (ODF 2021). Salvage harvest would remove standing dead trees and reduce understory complexity (Pacific Northwest Research Station 2007). Salvage harvest within terrestrial anchor sites would be limited to roadside hazards or other safety risks (ODF 2021). Salvage harvest in RMAs would also be restricted per OAR 629-642-0600(3). These RMA restrictions, or retention prescriptions, conserve stream shade, woody debris, and bank stability while creating favorable conditions for rapid establishment of new, healthy riparian stands.

Prescribed burns would continue throughout the permit area as deemed necessary for fire risk reduction. Prescribed burns would result in nutrient release, fuels reduction, a more heterogeneous forest structure, and decreased understory structure. Best management practices would reduce impacts on long-term health of the understory.

Based on modeling, the continuation of current management of riparian areas under the no action alternative would result in increased overall tree age in these areas over the analysis period from between 60 and 80 years in Year 1 to between 130 and 150 years by Year 70, with 92 percent of stands being late-seral forests (an increase of 72 percent over the analysis period). Dominant forest types in riparian areas would be consistent throughout the analysis period. Conifer, mixed conifers, and hardwood forest would each represent the dominant forest types in one-third of the permit area; western hemlock would be dominant in the remaining 10 percent.

Alternative 2: Proposed Action

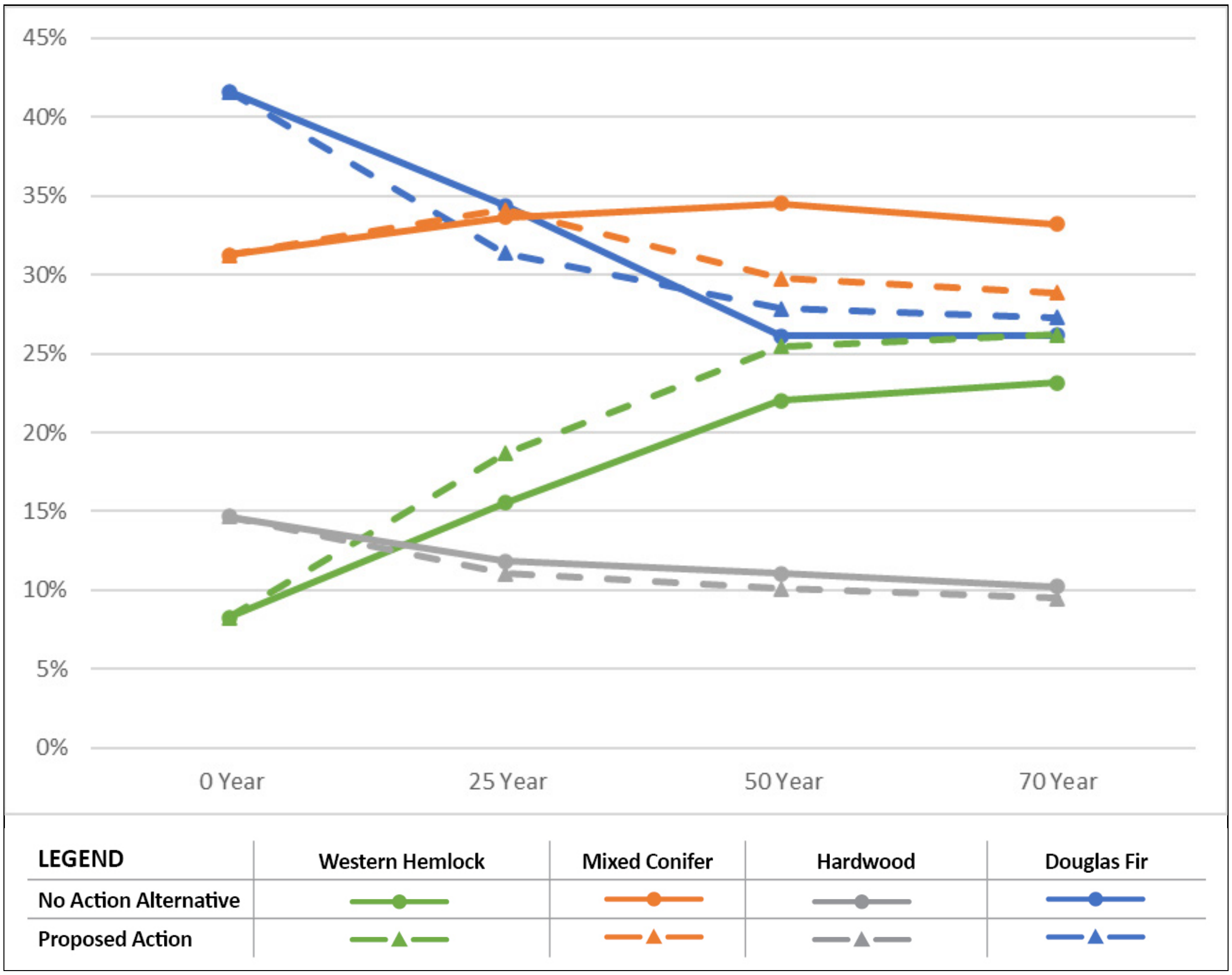
The activities described for the no action alternative would also drive changes in forest structure and type under the proposed action. Based on modeling, clearcut harvests would increase compared to the no action alternative (an average 0.73 percent of the permit area per year compared to 0.65 percent under the no action alternative) over the permit term. Clearcut harvests would occur primarily outside of the habitat conservation areas (HCAs) and entirely outside of the RCAs with the majority of activity in the same districts as under the no action alternative. Within the HCAs, stand management would be conducted in healthy conifer stands, red alder stands, or those stands affected by Swiss needle cast to achieve the desired forest condition during the first 30 years of the permit term. Based on modeling, the area of thinning would also increase (an average 0.34 percent of the permit area per year compared to 0.26 percent under the no action alternative).

Stand management within the HCAs would focus on establishing large blocks of late-seral forest over a range of environmental gradients, including a series of latitudinal and elevational gradients. In addition, the HCAs would be distributed across the landscape to increase permeability, or the ability for plant species to spread or move across a landscape and reduce fragmentation.

Based on modeling, there would be similar trends in forest structure and type changes over the permit term under the proposed action as described for the no action alternative (Figures 3.5-1 and 3.5-2). The key exceptions would be as follows.

- The age of trees harvested would be older over the permit term.
- Mid-seral forests would increase more (9 percent) and late-seral forests would increase less (10 percent) than under the no action alternative over the permit term.
- Western hemlock stands would increase more (3 percent) and mixed conifer stands would decrease (4 percent) compared to the no action alternative over the permit term.

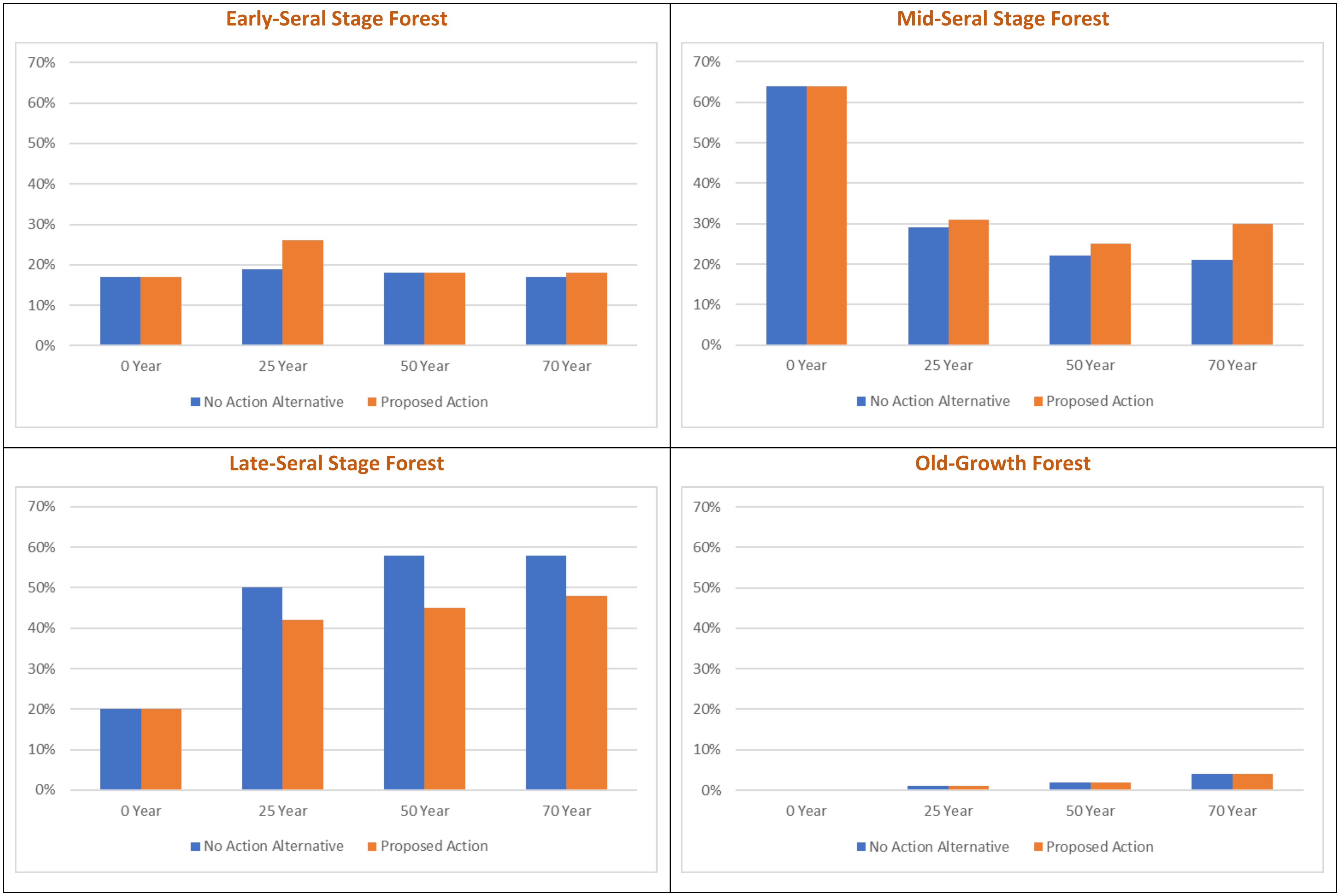
Figure 3.5-1. Modeled Percent Forest Type in Permit Area during Analysis Period—No Action Alternative and Proposed Action



Source: Forest model

Appendix 3.5, Table 2, presents modeled changes in extent of dominant forest structure during the permit term under the proposed action compared to the no action alternative.

Figure 3.5-2. Modeled Percent Forest Structure in Permit Area during Analysis Period—No Action Alternative and Proposed Action



Source: Forest model

Salvage harvest in the HCAs and RCAs would be limited to what is deemed necessary for safety. This reduction of salvage harvesting would increase the standing dead, understory organic matter, and structural complexity, including green trees and large downed logs in these areas compared to the no action alternative. Effects of prescribed burning on forest structure would be the same as under the no action alternative.

Riparian vegetation under the proposed action would be nearly the same type, structure, and age as the no action alternative but would cover a greater area (an additional 3,356 acres) due to expanded riparian buffers. It would result in slightly more hardwood stands within riparian buffers over the permit term (an additional 333 acres); further increase areas and corridors of passive forestry management with greater legacy tree retention and clustering of green trees along seasonal and perennial stream confluences; and further increase understory organic matter and structural complexity.

Alternative 3: Increased Conservation

Effects on forest structure and type under Alternative 3 compared to the no action alternative would be the same as described for the proposed action with the following exceptions. Expanded riparian buffers beyond what the no action or proposed action provide (an additional 12,837 and 9,481 acres, respectively) would result in greater increases in the beneficial changes than described for the proposed action. These beneficial changes include more forested corridors with increased legacy tree retention, wider tree clusters along stream confluences, and more understory organic matter and structural complexity. Based on modeling, there would be slightly greater decreases in mid-seral forests and increases in late-seral forests than under the proposed action (1 percent change for each) over the permit term. Modeling also projected slightly more mixed conifer and hardwood stands and slightly less Douglas-fir and western hemlock stands (less than half a percent difference for each).

Alternative 4: Reduced Permit Term

Effects on forest structure and type under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term. Based on modeling, by Year 50, forest composition would be primarily mid- to late-seral forest comprising 28 percent Douglas-fir, 25 percent western hemlock, roughly 25 percent mixed conifer, 10 percent hardwood, 5 percent conifer-hardwood, and 4 percent other trees.

Alternative 5: Increased Timber Harvest

Effects on forest structure and type under Alternative 5 compared to the no action alternative would be the same as described for the proposed action throughout the permit area with the following exceptions. Based on modeling, there would be an increase in average annual harvest over the permit term of 223 acres (0.03 percent) compared to the proposed action and 672 acres (0.11 percent) compared to the no action alternative, resulting in generally younger and less structurally developed forest stands throughout the permit area. Specifically, mid-seral forests would be less reduced over the permit term when compared to the proposed action and no action alternative (1 and 10 percent more, respectively) with less gain in late-seral forests (2 and 12 percent less, respectively). Composition of dominant forest type would remain largely the same with slightly more western hemlock stands under Alternative 5 when compared to the proposed action and no action alternative (between 1 and 2 percent more, respectively).

3.5.3.2 Permanent Removal of Vegetation

Alternative 1: No Action

Under the no action alternative, road construction and maintenance, quarry and auxiliary facility construction and maintenance, water drafting, and recreational infrastructure development and maintenance would result in permanent removal of vegetation.

Based on modeling, new road construction would result in 228 acres of vegetation removal over the analysis period. In some cases, roads would be fully vacated, which may include reestablishment of vegetation. Road construction, maintenance, and vacating would be conducted in accordance with Oregon FPA (OAR 629) and other applicable statutes described in the Forest Roads Manual and Forest Engineering Roads Manual (ODF 2000). These statutes would reduce impacts on vegetation by fully maximizing existing roads (OAR 629-625-0200(5)) and designing the roads to be no wider than necessary (OAR 629-625-0310(3)).

Recreational infrastructure development (including trails), and quarry and auxiliary facility development would also remove areas of vegetation permanently or over the long term. Compliance with Oregon FPA rules (OAR 660-023-0180) would minimize effects of quarry and auxiliary facility development siting on high-quality vegetation.

Alternative 2: Proposed Action

The types of effects related to permanent removal of vegetation would be the same as described for the no action alternative. The magnitude of removal would be similar to the no action alternative, though timing and distribution would likely differ in response to timing and distribution of harvest activities. Based on modeling, new road construction would result in 243 acres of vegetation removal over the analysis period (compared to 228 acres under the no action alternative). Additional restrictions on activities near streams and the expanded area where these restrictions apply (RCAs) under the proposed action (Conservation Actions 2 and 11) would likely reduce the removal of vegetation near streams.

Alternative 3: Increased Conservation

Effects related to permanent removal of vegetation under Alternative 3 compared to the no action alternative would be the same as described for the proposed action. Like the proposed action, the timing and distribution would likely differ in response to timing and distribution of harvest activities. In addition, expanded RCAs could further reduce removal of vegetation near streams. More stringent requirements related to road vacating could increase the potential for vacating roads in RCAs and HCAs, which could result in revegetation of previously roaded areas compared to the no action alternative and proposed action.

Alternative 4: Reduced Permit Term

Effects related to permanent removal of vegetation under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects related to permanent removal of vegetation under Alternative 5 compared to the no action alternative would be the same as described for the proposed action.

3.5.3.3 Invasives

Covered activities that entail ground disturbance could allow invasives to establish in the study area under all alternatives. Timber harvest and road construction would have the greatest potential to introduce and spread invasive weeds in the study area. ODF would continue to implement best management practices to reduce the spread of invasive weeds under all alternatives. These include periodic washing seeds, plants, and mud from heavy equipment and agency vehicles; treatment of invasive plants through manual or mechanical means; chemical spot treatment; and targeted roadside spray applications. In addition, per Section 2416 of the timber sales contract, purchasers are required to wash all equipment used during timber sales. As mentioned, best management practices to minimize ground disturbance during road maintenance would fully maximize existing roads (OAR 629-625-0200(5)) and design roads to be no wider than necessary (OAR 629-625-0310(3)).

3.5.3.4 Wetland Vegetation

Alternative 1: No Action

Clearcut harvest, thinning, salvage, and prescribed burns that occur in wetlands would reduce wetland function through the removal of vegetation. Based on modeling, clearcut harvest would affect an annual average of 25 acres of documented wetlands over the analysis period under the no action alternative (0.6 percent of permit area wetlands annually). Most of the affected wetlands are in the Coast Range. Riverine wetlands would be the primary wetland type affected. Based on modeling, thinning would affect an annual average of 23 acres over the analysis period (0.3 percent of permit area wetlands annually). Salvage harvest could affect additional areas depending on the future disturbance. Effects of harvest and thinning on wetlands would be minimized through compliance with OAR 629-655 and would follow management prescriptions described in the Northwest FMP Appendix J,[4] Table J-3, Management Prescriptions for Lakes, Ponds, and Wetlands, which is provided in Appendix 3.5.

Since the primary purpose of prescribed burns is to remove hazardous fuel sources, these would likely occur in forested wetlands and would have the same effects as described under Section 3.5.3.1, *Forest Structure and Type*.

Road construction, quarry and auxiliary facility construction and maintenance, water drafting, and recreational infrastructure development and maintenance would likely be prohibited in wetlands because construction could require converting wetlands to upland habitat (Clean Water Action Section 404). Effects and best management practices from road maintenance would be the same as described under Section 3.5.3.2, *Loss of Vegetation.*

[4] This appendix outlines revegetation and vegetation management in wetlands to achieve mature forest conditions based on a site-specific prescription conforming to the wetland type or classification.

Alternative 2: Proposed Action

The types of effects on wetlands would be the same under the proposed action as described for the no action alternative but affected wetland acreage would be greater. Based on modeling, clearcut harvest activities would affect an annual average of 59 acres of wetlands over the permit term (0.7 percent of the permit area wetlands annually). The proposed action would harvest slightly more forest shrub wetlands and riverine wetlands (largely in the Coast Range) than the no action alternative. Based on modeling, thinning would affect an annual average of 29 acres over the permit term (0.4 percent of the permit area wetlands annually). Limits on salvage harvest to removal of hazard trees in HCAs and RCAs would reduce potential post-disturbance effects on wetlands in these areas.

Expanded riparian buffers applied to stream associated wetlands would reduce effects on wetland vegetation associated with seeps, springs, and riverine wetlands.

Alternative 3: Increased Conservation

Effects on wetlands under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that, based on modeling, there would be slightly less thinning (annual average of 27 acres, 0.3 percent of permit area wetlands).

Alternative 4: Reduced Permit Term

Effects on wetlands under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on wetlands under Alternative 5 compared to the no action alternative would be the same as described for the proposed action, but the affected acreage would be greater. Based on modeling, clearcut harvest activities would affect an annual average of 62 acres of wetlands over the permit term (0.8 percent of the permit area wetlands annually) and thinning would affect an annual average of 30 acres over the permit term (0.4 percent of the permit area wetlands annually). Affected wetland type would still primarily be riverine wetlands in the Coast Range though forested wetland would also be more affected when compared to the proposed action or no action alternative.

3.5.3.5 Special-Status Plant Species

Forest and recreation management under all alternatives have the potential to affect special-status plant species in the permit area through habitat degradation and removal. Best management practices to avoid special-status plant species would reduce the potential for these effects. ODF would use the Oregon Biodiversity Information Center database to identify known occurrences and locations of rare species, species of concern, and state and federal special-status plant species, as well potential habitat. If identified within an area flagged for timber sale, ODF staff would be trained to identify the plant of concern to scan the area during timber sale layout.

3.5.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2 that would overlap with impacts of the proposed action and alternatives on vegetation.

Climate change will increase frequency and length of drought and could result in prolonged heat waves. Increasing disturbance event frequency, intensity, and duration will affect forest stand type and structure throughout western Oregon. These trends will affect forest type and structure, special-status plant species, and wetland vegetation. In addition, tree growth, especially Douglas-fir, will decrease in water limited areas. Acute drought and prolonged heat waves, anticipated to be more frequent with climate change, are likely to result in widespread tree mortality. Tree mortality can also arise from invasive pathogens, such as Port Orford cedar root disease (*Phytophthora lateralis*), as well as native pathogens and pests like root diseases, Swiss needle cast, and the Douglas-fir bark beetle, respectively.

Forest management on lands adjacent to the plan area would have the same effects described for the proposed action and alternatives. Agricultural activities on lands adjacent to the plan area would decrease low water flows and water quality, potentially affecting the hydrology and function of wetlands in the plan area. Recreational activities in and adjacent to the plan area and development on lands adjacent to the plan area would affect forest structure and type; potentially affect special-status plant species and wetlands; and increase spread of invasive species.

3.6 Fish and Wildlife

3.6.1 Methods

The study area for fish and wildlife consists of the areas where fish and wildlife could be affected by the proposed action and alternatives. For fish, the study area includes all streams in the plan area and streams outside of the plan area that may be affected by covered activities and conservation actions (primarily those downstream of the plan area). For purposes of analysis, wildlife species were separated into five categories based on their habitat: stream, riparian[1], wetland (including wet meadow), and forest. The study area for stream-dependent wildlife is the same as the fish study area. The study area for other wildlife is the plan area.

Tables 3.6-1 to 3.6-5 list the species evaluated in this section. For terrestrial species, including riparian-dependent species, the analysis considered effects on strategy species identified in the Oregon Conservation Strategy (ODFW 2019) and special-status species identified in the Oregon Explorer Natural Resources Library (Oregon Natural Heritage Information Center 2021) that are known to occur in the ecoregions overlapping with the study area (Figure 3.3-1), and that have global extinction risks of critically imperiled, imperiled, and vulnerable (Master et al. 2012:46–47).

For fish and other stream-dependent wildlife, the analysis considered effects on the covered species, as well as other federally listed species, Oregon Department of Fish and Wildlife (ODFW) state sensitive species, native species listed on NatureServe with ratings of vulnerable or worse and also known or suspected to be in or near the study area, and species of recreational, cultural or ecological significance.

The analysis of effects on fish and stream-dependent wildlife species considered projected harvest, road activities, and other covered activities, as well as riparian protections and other conservation actions in terms of their effect on stream and riparian habitat quantity and quality. The summation of habitat effects for an alternative was used to draw conclusions on effects on species and species groups. Information from Section 3.4, *Water Resources*, informed the assessment of potential water quality effects on fish and stream- and pond-dependent wildlife species, including stream-dependent amphibians and invertebrates, especially considering water temperature, flow, and large wood effects. Section 3.3, *Geology and Soils*, informed the assessment of potential effects of landslide and debris flow on stream habitat, fish, and stream-dependent wildlife.

Information from Section 3.5, *Vegetation*, and Appendix 3.5, *Vegetation Technical Supplement*, informed the assessment of changes in vegetation and habitat structure for forest-dependent species, as well as stream-dependent species that are affected by changing vegetation condition. National Wetland Inventory data was used to analyze effects on riparian and non-riparian, non-stream dependent wetland habitat, with the *forested/shrub wetland* category used to represent riparian habitat and the *freshwater pond*, *emergent wetland*, *lake*, and *estuarine marine wetland* categories used to represent non-riparian, non-stream dependent wetland habitat. The analysis of effects on covered species' habitat distribution and quality considered the results of species habitat models at years 1, 25, 50, and 70. The species models are described in Appendix 3.6-B, *Terrestrial Wildlife Technical Supplement*. These models likely overestimate the amount of available habitat for

[1] Riparian wildlife live near streams, while stream-dependent wildlife live in streams during part of their life cycle.

each species because recent fires have occurred subsequent to the vegetation mapping used for these models (Section 3.5). For the forest-dependent species without habitat models, the analysis relied on the vegetation analysis and existing literature correlating forest structure with habitat requirements, as described in Section 3.6.2, *Affected Environment*. Changes in retention of snags and downed wood/woody debris were based on descriptions of the policies and requirements under each alternative, in addition to literature on changes in snag and woody debris availability with forest succession.

3.6.2 Affected Environment

This section describes the species in the study area that are evaluated in the EIS and the habitats on which they depend. Appendix 3.6-A, *Fish and Stream-Dependent Species Technical Supplement*, and Appendix 3.6-B describe habitat requirements and threats to species potentially occurring in study area. Detailed descriptions of relevant life history and habitat needs and threats to covered species are provided in HCP Appendix C, *Species Accounts*.

3.6.2.1 Fish and Stream-Dependent Wildlife Species

Fish and stream-dependent wildlife species occupy habit from small headwater streams to large rivers in the study area, and also rely on the environmental characteristics of the abutting riparian habitats and off-channel habitats including floodplain ponds, side channels, and seasonal floodplain. Fish and stream-dependent species habitats are the combination of habitat structural elements (e.g., pool, riffles, and off-channel water features), quality of these elements and water quality (e.g., sediment, streambed bed mobility, water temperature, contaminants), the riparian corridor (e.g., sources of nutrients, food, and organic matter), and the community of organisms—both aquatic and not—that interact as predators, food sources, competitors or otherwise.

The current condition of habitat for fish and stream-dependent species in the study area is influenced by natural processes, legacy effects of historical forest management practices that occurred prior to implementation of current forest management practices, and effects of current forest management practices implemented in more recent years in addition to current and past agriculture practices and urban development. The analysis projects the future condition of the affected environment based on climate change and natural disturbance effects. Section 3.4.3.1, *Surface Water,* describes the surface water hydrology related to streams and rivers in the study area, and Section 3.5 briefly describes riparian areas and vegetated cover in the study area. In summary, large wood in the study area has been depleted as compared to historical conditions, in-stream flows and temperatures have been affected by forestry and agricultural management and will also be affected by climate change, and sedimentation has been affected by forestry and agricultural management and landslides. Appendix 3.6-A provides a more detailed description of the affected environment habitat for fish and stream-dependent species.

Table 3.6-1 lists the fish and stream-dependent species in the study area evaluated in the EIS. Species included are those covered by the HCP, special-status species, and species that are of ecological, cultural, and recreational interest. Native fish species and native stream-dependent wildlife are the focus of this analysis. HCP Appendix C describes life histories of and threats to covered species in detail. Appendix 3.6-A of this EIS describes life histories of and threats to covered species and noncovered species in brief, as well as the geographic extent within the study area by species evaluated in the EIS (Table 3.6-1).

Table 3.6-1. Fish and Stream-Dependent Wildlife Species Evaluated in the EIS

Species Common Name	Species Scientific Name	Status (Federal/State/ Global[a] NatureServe)
COVERED SPECIES		
Fish		
Oregon Coast coho	*Oncorhynchus kisutch*	FT/SS/G5
Oregon Coast spring-run Chinook	*Oncorhynchus Tshawytscha*	-/SS/G5
Lower Columbia River coho	*Oncorhynchus kisutch*	FT/SS/G5
Upper Willamette River spring-run Chinook	*Oncorhynchus tshawytscha*	FT/SS/G5
Upper Willamette River steelhead	*Oncorhynchus mykiss*	FT/SS/G5
Columbia River chum	*Oncorhynchus keta*	FT/SS/G5
Southern Oregon/Northern California Coastal spring-run Chinook	*Oncorhynchus tshawytscha*	-/SS/G5
Southern Oregon/Northern California Coast coho	*Oncorhynchus kisutch*	FT/SS/G5
Lower Columbia River Chinook	*Oncorhynchus tshawytscha*	FT/SS/G5
Eulachon	*Thaleichthys pacificus*	FT/-/G5
Amphibians		
Columbia torrent salamander	*Rhyacotriton kezeri*	FC/SS/G3
Cascade torrent salamander	*Rhyacotriton cascadae*	FC/SS/G3
NONCOVERED SPECIES		
Fish		
Chum (Coastal SMU/Pacific Coast ESU)	*Oncorhynchus keta*	-/SS/G5
Lower Columbia River steelhead	*Oncorhynchus mykiss*	FT/SS/G5
Oregon Coast steelhead	*Oncorhynchus mykiss*	-/SS/G5
Bull trout	*Salvelinus confluentus*	FT/ SS/G5
Coastal cutthroat trout	*Oncorhynchus clarkii*	-/SS (Lower Columbia SMU/Columbia River ESU)/G5
Umpqua chub	*Oregonichthys kalawatseti*	-/SS/G2
Oregon chub	*Oregonichthys crameri*	FD/SS/G3
Pacific lamprey	*Entosphenus tridentatus*	FCo/SS/G4
Oregon western brook lamprey	*Lampetra richardsoni*	-/SS/G4
Sculpin (coast range, mottled, reticulated, riffle, prickly, Paiute)	Family Cottidae	-/-/G4-G5
Dace (Columbia River, speckled, longnose, leopard)	*Rhinichthys* (spp.)	-/-/G4G5
Millicoma dace	*Rhinichthys cataractae*	-/SS/G5
Redside shiner	*Richardsonius balteatus*	-/-/G5
Largescale sucker	*Catostomus macrocheilus*	-/-/G5
Peamouth	*Mylocheilus caurinus*	-/-/G5
Three-spine stickleback	*Gasterosteus aculeatus*	-/-/G5

Species Common Name	Species Scientific Name	Status (Federal/State/ Global[a] NatureServe)
Amphibians		
Coastal tailed frog	*Ascaphus truei*	-/SS/G4
Cope's giant salamander	*Dicamptodon copei*	-/SS/G3
Southern torrent salamander	*Rhyacotriton variegatus*	-/SS/G3
Pacific giant salamander	*Dicamptodon tenebrosus*	-/-/G5
Rough-skinned newt	*Taricha granulosa*	-/-/G5
Invertebrates		
Spurred bizarre caddisfly	*Lepidostoma astanea*	-/-/G2
A rhyacophilid caddisfly	*Rhyacophila chandleri*	-/-/G3
Haddock's rhyacophilan caddisfly	*Rhyacophila haddoki*	-/-/G2
A rhyacophilid caddisfly	*Rhyacophila leechi*	-/-/G3
Floater mussels	*Anodonta* (spp.)	-/-/G2-G5
Western ridged mussel	*Gonidea angulata*	FC/-/G3
Western pearlshell	*Margaritifera falcata*	-/-/G5

[a] NatureServe rankings are global and may differ at state level.
ESU = evolutionarily significant unit; SMU = species management unit
Status: (-) = not listed or no status identified; FT = federally listed as threatened; FC = candidate for federal listing; FCo= federal species of concern; FD = federally delisted; SS = Oregon sensitive species; G1= critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure

3.6.2.2 Forest-Dependent Species

Section 3.5.2.1, *Vegetation Cover*, describes forest vegetation present in the study area and Table 3.6-2 lists the special-status species dependent on forest vegetation. The wildlife value of forest habitat is largely dependent on the habitat's compositional diversity (i.e., diversity of tree and other plant species), structural complexity (i.e., layers of canopy, understory, and herbs, with sufficient snags and downed wood), and spatial heterogeneity (i.e., a mosaic of habitat types across the landscape, such as meadows near closed canopy forest).

Table 3.6-2. Forest-Dependent Species Evaluated in the EIS

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
COVERED SPECIES			
Amphibians			
Oregon slender salamander	*Batrachoseps wrighti*	FCo/SS/G3	WC, WV
Birds			
Northern spotted owl	*Strix occidentalis*	FT/OT/G3	KM, WC, WV
Marbled murrelet	*Brachyramphus marmoratus*	FT/OT/G3	CR, KM
Mammals			
Pacific Marten, coastal population	*Martes caurina*	FT/SS/G4	CR, KM

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
Red tree vole	*Arborimus longicaudus*	FC/SS/G3	CR, KM, WC, WV
NONCOVERED SPECIES			
Mammals			
Hoary bat	*Lasiurus cinereus*	FCo/SS/G3	CR, KM, WC, WV
Wolverine	*Gulo*	PT/SS/G4	CR
Townsend's big-eared bat	*Corynorhinus townsendii*	FCo/SS/G4	CR, KM, WC, WV
Ringtail	*Bassariscus astutus*	-/SS/G5	CR, KM, WC
Fisher	*Pekania pennanti*	PT/SS/G5	CR, KM, WC
Silver-haired bat	*Lasionycteris noctivagans*	FCo/SS/G3	CR, KM, WC, WV
Fringed myotis	*Myotis thysanodes*	FCo/SS/G4	CR, KM, WC, WV
Long-legged myotis	*Myotis volans*	FCo/SS/G4	CR, KM, WC, WV
Gray wolf	*Canis lupus*	FE/SS/G5	CR, KM, WC, WV
California myotis	*Myotis californicus*	-/SS/G5	CR, KM, WC, WV
Western gray squirrel	*Sciurus griseus*	-/SS/G5	CR, KM, WC, WV
Pacific marten, interior population	*Martes caurina*	-/SS/G4	KM, WC
Sierra Nevada red fox	*Vulpes*	-/SS/G5	WC
Little brown myotis	*Myotis lucifugus*	-/SS/G3	CR, KM, WC, WV
Birds			
Olive-sided flycatcher	*Contopus cooperi*	-/SS/G4	CR, KM, WC, WV
Northern goshawk	*Accipiter gentilis*	-/SS/G5	CR, KM, WC, WV
Pileated woodpecker	*Dryocopus pileatus*	-/SS/G5	CR, KM, WC, WV
Purple martin	*Progne subis*	-/SS/G5	CR, KM, WC, WV
White-headed woodpecker	*Dryobates albolarvatus*	FCo/SS/G4	KM, WC
Flammulated owl	*Psiloscops flammeolus*	-/SS/G4	KM, WC
Great gray owl	*Strix nebulosa*	-/SS/G5	KM, WC
Black-backed woodpecker	*Picoides arcticus*	-/SS/G5	WC
American three-toed woodpecker	*Picoides dorsalis*	-/SS/G5	WC
Common nighthawk	*Chordeiles minor*	FCo/SS/G5	CR, KM, WC, WV
Lewis's woodpecker	*Melanerpes lewis*	-/SS/G4	CR, KM, WC, WV
Chipping sparrow	*Spizella passerina*	-/SS/G5	CR, KM, WC, WV
Acorn woodpecker	*Melanerpes formicivorus*	-/SS/G5	CR, KM, WV
California condor	*Gymnogyps californianus*	FE/SS/G2	CR, KM, WC, WV
Slender-billed nuthatch	*Sitta carolinensis*	-/SS/G5	CR, KM, WC, WV

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
Amphibians			
Del Norte salamander	*Plethodon elongatus*	FCo/SS/G4	CR, KM
Clouded salamander	*Aneides ferreus*	-/SS/G3	CR, KM, WC, WV
Larch Mountain salamander	*Plethodon larselli*	FCo/SS/G3	WC
Siskiyou Mountains salamander	*Plethodon stormi*	FCo/SS/G3	KM
Invertebrates			
Oregon shoulderband	*Helminthoglypta hertleini*	-/SS/-	KM, WC

[a] NatureServe rankings are global and may differ at state level.

Status: (-) = not listed or no status identified; FT = federally listed as threatened; FC = candidate for federal listing; FCo= federal species of concern; FD = federally delisted; S = Oregon strategy species; G1= critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure Ecoregions: CR = Coast Range; KM = Klamath Mountains; WC = West Cascades; WV = Willamette Valley

As trees age and grow, they increasingly develop a complex structure with key habitat attributes, such as large limbs, decay, and complex bark structure. Large limbs provide nesting platforms for marbled murrelets (*Brachyramphus marmoratus*) and other arboreal mammals and birds, and harbor epiphytes that provide forage for deer (*Odocoileus* spp.) and elk (*Cervus canadensis*). Decay in older trees can result in hollows, natural cavities, peeling bark, and dead branches, providing many wildlife habitat opportunities. Structural irregularities provide nesting cover for northern flying squirrel (*Glaucomys sabrinus*), fisher, northern spotted owl, and northern goshawk (*Accipiter gentilis*). Hollows and cavities provide habitat for bats, Vaux's swift (*Chaetura vauxi*), woodpeckers, nuthatches (*Sitta* spp.) and chickadees (*Poecile* spp.). Numerous bird species that glean invertebrates from bark crevices also benefit from older trees, which have deeper crevices and a greater tendency to support invertebrates than younger trees (Hagar 2007:36). Downed wood is important for many terrestrial salamanders and other wildlife inhabiting the forest floor, including clouded salamanders, which prefer habitat under bark on logs, and Oregon slender salamanders, which tend to occur in the interior of down logs (Rose et al. 2001:585).

Although accumulation of woody debris on the forest floor and other characteristics described in the preceding paragraph are generally attributed to old-growth forests, these features are also found to some degree in young and mature unmanaged forests (Spies and Franklin 1991:108). Wildlife communities occurring in naturally regenerated, unmanaged young, mature, and old-growth forests are often similar, and this may be attributed to the structural heterogeneity of forests with a history of natural disturbances such as fire, whereby large live trees, snags, and logs that are retained through stand-replacing fires are then present in the young, regenerating stand. Unmanaged stands, however, are not representative of stands in the study area that have been subject to various treatments to optimize timber yield (e.g., planting with selected stock and thinning to predetermined spacing); such management tends to produce stands with low compositional and structural diversity.

Many birds associated with early- to mid-seral forest stages use understory vegetation for foraging, cover, and nesting, hence management focusing solely on conifers, as has historically been done in the study area, may result in habitat loss for these species and may partially explain their declining populations in the Pacific Northwest (Altman and Hagar 2006:5–6). Management for multilayer vegetation structure enhances bird diversity in a forest stand. Early-seral forests dominated by shrubs and with less than 30 percent conifers support higher bird diversity than any other stage (Altman and Hagar 2006:8). Dense young stands composed of a single coniferous canopy layer, on the other hand, support the fewest number of bird species of any seral stage (Altman and Hagar 2006). Insectivorous birds in Pacific Northwest forests are associated with deciduous vegetation, and young stands that support a high proportion of deciduous vegetation tend to have higher abundance and diversity of these insectivorous species (Altman and Hagar 2006:9). Deciduous foliage supports an abundance and diversity of herbivorous insects in the spring and summer.

Fragmentation of forest habitat limits movement of many forest-dependent wildlife species across the landscape. Decreased movement can reduce genetic diversity and increases the likelihood of local extinction from an area. For old-forest specialist species, like the northern spotted owl and marbled murrelet, larger patches of forested habitat provide more functional habitat than the same amount of habitat configured into smaller patches. Larger habitat patches provide more interior habitat relative to edge habitat and hence increase protection against threats like nest predators, windthrow and changes in microclimate.

3.6.2.3 Riparian-Dependent Species

Riparian habitat for wildlife addressed in this section consists primarily of deciduous vegetation near the streams' edge.[2] Riparian habitat typically support a higher biodiversity of terrestrial species than surrounding areas. An estimated 53 percent of wildlife species in Oregon and Washington use riparian habitat, even though these habitats cover only an estimated 1 to 2 percent of the landscape (Kauffman et al. 2001:365). This high biodiversity can be attributed to various factors including input of organic matter from water flows; disturbance from flooding, landslides, and debris flows that result in varied habitat composition and structure; diverse geomorphology; and high productivity due to deep soils and availability of water and nutrients (Kauffman et al. 2001:362). Table 3.6-3 lists the special-status species dependent on riparian habitat in the four ecoregions evaluated, including Columbian white-tailed deer (*Odocoileus virginianus*), yellow-breasted chat (*Icteria virens*), mountain quail (*Oreortyx pictus*), willow flycatcher (*Empidonax traillii*), clouded salamander (*Aneides Ferreus*), and Pacific walker (*Pomatiopsis binneyi*).

Table 3.6-3. Riparian-Dependent Species Evaluated in the EIS

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
NONCOVERED SPECIES			
Mammals			
Columbian white-tailed deer	*Odocoileus virginianus*	FE/S/G5	CR, KM, WV
Birds			
Yellow-breasted chat	*Icteria virens*	-/SG5	CR, KM, WC, WV
Mountain quail	*Oreortyx pictus*	-/S/G5	CR, KM, WC, WV
Willow flycatcher	*Empidonax traillii*	FCo/S/G5	WV
Amphibians			
Clouded salamander	*Aneides Ferreus*	-/S/G3	CR, KM, WC, WV

[2] Riparian vegetation described in Section 3.5, *Vegetation*, addresses a wider swath on either side of the stream that includes evergreen vegetation.

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
Invertebrates			
Pacific walker	*Pomatiopsis binneyi*	-/S/-	CR

[a] NatureServe rankings are global and may differ at state level.

Status: (-) = not listed or no status identified; FT = federally listed as threatened; FC = candidate for federal listing; FCo= federal species of concern; FD = federally delisted; S = Oregon strategy species; G1= critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure

Ecoregions: CR = Coast Range; KM = Klamath Mountains; WC = West Cascades; WV = Willamette Valley

3.6.2.4 Wetland-Dependent Species

Many wildlife species in the study area are dependent on ponds, lakes, freshwater marshes, seeps, springs, and wet meadows. Table 3.6-4 indicates the special-status species occurring in wetlands and meadows within the four ecoregions evaluated. Some of these species, such as American white pelican (*Pelecanus erythrorhyncho*) and red-necked grebe (*Podiceps grisegena*), require lakes or ponds while others, such as most of the invertebrates, often occur in wet meadows, marshy areas, or seeps (ODFW 2016).

Table 3.6-4. Wetland-Dependent Species Evaluated in the EIS

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
NONCOVERED SPECIES			
Birds			
American white pelican	*Pelecanus erythrorhynchos*	-/SS/G4	CR
Short-eared owl	*Asio flammeus*	-/SS/G5	CR, KM, WC, WV
Red-necked grebe	*Podiceps grisegena*	-/SS/G5	CR, WC
Tricolored blackbird	*Agelaius tricolor*	FCo/SS/G1	KM, WV
Reptiles			
Western pond turtle	*Actinemys marmorata*	FCo/SS/G3	CR, KM, WC, WV
Painted turtle	*Chrysemys picta*	-/SS/G5	CR, KM, WC, WV
Amphibians			
Western toad	*Anaxyrus boreas*	-/SS/G4	CR, KM, WC, WV
Northern red-legged frog	*Rana aurora*	-/SS/G4	CR, KM, WC, WV
Cascades frog	*Rana cascadae*	-/SS/G3	EC, KM, WC
Oregon spotted frog	*Rana pretiosa*	FT/SS/G2	WC, WV

Species Common Name	Species Scientific Name	Status (Federal/ State/Global[a] NatureServe)	Ecoregions
Invertebrates			
Stonefly (unnamed)	*Capnia kersti*	-/SS/-	WV
Robust walker	*Pomatiopsis binneyi*	-/SS/-	CR
Black petaltail	*Tanypteryx hageni*	-/SS/-	CR, WC
Siskiyou hesperian	*Vespericola sierranus*	-/SS/-	KM
Beller's ground beetle	*Agonum belleri*	FCo/SS/-	WC
Columbia Gorge hesperian	*Vespericola depressa*	-/SS/-	WC
California floater freshwater mussel	*Anodonta californiensis*	FCo/SS/-	WV
Winged floater freshwater mussel	*Anodonta nuttalliana*	-/SS/-	WV
Insular blue butterfly	*Plebejus saepiolus littoralis*	FCo/SS/-	CR
Western bumble bee	*Bombus occidentalis*	-/SS/-	CR, KM, WC, WV
Mardon skipper butterfly	*Polites mardon*	FE/SS/-	KM
Franklin's bumble bee	*Bombus franklini*	FCo/SS/-	KM, WC

[a] NatureServe rankings are global and may differ at state level.

Status: (-) = not listed or no status identified; FT = federally listed as threatened; FC = candidate for federal listing; FCo= federal species of concern; FD = federally delisted; S = Oregon strategy species; G1= critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure

Ecoregions: CR = Coast Range; EC = East Cascades; KM = Klamath Mountains; WC = West Cascades; WV = Willamette Valley

3.6.3 Environmental Consequences

3.6.3.1 Covered Fish and Stream-Dependent Wildlife Species

Salmonids

Alternative 1: No Action

Timber harvest under the no action alternative would reduce wood available for in-stream recruitment, increase sedimentation, and cause increases in stream temperatures, all of which can decrease habitat quality for salmonids. Harvest and equipment restrictions in riparian buffers (RMAs; Table 2-1), where applicable, would reduce these effects. As forests in protected riparian buffers mature over the analysis period, recruitment of large wood to streams would increase, as would shading and contribution of food (invertebrates falling from trees). Though these changes would improve habitat over the analysis period, they would not fully protect all riparian ecological functions (Spies et al. 2018).

Harvest near streams would increase sediment in streams due to soil disturbance and increased slope instability. Harvest is restricted in riparian buffers depending on stream type and distance from the stream channel, though ODF does not conduct harvest activities often in these areas (Wilson pers. comm.). One important exception is that ODF does not have restrictions on post-disturbance salvage harvest. With disturbance events expected to increase with climate change, salvage harvest in riparian buffers is likely to increase under the no action alternative. Also, seasonal, non-fish-bearing streams would have less riparian protection and would continue to be a source of sediment to streams. Fine sediment entering streams during winter storms would get transported downstream to fish-bearing streams, adversely affecting spawning riffles for covered salmonids, as described in Appendix 3.6-A.

Reduced riparian vegetation cover can lead to increased stream temperatures due to reduced shade (Spies et al. 2018). As described in Section 3.4, RMA widths under the no action alternative would not mitigate temperature effects of forest management activities; the potential for thinning and post-disturbance harvest in these areas would further reduce the effectiveness of the buffers. This would be expected to cause increased water temperatures throughout the basin, which would adversely affect covered salmonids. Warmer air temperatures and lower summer flows expected with climate change would exacerbate temperature conditions and further worsen conditions for salmonids, though growth and maturation of riparian areas into the future could ameliorate some effects.

As described in Section 3.4.3.1, although effects on low and peak flows are not expected at the subwatershed scale, these effects could occur at the local scale, which could adversely affect salmonid habitat in these areas. In areas where middle-aged stands are concentrated, individual streams would be most likely to experience decreases in low flows.

Harvest, road construction, and continued use of existing roads built on steep slopes would continue to increase potential frequency of shallow-rapid landslide, as described in Section 3.3. Shallow-rapid landslide and associated events can have both beneficial and adverse effects on aquatic habitat, and accordingly on covered salmonids.

Road construction, maintenance, and use in or near riparian areas would increase fine sediment to streams. Current practices, described in Section 3.3, would minimize these effects. New roads built in these areas would also permanently decrease beaver activity depending on where in the landscape the roads are located, causing loss of habitat complexity.

New roads at stream crossings would be designed for fish passage post-construction. Culverts would also disrupt downstream transport of large wood and sediment affecting habitat complexity in downstream streams. New roads built in floodplains under the no action alternative would restrict floodplain access, decreasing habitat quantity for aquatic species. The no action alternative does include strategies to mitigate road effects with the goals of preventing water quality problems, minimizing disruption of natural drainage patterns, and providing for adequate fish passage (ODF 2010). Overall, some covered salmonids would be adversely affected as more roads are constructed to access timber harvest units over the analysis period.

Vacating roads fully would restore fish passage, having a beneficial effect on covered salmonid habitat. When a road is fully vacated, all stream crossing structures are removed, restoring passage for all species and the unimpeded downstream movement of sediment and wood. Sidecast and grass-seeding disturbed soil are pulled back, decreasing confinement of stream reaches and creating better habitat potential for species, and the roadbed is torn up, decreasing confinement and impervious surfaces, which improves flow conditions. Cross drain culverts may be left in place. Removing stream crossing structures causes less disturbance to the aquatic environment, improving habitat quality.

Construction and operation of quarries and auxiliary facilities in riparian areas under the no action alternative could increase fine sediment and contaminants in nearby streams. Vehicle and heavy equipment use at these sites would cause soil disturbance that could increase the amount of fine sediment in streams. These activities could also increase the potential for chemical contaminants to enter streams, which would adversely affect water quality for salmonids.

Water drafting would draw water directly from streams, decreasing stream flow, which would negatively affect stream habitat. Reducing flows in streams reduces overall habitat capacity, can increase stream temperatures, decrease dissolved oxygen, and increase concentration of contaminants—all of which would cause temporary adverse effects on salmonid habitat. Water drafting for fire suppression may increase in response to increasing severity and frequency of fires anticipated with climate change over the analysis period.

Controlled burns (excluding slash burns) in riparian areas could increase fine sediment runoff to streams, temporarily alter the pH of streams due to ash, temporarily decrease input of terrestrial invertebrates as food into the stream system postburn and alter the size and type of wood contributed to the stream, ultimately decreasing the volume of wood available to the stream in the long term, causing an adverse effect on salmonid habitat.

Development and maintenance of recreation infrastructure in riparian areas would disturb aquatic habitats through increased sediment inputs and reduced riparian canopy. Increased activity from recreation users of existing and new developments would also cause disturbance or harassment of species, which could force species away from preferred habitats in riparian areas. Minor forest product harvest would likely not affect salmonids because the majority of this activity is not directly associated with the stream environment.

Populations of covered salmonid species that spend a significant portion of their life history in the study area would experience the adverse and beneficial effects described above. This includes all of the covered salmonid species, except Lower Columbia River Chinook salmon, which spawn and rear in tributaries to the Columbia River upstream of the study area (Appendix 3.6-A, Figure 1).

Under the no action alternative, ODF may continue to participate in monitoring efforts, such as ODFW's habitat monitoring in streams, but would not be committed to such programs.

Alternative 2: Proposed Action

The types of effects on covered salmonids would be the same under the proposed action as described for the no action alternative. Based on modeling, timber harvest and related activities (reforestation, road construction activities) would be greater than under the no action alternative, which would increase effects of these activities (Tables 3.1-1 through 3.1-4). Conservation Actions 1, 2, 7, 8, and 12 would reduce adverse effects of the covered activities on covered salmonids and provide more protection to streams and riparian areas, as described below.

Expanded riparian buffers (RCAs, Table 2-3) would further increase large wood that is recruited to streams[3], reduce sediment to streams, decrease water temperature effects, and improve water quality and food for covered salmonids compared to the no action alternative.

Prohibition of harvest or thinning, including post-disturbance salvage, in RCAs (Conservation Action 1), and increased width of equipment restriction zones (Conservation Action 2) would reduce activity and disturbance near streams, decreasing fine sediment input to streams, and provide additional tree growth and large wood over time. This would improve overall riparian health

[3] Based on the wood recruitment model, estimated average recruitment of wood to streams over the permit term would be 96.7 percent compared to 96.3 percent under the no-action alternative.

resulting in a healthier aquatic environment with reduced potential for adverse effects on covered salmonids from management activities as compared to the no action alternative.

Prohibition of new quarry construction in RCAs (Conservation Action 11), restrictions on new trail construction in RCAs (Conservation Action 12), and limitations on water drafting would decrease effects of these activities described under the no action alternative.

The commitment to a number of stream enhancement projects over the permit term and per decade (Conservation Action 3) would increase certainty of long-lasting beneficial effects on habitat that would address limiting factors for covered salmonids compared to the no action alternative, which does not include this commitment. Additional commitments for culvert removals (Conservation Action 4) and more stringent design criteria could improve access to habitat for covered salmonids compared to the no action alternative.

ODF would commit to monitoring and documenting progress toward implementation of the aquatic conservation actions and achieving the biological objectives for habitat for covered aquatic species over the permit term as described in HCP Chapter 6, *Monitoring and Adaptive Management*. Should monitoring results indicate that biological objectives are not being realized, ODF would use the adaptive management process to implement changes to improve progress toward the biological objectives. ODF would also implement adaptive management strategies in response to changes in certain baseline conditions, including stream temperature changes and the spread of aquatic invasive plants, as described in HCP Chapter 7, *Assurances*, and in Appendix 3.6-A. These responses include restoration actions, species management actions, and implementing additional protective measures in streams. These monitoring, adaptive management, and response commitments are anticipated to benefit covered salmonids in the permit area by protecting habitat, compared to the no action alternative, which does not have similar commitments.

Alternative 3: Increased Conservation

Effects on covered salmonids under Alternative 3 compared to the no action alternative would be the same as described for the proposed action except that expanded riparian buffers (RCAs; Table 2-4) for small perennial streams and seasonal streams that are high energy or in potential debris flow tracks would further increase recruitment of large wood[4] and reduce unwanted sedimentation in aquatic habitat. Additionally, road vacating requirements under Alternative 3, including drainage improvements, vacating-related target setting, compliance reporting, and improved best management practices, would increase beneficial effects for covered salmonids, including increased habitat accessibility, decreased peak flows, decreased stream confinement and improved water quality.

Alternative 4: Reduced Permit Term

Effects on covered salmonids under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.[5]

Alternative 5: Increased Timber Harvest

Effects on covered salmonids under Alternative 5 compared to the no action alternative would be similar as described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest and overall decrease in acres of HCAs.

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[4] Estimated average wood recruitment would be 98.8 percent.

[5] Estimated average wood recruitment would be 97.1 percent.

Eulachon

Alternative 1: No Action

Effects of forest and recreation management activities under the no action alternative described above for covered salmonids and the restrictions and protections that would reduce these effects would also apply to eulachon habitat. Eulachon spend a significant portion of their life history in the plan area and would therefore experience these adverse and beneficial effects. Freshwater eulachon spawning habitat and estuarine nursery habitat would be particularly sensitive to these effects (Howell et al. 2001; NMFS 2017).

Alternative 2: Proposed Action

The types of effects on eulachon under the proposed action would be the same as described for the no action alternative. Based on modeling, timber harvest and related activities (reforestation, road construction) would be greater than under no action alternative, which would increase adverse effects of these activities on eulachon (Tables 3.1-1 through 3.1-4). Conservation Actions 1, 2, 7, 8, and 12 would reduce adverse effects of the covered activities on eulachon, as described for covered salmonids. These conservation actions and the monitoring and adaptive management provisions would provide more protection to streams and riparian areas compared to the no action alternative.

Alternative 3: Increased Conservation

Effects on eulachon under Alternative 3 compared to the no action alternative would be the same as described for the proposed action except that further expanded riparian protection and more stringent road vacating requirements would further increase beneficial effects as described for covered salmonids.

Alternative 4: Reduced Permit Term

Effects on eulachon under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on eulachon under Alternative 5 compared to no action alternative would be the same as described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest and less protection provided by the HCAs.

Torrent Salamanders

Alternative 1: No Action

Timber harvest under the no action alternative would reduce wood available for in-stream recruitment, increase sedimentation, and cause increases in stream temperatures. Where riparian buffers (RMAs, Table 2-1) are nonexistent or narrow (i.e., 35–50 feet), these changes would especially adversely affect habitat for both Columbia torrent salamanders and Cascade torrent salamanders. Timber harvest activities, including machine usage, foot traffic, and felled trees, may directly harm torrent salamanders through injury or mortality. Harvest and equipment restrictions in riparian buffers would reduce these effects.

Torrent salamanders using fish-bearing streams would benefit from maturing riparian areas over time (as described under covered salmonids), though torrent salamanders often are pushed into fishless headwaters, including intermittent streams (Olson and Weaver 2007), with lesser protection. Downstream perennial reaches may be less hospitable to torrent salamanders due to potential predators including giant salamanders (*Dicamptodon* spp.), coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), and sculpins (Cottidae) (Olson and Burton 2019). Torrent salamanders are highly sensitive to increased sedimentation in their in-stream breeding habitats (Emel et al. 2019), and activities that would increase fine sediment as described for covered salmonids would adversely affect populations of torrent salamanders. Given that this species depends on riparian areas along seasonal, non-fish-bearing streams, which have less protection than fish-bearing streams, these effects would be greater. Salvage harvest would reduce downed wood that creates beneficial habitat for torrent salamanders.

Torrent salamanders depend on cool-water habitats (Emel et al. 2019), and increased temperatures in the study area described for covered salmonids would have adverse effects on their populations. Effects of forest management on peak and low flows would be the same as described for covered salmonids. If small, headwater streams where torrent salamander populations are more successful go dry, or more streams become intermittent, the salamanders may be pushed downstream into areas that are less hospitable to their populations for reasons including predation and competition. Additionally, fragmented forest cover can adversely affect gene flow for torrent salamanders, increasing their vulnerability to additional disturbances (Emel et al. 2019).

Effects of road construction, use, and maintenance would be similar to those described for covered salmonids, with fine sediment having an adverse effect on the aquatic life stages of torrent salamanders. Additionally, torrent salamanders avoid road crossings, and increased density of roads diminishes their dispersal ability, negatively affecting their populations (Emel et al. 2019). Vacating roads would have a beneficial effect on torrent salamanders because the revegetated surface would increase overland dispersal.

Construction and operation of quarries and auxiliary facilities in riparian areas, water drafting, controlled burns, and development and maintenance of recreation infrastructure in riparian areas under the no action alternative would have the same effects as described under covered salmonids, adversely affecting torrent salamanders. Minor forest product harvest would likely not affect torrent salamanders because the majority of this activity is not directly associated with the stream environment.

Alternative 2: Proposed Action

The types of effects on torrent salamanders under the proposed action would be the same as described for the no action alternative. Based on modeling, timber harvest and related activities (reforestation, road construction activities) would be greater than under no action alternative, which would increase adverse effects of these activities (described under the no action alternative) on torrent salamanders (Tables 3.1-1 through 3.1-4). Effects of other management activities would be the same as described for the no action alternative. Conservation Actions 1, 2, 7, 8, and 12 would reduce adverse effects of the covered activities on torrent salamanders and provide more protection to streams and riparian areas compared to the no action alternative, as described for covered salmonids with the following differences.

Decreased harvest within HCAs would reduce adverse effects on torrent salamanders in these areas compared to the no action alternative and increased forest connectivity provided by HCAs would benefit the species.

The benefits of expanded RCAs (Table 2-3) described for covered salmonids would also apply to some of the areas important to torrent salamanders. However, as described under the no action alternative, non-fish-bearing streams and headwater streams including intermittent streams are important habitat for torrent salamanders, and adverse effects under the no action alternative would persist in some of these streams (seasonal, non-fish-bearing streams that are not high energy or along debris flow tracks).

Additional roads constructed under the proposed action would further decrease overland habitat connectivity for torrent salamanders, having an adverse effect on their populations. While prohibition of new quarry construction and recreation infrastructure other than trails and boat ramps in RCAs (Conservation Actions 11 and 12) would decrease related effects on torrent salamanders described under the no action alternative in areas with RCAs, effects would continue to occur in areas without RCAs.

Commitment to stream-enhancement activity (Conservation Action 3) would be unlikely to meaningfully improve habitat for torrent salamanders, whose populations perform better in fishless streams. The monitoring and adaptive management plan for torrent salamanders included as part of the proposed action would serve to increase knowledge of torrent salamanders occurring in perennial streams and would have beneficial effects on torrent salamanders.

Alternative 3: Increased Conservation

Effects on torrent salamanders under Alternative 3 compared to the no action alternative would be the same as described for the proposed action except that expanded riparian buffers (RCAs; Table 2-4) for small perennial non-fish-bearing streams and seasonal streams that are high energy or in potential debris flow tracks would increase beneficial effects on torrent salamanders and reduce some effects of harvest. Also, increased road vacating goals in the RCAs and HCAs under Alternative 3 compared to the no action alternative and proposed action would result in increased revegetation of road surfaces in these areas and thereby increase overland dispersal capacity for torrent salamanders.

Alternative 4: Reduced Permit Term

Effects on torrent salamanders under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on torrent salamanders under Alternative 5 compared to the no action alternative would be the same as described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest and less protection provided by the HCAs.

3.6.3.2 Noncovered Fish Species

Alternative 1: No Action

Overall, effects on noncovered fish would be similar to those described for covered salmonids and eulachon above, resulting in reduced habitat quality for a range of noncovered, native fish.

Alternative 2: Proposed Action

The types of effects on noncovered fish species under the proposed action would be similar to those described for the no action alternative except that modeled increases in forest management activities would increase adverse effects, while expanded riparian and aquatic protection and stream enhancement would result in greater beneficial effects as described above for covered salmonids.

Alternative 3: Increased Conservation

Effects on noncovered fish species under Alternative 3 compared to the no action alternative would be similar to those described for the proposed action except that further expanded riparian protection and more stringent road vacating requirements would increase beneficial effects as described for covered salmonids.

Alternative 4: Reduced Permit Term

Effects on noncovered fish species under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on noncovered fish species under Alternative 5 compared to the no action alternative would be the same as described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest and less protection provided by the HCAs.

3.6.3.3 Noncovered Stream-Dependent Wildlife Species

Alternative 1: No Action

Effects on noncovered stream-dependent wildlife species found in fishless areas would be similar to those described for torrent salamanders above. Effects on freshwater mussels and noncovered stream-dependent wildlife that may or may not coexist with fish would be similar to those described for covered salmonids and eulachon. Mussels are more susceptible to many short-term disturbances such as sediment pulses, dewatering, and even restoration activities than fish because they are largely immobile as juveniles and adults.

The no action alternative would adversely affect non-fish species that may rely more on fishless streams, including amphibians, such as Copes giant salamander, and insects including the spurred bizarre caddisfly and very rare rhyacophilan caddisflies, due to limited riparian protections in these areas.

Alternative 2: Proposed Action

Effects on noncovered stream-dependent wildlife species that rely on fishless areas under the proposed action would be similar to those described for torrent salamanders. Effects on freshwater mussels and noncovered stream-dependent wildlife that may or may not coexist with fish would be similar to those described for covered salmonids and eulachon. Modeled increases in harvest and road construction would result in increased adverse effects compared to the no action alternative. The conservation actions would reduce adverse effects and result in greater beneficial effects compared to the no action alternative for species in all stream types in the permit area except small, fishless seasonal streams that are not high energy, or species in habitat along debris flow tracks.

Alternative 3: Increased Conservation

Effects on noncovered stream-dependent wildlife species under Alternative 3 compared to the no action alternative would be similar to those described for the proposed action except that expanded riparian buffers and more stringent road vacating requirements would increase beneficial effects as described under Alternative 3 for covered salmonids and torrent salamanders above.

Alternative 4: Reduced Permit Term

Effects on noncovered stream-dependent wildlife species under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on noncovered stream-dependent wildlife species under Alternative 5 compared to the no action alternative would be similar to those described for the proposed action except that adverse effects related to harvest would increase with increased acreage of harvest.

3.6.3.4 Covered Forest-Dependent Species

Oregon Slender Salamander

Alternative 1: No Action

Under the no action alternative, activities leading to injury or mortality of Oregon slender salamander would be prohibited when Oregon slender salamander becomes federally listed. This document assumes this listing as part of the analysis. Habitat removal or modification through timber harvest is the primary effect on Oregon slender salamander under the no action alternative. Other activities that could affect this species over the analysis period include road construction and development of quarries and auxiliary facilities and recreational facilities.

Timber harvest under the no action alternative would modify Oregon slender salamander habitat, which could result in reduced survival or reproductive success in areas where the species occurs. This could lead to mortality over time if individuals are exposed to warmer, drier conditions postharvest.

Based on the Oregon slender salamander habitat model projections, total habitat would decrease throughout the analysis period, but highly suitable habitat would increase significantly, from 65 acres to over 9,000 acres (Appendix 3.6-B, Figure 1). The forest model assumes suitable habitat for federally listed species would be occupied by those species and therefore off limits to harvest under the no action alternative. However, if some of these areas were not occupied, they may be available for harvest. Timber harvest activities would likely fragment habitat, and habitat patches could become inaccessible to the species or require additional effort to access. Assured habitat connectivity and dispersal habitat for the species would be limited to riparian corridors.

ODF’s response to disturbance events would result in a combination of effects on Oregon slender salamander under the no action alternative. ODF’s avoidance of occupied habitat would shift if species distribution shifts as a result of disturbance, and this flexibility would provide some benefits related to species adaptation to catastrophic disturbance events, which are expected to increase with climate change. However, salvage harvest would be allowed in unoccupied areas, which would remove downed wood that is valuable to the species. If occupied areas become unoccupied by the species (assuming the species becomes listed), ODF would no longer be required to avoid these areas. ODF would not be committed to avoid harvest or manage for the species in previously occupied areas, which would be important to increasing the likelihood of re-occupation of disturbed areas by the species and the long-term species persistence.

Other activities such as road construction and development of quarries and auxiliary facilities and recreational facilities could cause direct injury or mortality from inadvertently crushing individuals with equipment or vehicles. These effects are expected to be minor under the no action alternative because occupied habitat would be avoided when the species is federally listed. However, habitat modification through these other activities could prevent otherwise suitable habitat areas from becoming occupied. This would be habitat loss in addition to what is reflected in the models for timber harvest. Road construction may diminish habitat connectivity, although roads are not generally known to be barriers to salamanders in this taxon (Clayton and Olson 2007:17).

Monitoring under the no action alternative would be limited to surveys conducted to determine species presence, if the species becomes listed. There would be no commitment to monitoring and adaptive management to provide for the persistence of the species in the study area.

Alternative 2: Proposed Action

The types of effects on Oregon slender salamander under the proposed action would be the same as described for the no action alternative. Unlike the no action alternative, take of Oregon slender salamander in the form of injury, mortality, or habitat modification would be permitted even if the species becomes listed during the permit term. This take would be minimized and mitigated by protection of habitat in HCAs (Conservation Action 6), increase in the quantity and quality of habitat over the permit term, inside HCAs (Conservation Action 7), and retention of legacy structure, including downed wood, in harvested stands outside of the HCAs (Conservation Action 8).

The primary form of take under the proposed action would be habitat modification resulting from timber harvest activities. Based on the Oregon slender salamander habitat model projections, trends for highly suitable habitat in the permit area would be very similar to the no action alternative, increasing at each time interval analyzed (Appendix 3.6-B, Figure 1). However, the modeled amount of suitable habitat and total habitat is projected to be greater under the proposed action than the no action alternative. Habitat connectivity for Oregon slender salamander under the proposed action is expected to be greater than under the no action alternative, because the HCAs and RCAs are designed to provide large, interconnected patches of mid- to late-seral forest.

ODF's response to disturbance events would result in a combination of effects on Oregon slender salamander habitat and survival under the proposed action. Although Oregon slender salamanders may move on the landscape to respond to altered habitat, the locations of protected areas would not change under the proposed action as they would for the no action alternative, except for minor temporary shifts under changed circumstances (Appendix 3.6-B). While the lack of flexibility in locations of protected areas after catastrophic disturbances could be a disadvantage for the species, the focus on fixed HCAs would have benefits. Salvage harvest in the HCAs would be limited to protecting public safety or facilities and done in a manner to optimize covered species habitat where possible, increasing the opportunity for disturbed areas to be passively or actively restored.

Other activities would have the same effects on Oregon slender salamanders over the permit term under the proposed action as the no action alternative, except that the modeled increase in road miles could increase related habitat removal and result in increased injury or mortality due to increased access (Table 3.1-4). Additionally, activities involving vehicles and equipment could result in injury or mortality of Oregon slender salamander that would not be authorized under the no action alternative.

Baseline monitoring under the proposed action (HCP Chapter 6, *Monitoring and Adaptive Management*) would provide a better understanding of Oregon slender salamander distribution, abundance, and habitat use in the permit area, including effects of timber harvest, silvicultural practices, and fire. Monitoring results would inform adaptive management responses to ensure that the HCP's biological goal of supporting the persistence of Oregon slender salamander in the study area is met. Adaptive management adjustments may involve modifications to the way covered activities are implemented, including the number, extent, and location of covered activities, as well as project-specific designs and specifications. The required monitoring and adaptive management would provide greater certainty compared with the no action alternative that the conservation needs of the species in the study area would be met.

Alternative 3: Increased Conservation

Effects on Oregon slender salamander under Alternative 3 compared to the no action alternative would be nearly the same as described for the proposed action. All modeled habitat projections are within 0.5 percent the proposed action projections by the end of the permit term.

Alternative 4: Reduced Permit Term

Effects on Oregon slender salamander under Alternative 4 compared to the no action alternative would be the same as under the proposed action during the first 50 years of the permit term. By the end of the 50-year permit term, total modeled habitat in the permit area is slightly higher and highly suitable habitat is slightly lower than the no action alternative.

Alternative 5: Increased Timber Harvest

Effects on Oregon slender salamander under Alternative 5 compared to the no action alternative would be nearly the same as described for the proposed action. All modeled habitat projections are within 0.5 percent of the proposed action projections by the end of the permit term.

Northern Spotted Owl

Alternative 1: No Action

Under the no action alternative, take of northern spotted owl would not be authorized and ODF would continue to avoid active spotted owl sites consistent with their Northern Spotted Operational Policies (ODF 2017). Habitat removal or modification through timber harvest is the primary effect on northern spotted owl under the no action alternative. Other activities that could affect northern spotted owl over the analysis period include road construction and development of quarries and auxiliary facilities and recreational facilities.

Based on northern spotted owl habitat model projections, nesting and roosting habitat would increase, while foraging and dispersal habitat would decrease over the analysis period (Appendix 3.6-B, Figure 2). The model assumes suitable habitat for federally listed species would be occupied by those species and therefore off limits to harvest under the no action alternative. However, if some of these areas were not occupied, they may be available for harvest. Timber harvest activities would likely fragment habitat, and habitat patches could require additional effort for the owls to access.

Assured habitat connectivity and dispersal habitat for northern spotted owl would be limited to riparian corridors.

Within designated critical habitat units, trends would be similar to those described above for the entire permit area, with nesting and roosting habitat increasing and dispersal and foraging habitat decreasing (Appendix 3.6-B, Figure 3).

ODF would need to shift harvest locations in response to large disturbance events such as fires or storms if spotted owl distribution shifts as a result of disturbance. If occupied areas become unoccupied by the species, ODF would no longer be required to protect these newly unoccupied areas. If formerly unoccupied areas become occupied, ODF would avoid activities in these areas. ODF would not be committed to restoring disturbed unoccupied areas. This may lead to a decrease in the likelihood of occupation by the species and the long-term species persistence. Salvage practices could delay or prevent habitat recovery.

Timber harvest in designated critical habitat units would be allowed under the no action alternative in areas not occupied by the species. When harvested, these areas would not likely support the physical or biological features essential to the conservation of the species within designated critical habitat units. This would adversely affect species recovery by preventing colonization into unoccupied critical habitat areas.

New road construction, and development of quarries and auxiliary facilities and recreational facilities could also result in habitat removal in addition to the habitat loss reflected in the model for timber harvest. Additionally, increased access to occupied habitat provided by roads and recreational development could result in disturbance of northern spotted owl feeding, breeding, and sheltering behavior. Monitoring under the no action alternative would be limited to surveys conducted to determine species presence and there would be no adaptive management to ensure species conservation in the study area.

Alternative 2: Proposed Action

The types of effects on northern spotted owl under the proposed action would be the same as described for the no action alternative. Unlike the no action alternative, take of northern spotted owl would be authorized. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and protection of nest trees (Conservation Action 10).

Harm due to modification of occupied habitat from timber harvest activities would be the primary effect on northern spotted owls over the permit term under the proposed action. Of the 31 known active northern spotted owl active sites in the permit area, 28 are included in HCAs and would be protected (Conservation Actions 6 and 7). Stand management activities in HCAs would increase habitat quality for covered species, including northern spotted owl, over the permit term. The three activity centers outside of HCAs, consisting of two active pair sites and one resident single site, would likely be degraded over time from harvest activities reducing habitat quality. None of the three sites have had recent northern spotted owl activity. Owls were last seen at one site in 2014, at another in 2015, and at the third in 2016. Two of the three activity centers have a portion of the site inside an HCA.

Based on modeling, nesting and roosting habitat would increase over the permit term but less than under the no action alternative (Appendix 3.6-B, Figure 2). However, the model results for the proposed action reflect greater certainty than those for the no action alternative because they are based on the protection of designated HCAs for the duration of the permit term, whereas the no action alternative habitat results are based on avoidance due to assumed occupancy that is uncertain. Decreases in modeled foraging habitat over the permit term trend similar to the no action alternative. Modeled dispersal habitat decreases through year 25 and remains stable through the remainder of the permit term, resulting in more dispersal habitat by the end of the permit term and greater habitat connectivity compared to the no action alternative.

In designated critical habitat units, modeled trends are similar to those described above for the entire permit area (Appendix 3.6-B, Figure 3).

ODF's response to catastrophic disturbance events would have a combination of effects on northern spotted owls under the proposed action. Although individuals may move across the landscape to respond to altered habitat, the locations of protected areas would not change under the proposed action based on species occurrence as they would for the no action alternative, except for minor temporary shifts under changed circumstances (Appendix 3.6-B). The set designation of protected area locations could be a disadvantage for the species because protected areas would not shift to adapt to changing environmental conditions. The focus on fixed HCAs under the proposed action would have benefits, however, in that salvage harvest would be more limited in HCAs under the proposed action, increasing the opportunity for disturbed areas to be passively or actively restored.

Based on modeling, road construction would be greater under the proposed action compared to the no action alternative, which could result in increased habitat removal and disturbance related to increased access (Table 3.1-4). Other activities that affect northern spotted owl under the proposed action are the same as described under the no action alternative.

The conservation strategy under the proposed action would focus conservation in contiguous areas of suitable habitat, including dispersal habitat, and associated active northern spotted owl nesting territories within HCAs, whereas the no action alternative would only protect occupied patches. A minimum of 40 percent of the landscape would be maintained as dispersal habitat under the proposed action (Conservation Action 8), an amount sufficient to maintain connectivity for northern spotted owl dispersal (Davis et al. 2016). Therefore, the proposed action would increase habitat connectivity compared to the no action alternative.

In addition to the commitments toward habitat protection and enhancement in Conservation Actions 6, 7, and 8, Conservation Action 9 would require ODF to establish a conservation fund for barred owl research and management activities within the permit area. Based on initial research (Wiens et al. 2019), control of barred owls could enhance survival and site tenacity in the permit area over the permit term. Barred owl research and management activities would not be assured under the no action alternative. These commitments to habitat protection and enhancement on specific areas of the landscape, coupled with the assurances associated with an HCP, make ODF's long-term investments of money and resources toward habitat protection less risky and more likely to provide protection for spotted owl compared to the no action alternative.

ODF would be committed to monitoring and adaptively managing the HCAs for the species' long-term persistence during the permit term under the proposed action. ODF would commit to monitoring and documenting progress toward achieving the biological objectives for habitat over the permit term. Should monitoring results indicate that biological objectives are not being realized, ODF would use the adaptive management process to implement changes to improve progress toward the biological objectives. This is anticipated to increase long-term habitat maintenance to sustain the northern spotted owl population in the permit area, compared to the no action alternative, which has no requirements for monitoring and adaptive management for this purpose.

Alternative 3: Increased Conservation

Effects on northern spotted owl under Alternative 3 compared to the no action alternative would be nearly the same as described for the proposed action. All modeled habitat projections are less than 2 percent below the proposed action projections by the end of the permit term.

Alternative 4: Reduced Permit Term

Effects on northern spotted owl under Alternative 4 compared to the no action alternative would be the same as the proposed action during the first 50 years of the permit term. By the end of the 50-year permit term, modeled nesting and roosting habitat and foraging habitat in the permit area is lower than the no action alternative, while dispersal habitat is higher (Appendix 3.6-B, Figure 2). The trends are similar for modeled habitat in designated critical habitat units (Appendix 3.6-B, Figure 3).

Alternative 5: Increased Timber Harvest

Effects on northern spotted owl under Alternative 5 compared to the no action alternative would be similar to the proposed action. All modeled habitat projections are less than 4 percent below the proposed action projections by the end of the permit term.

Marbled Murrelet

Alternative 1: No Action

Under the no action alternative, take of marbled murrelet would not be authorized and ODF would continue to avoid occupied marbled murrelet sites consistent with their Guidance for Implementing Marbled Murrelet Policies and Procedures (ODF 2016). Habitat removal or modification through timber harvest is the primary effect on marbled murrelet under the no action alternative. Other activities that could affect marbled murrelet over the analysis period include road construction and development of quarries and auxiliary facilities and recreational facilities.

Harvest activities (especially clearcut harvest, retention cutting, and thinning) in unoccupied habitat would be the primary factor adversely affecting marbled murrelet habitat through reduction in habitat quality and quantity. Harvest could also fragment habitat, making habitat patches more accessible and thereby increasing predation risk. Assured connectivity and dispersal areas for marbled murrelet would be limited to riparian corridors under the no action alternative.

Based on the marbled murrelet model projections, the total amount of modeled habitat and highly suitable habitat for marbled murrelet would increase at each time interval analyzed (25, 50, and 70 years), and suitable habitat would increase from 0 to 25 years but then decrease (Appendix 3.6-B, Figure 4). The model assumes suitable habitat for federally listed species would be occupied by those species and therefore off limits to harvest under the no action alternative. However, if some of these areas were not occupied, they may be available for harvest.

To avoid take, ODF would need to shift harvest locations in response to large disturbance events such as fires or storms as marbled murrelet distribution shifts as a result of disturbance. If occupied areas become unoccupied by the species, ODF would no longer be required to protect these areas. If formerly unoccupied areas become occupied, ODF would avoid activities in these areas. ODF would not be committed to restoring disturbed unoccupied areas. This may lead to a decrease in the likelihood of occupation by the species and the long-term species persistence. Salvage practices could delay or prevent habitat recovery.

New road construction and development of quarries and auxiliary facilities and recreational facilities could also result in habitat removal in addition to loss from harvest activities reflected in the model. Increased access to occupied habitat provided by roads and recreational development could increase disturbance of marbled murrelet feeding, breeding, and sheltering behavior. Monitoring under the no action alternative would be limited to species surveys for the purpose of take avoidance.

The total amount of marbled murrelet habitat likely would increase over the analysis period, benefitting the species as compared with existing conditions. Since conservation would focus on occupied habitat with no comprehensive strategy or monitoring and adaptive management for the species, however, habitat connectivity would not be assured and there would be a low level of certainty of the species' persistence in the study area.

Alternative 2: Proposed Action

The types of effects on marbled murrelet under the proposed action compared to the no action alternative would be the same as described for the no action alternative. Unlike the no action alternative, ODF would be authorized to incidentally take marbled murrelets. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and protection of nest trees (Conservation Action 10).

Harm due to modification of occupied habitat from timber harvest activities would be the primary effect on marbled murrelets over the permit term. Loss of nesting habitat would be rare over the permit term, however, because the majority of confirmed occupied sites are located in HCAs (Conservation Action 6). Of 363 survey detections indicating marbled murrelet occupancy in the permit area, all but four are included in HCAs (three of the four detections are from one survey location). ODF would only implement management activities in HCAs to increase habitat quantity for marbled murrelet over the permit term (Conservation Action 7), so would not be expected to result in loss of nest trees. Occupied stands outside of HCAs could be lost over time, likely due to a reduction in habitat quality in the stand. Under Conservation Action 10, however, leave tree commitments would retain platform trees and associated cover trees, which would benefit the species by providing suitable habitat conditions.

Under the proposed action, the modeled amount of total habitat and highly suitable habitat for marbled murrelet increases with each time interval (25, 50, and 70 years) but to a lesser degree than under the no action alternative. Modeled suitable habitat is the same as the no action alternative at the beginning and end of the permit term but does not have the same variability (Appendix 3.6-B, Figure 4). However, the model results for the proposed action reflect greater certainty than those for the no action alternative, as described for northern spotted owl.

Habitat connectivity for marbled murrelet under the proposed action likely would be greater than the no action alternative, because the HCAs and RCAs are designed to provide large, interconnected patches of late-seral forest.

ODF's response to disturbance events would have a combination of effects on marbled murrelets under the proposed action. Although individuals may move across the landscape to respond to altered habitat under the proposed action, the locations of protected areas would not change as they would for the no action alternative, except for minor temporary shifts under changed circumstances (Appendix 3.6-B). The set designation of protected area locations could be a disadvantage for the species as protected areas would not shift to adapt to changing environmental conditions. The focus on fixed HCAs under the proposed action would have benefits, however, in that salvage harvest would be more limited in HCAs under the proposed action, increasing the opportunity for disturbed areas to be passively or actively restored.

Based on modeling, road construction would be greater under the proposed action compared to the no action alternative, which could result in increased habitat removal and disturbance related to increased access (Table 3.1-4). Other activities that affect marbled murrelet under the proposed action are the same as described under the no action alternative.

ODF would be committed to monitoring and adaptively managing the HCAs for the species' long-term persistence during the permit term under the proposed action. ODF would commit to monitoring and documenting progress toward maintenance and enhancement of existing habitat over the permit term. Should monitoring results indicate that biological objectives are not being realized, ODF would use the adaptive management process to implement changes to improve progress toward the biological objectives. This is anticipated to increase long-term habitat maintenance to sustain the marbled murrelet population in the permit area, compared to the no action alternative, which has no requirements for monitoring and adaptive management for this purpose.

Alternative 3: Increased Conservation

Effects on marbled murrelets under Alternative 3 compared to the no action alternative would be nearly the same as described for the proposed action. All modeled habitat projections are less than 1 percent below proposed action projections by the end of the permit term.

Alternative 4: Reduced Permit Term

Effects on marbled murrelets under Alternative 4 compared to the no action alternative would be the same as the proposed action during the first 50 years of the permit term. By the end of the 50-year permit term, total modeled habitat and highly suitable modeled habitat for marbled murrelet increases but to a lesser degree than under the no action alternative, and suitable modeled habitat is less than the no action alternative (Appendix 3.6-B, Figure 4).

Alternative 5: Increased Timber Harvest

Effects on marbled murrelets under Alternative 5 compared to the no action alternative would be similar to the proposed action. All modeled habitat projections are between 2 and 4 percent below proposed action projections by the end of the permit term.

Coastal Marten

Alternative 1: No Action

Under the no action alternative, ODF would continue to avoid management activities that could cause take in occupied coastal marten habitat. However, these activities would continue in unoccupied habitat.

Harvest activities (especially clearcut harvest, retention cutting, and thinning) in unoccupied habitat would be the primary factor adversely affecting coastal marten habitat through reduction in habitat quality and quantity. Harvest could also fragment habitat, making habitat patches more accessible and thereby increasing predation risk. Assured connectivity and dispersal areas for coastal marten would be limited to riparian corridors under the no action alternative.

Based on modeling, mid-seral forests are projected to decrease and late-seral forest are projected to increase by an equivalent amount over the analysis period (Figure 3.5-2), with the greatest changes occurring in the first 25 years. This would result in an increase in overall habitat suitability for coastal marten over the analysis period.

To avoid take, ODF would need to shift harvest locations in response to large disturbance events such as fires or storms as coastal marten distribution shifts as a result of disturbance. If occupied areas become unoccupied by the species, ODF would no longer be required to protect these areas. If formerly unoccupied areas become occupied, ODF would avoid activities in these areas. ODF would not be committed to restoring disturbed unoccupied areas. This may lead to a decrease in the likelihood of occupation by the species and the long-term species persistence. Salvage practices could delay or prevent habitat recovery.

In addition to timber harvest, new road construction, and development of quarries and auxiliary facilities, and recreational facilities could also result in coastal marten habitat removal. Increased access to occupied habitat provided by roads and recreational development could result in increased disturbance of coastal marten feeding, breeding, and sheltering behavior.

Monitoring under the no action alternative would be limited to species surveys for the purpose of take avoidance. There would be no commitment to monitoring and adaptive management to provide for the persistence of the species in the study area.

Alternative 2: Proposed Action

The types of effects on coastal marten under the proposed action would be the same as described for the no action alternative. Unlike the no action alternative, take of coastal marten would be authorized. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and operational restrictions in occupied habitat outside HCAs (Conservation Action 10).

Harm due to modification of occupied habitat from timber harvest activities would be the primary effect on coastal martens over the permit term. Modeled projections of habitat suitability changes follow the same trend as the no action alternative, but with mid-seral forests decreasing less and late-seral forest increasing less over the permit term (Figure 3.5-2). As with the no action alternative, most changes would occur in the first 25 years. Overall habitat suitability for coastal marten would be similar to but lower than under the no action alternative based on these model projections. However, the model results for the proposed action reflect greater certainty than those for the no action alternative, as described for northern spotted owl.

Habitat connectivity for coastal marten under the proposed action likely would be greater than under the no action alternative, as the HCAs and RCAs are designed to provide large, interconnected patches of suitable habitat.

ODF's response to catastrophic disturbance events would have a combination of effects on coastal martens under the proposed action. Although individuals may move across the landscape to respond to altered habitat under the proposed action, the locations of protected areas would not change as they would for the no action alternative, except for minor temporary shifts under changed circumstances (Appendix 3.6-B). The set designation of protected area locations could be a disadvantage for the species as protected areas would not shift to adapt to changing environmental conditions. There would be limited salvage harvest in the HCAs, increasing the opportunity for disturbed areas to be passively or actively restored. ODF would be committed to continue adaptively managing the HCAs for the species' long-term persistence during the permit term.

Based on modeling, road construction would be greater under the proposed action compared to the no action alternative, which could result in increased habitat removal and disturbance related to increased access (Table 3.1-4). Other activities that affect coastal marten under the proposed action are the same as described under the no action alternative.

ODF would be committed to monitoring and adaptively managing the HCAs for the species' long-term persistence during the permit term under the proposed action. ODF would commit to monitoring and documenting progress toward maintenance and enhancement of existing habitat over the permit term. Should monitoring results indicate that biological objectives are not being realized, ODF would use the adaptive management process to implement changes to improve progress toward the biological objectives. This is anticipated to increase long-term habitat maintenance to sustain the coastal marten population in the permit area, compared to the no action alternative, which has no requirements for monitoring and adaptive management for this purpose.

Alternative 3: Increased Conservation

Effects on coastal marten under Alternative 3 compared to the no action alternative would be nearly the same as described for the proposed action, with slightly less (1 percent) mid-seral forest and slightly more (1 percent) late-seral forest.

Alternative 4: Reduced Permit Term

Effects on coastal marten under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on coastal marten under Alternative 5 compared to the no action alternative would be nearly the same as described for the proposed action, with slightly more (1 percent) mid-seral forest and slightly less (2 percent) late-seral forest.

Red Tree Vole

Alternative 1: No Action

Under the no action alternative, activities leading to injury or mortality of red tree vole would be prohibited when red tree vole becomes federally listed. This document assumes this listing as part of the analysis. Habitat removal or modification through timber harvest is the primary effect on red tree vole under the no action alternative. Other activities that could affect this species over the analysis period include road construction and development of quarries and auxiliary facilities and recreational facilities.

Based on red tree vole habitat model projections, total habitat would increase under the no action alternative over the analysis period, with highly suitable habitat substantially increasing and suitable habitat slightly decreasing (Appendix 3.6-B, Figure 5). The model assumes suitable habitat for federally listed species would be occupied by those species and therefore off limits to harvest under the no action alternative. However, if some of these areas were not occupied, they may be available for harvest. Assured habitat connectivity and dispersal habitat for red tree vole would be limited to riparian corridors under the no action alternative.

To avoid take, ODF would need to shift harvest locations in response to large disturbance events such as fires or storms as red tree vole distribution shifts as a result of disturbance. If occupied areas become unoccupied by the species, ODF would no longer be required to protect these areas. If formerly unoccupied areas become occupied, ODF would avoid activities in these areas. ODF would not be committed to restoring disturbed unoccupied areas. This may lead to a decrease in the likelihood of occupation by the species and the long-term species persistence. Salvage practices could delay or prevent habitat recovery.

In addition to timber harvest, new road construction and development of quarries, auxiliary facilities, and recreational facilities could also result in habitat removal in addition to habitat loss reflected in the model for timber harvest. Increased access to occupied habitat provided by roads and recreational development could result in disturbance of red tree vole feeding, breeding, and sheltering behavior.

Monitoring under the no action alternative would be limited to surveys conducted to determine species presence, if the species becomes listed. There would be no commitment to monitoring and adaptive management to provide for the persistence of the species in the study area.

Alternative 2: Proposed Action

The types of effects on red tree vole under the proposed action would be the same as described for the no action alternative. Unlike the no action alternative, take in the form of injury, mortality, or habitat modification would be permitted even if the species becomes listed during the permit term. This take would be minimized and mitigated by protection of occupied habitat within HCAs (Conservation Action 6), management of HCAs (Conservation Action 7), retention of legacy structure in harvested stands outside of the HCAs (Conservation Action 8), and protection of nest trees (Conservation Action 10).

Modeled habitat projections over the permit term follow the same trend as under the no action alternative, but modeled highly suitable habitat increases less substantially (Appendix 3.6-B, Figure 5). However, the model results for the proposed action reflect greater certainty than those for the no action alternative, as described for northern spotted owl. Habitat connectivity for red tree vole under the proposed action likely would be greater than under the no action alternative, because the HCAs and RCAs are designed to provide large, interconnected patches of late-seral forest.

ODF's response to disturbance events would have a combination of effects on red tree vole under the proposed action. Although individuals may move across the landscape to respond to altered habitat under the proposed action, the locations of protected areas would not change as they would for the no action alternative, except for minor temporary shifts under changed circumstances (Appendix 3.6-B). The set designation of protected area locations could be a disadvantage for the species as protected areas would not shift to adapt to changing environmental conditions. The focus on fixed HCAs under the proposed action would have benefits, however, in that salvage harvest would be more limited in HCAs under the proposed action, increasing the opportunity for disturbed areas to be passively or actively restored.

Other activities that affect red tree vole under the proposed action are the same as described under the no action alternative, except that the modeled increase in road miles could increase related habitat removal and disturbance related to access (Table 3.1-4).

ODF would be committed to monitoring and adaptively managing the HCAs for the species' long-term persistence during the permit term under the proposed action. ODF would commit to monitoring and documenting progress toward maintenance and enhancement of existing habitat over the permit term. Should monitoring results indicate that biological objectives are not being realized, ODF would use the adaptive management process to implement changes to improve progress toward the biological objectives. This is anticipated to increase long-term habitat maintenance to sustain the red tree vole population in the permit area, compared to the no action alternative, which has no requirements for monitoring and adaptive management for this purpose.

Alternative 3: Increased Conservation

Effects on red tree vole under Alternative 3 compared to the no action alternative would be nearly the same as described for the proposed action. All modeled habitat projections are less than 1.5 percent below proposed action projections by the end of the permit term.

Alternative 4: Reduced Permit Term

Effects on red tree vole under Alternative 4 compared to the no action alternative would be the same as the proposed action during the first 50 years of the permit term, with less total modeled habitat and highly suitable modeled habitat than the no action alternative by the end of the 50-year permit term (Appendix 3.6-B, Figure 5).

Alternative 5: Increased Timber Harvest

Effects on red tree vole under Alternative 5 compared to the no action alternative would be similar to the proposed action. All modeled habitat projections are less than 4 percent below proposed action projections by the end of the permit term.

3.6.3.5 Noncovered Forest-Dependent Wildlife Species

Alternative 1: No Action

Under the no action alternative, as described in Section 3.5.3.1, ongoing timber harvest and reforestation and young stand management would be the primary drivers of change in forest structure. These activities would also be the primary drivers of effects on noncovered forest-dependent wildlife, as habitat modification is the greatest threat to these species. Clearcut harvest would remove mid- to late-seral forest in the study area as described in Section 3.5. Species occurring in these habitats could be injured or killed by equipment or tree felling. Reforestation and young stand management following clearcut harvest would result in dense early-seral forests with closed canopies and little, simple, or no understory structures.

Removal of mid- and late-seral forest structure would adversely affect many noncovered wildlife species that depend on this habitat type during at least part of their lifecycle. Clearcut harvest would reduce production of downed wood that is valuable for the salamander and invertebrate species listed in Table 3.6-2. Although clearcut harvest would remove mid- and late-seral forest, based on modeling, the total amount of late-seral forest in the permit area would increase over the analysis period under the no action alternative (Figure 3.5-2) with the greatest changes occurring in the first 25 years of the analysis period.

Clearcut harvest could benefit wildlife species dependent on early-seral forest. Thinning and tree selection would reduce understory biodiversity and have an adverse effect on the many forest species dependent on diverse structure, such as northern goshawk. Thinning may be beneficial, however, for species that require open forest habitat such as olive-sided flycatcher.

Suitable habitat for wildlife species dependent on fire or drought related disturbance is expected to increase over time with increased disturbance. Some of these species tend to use burned late-seral forests. Where late-seral forests are removed from clearcut harvest, as described above, the potential for this burned late-seral forest habitat would also be reduced, adversely affecting these species. Continuation of current snag retention practices could reduce this effect. Increased late-seral forest acreage over the analysis period, as projected in the models, would benefit these species.

Land between sites occupied by federally listed species would be harvested where accessible, resulting in loss of habitat connectivity. Protected habitat patches likely would be relatively small, because they would be confined to areas occupied by listed species, resulting in a high ratio of perimeter to area and hence increasing harmful edge effects.

The effects of other activities on noncovered forest-dependent wildlife would vary by species but would be similar to those described above for the covered species. Road construction may impede movement for some noncovered amphibian species and invertebrates such as Oregon shoulderband (*Helminthoglypta hertleini*).

Alternative 2: Proposed Action

The types of effects on noncovered forest-dependent wildlife under the proposed action would be the same as described for the no action alternative. Based on modeling, overall habitat trends would be similar to those described under the no action alternative, with the greatest changes occurring in the first 25 years of the permit term; however, there would be less late-seral forests and more mid-seral forests in the permit area compared to the no action alternative (Figure 3.5-2). This would result in less habitat for species dependent on late-seral forest and more habitat for species depending on mid-seral forests compared to the no action alternative, the degree of benefit depending on the extent to which these forests are managed for structural diversity. The extent to which habitat is created for species dependent on wildfires or other natural disturbances would be comparable to the no action alternative, although restrictions on salvage harvest (Conservation Action 7) would reduce these effects in HCAs.

The proposed action would protect larger, more interconnected habitat areas than the no action alternative, measured in terms of patch size, distance between patches, and interior to perimeter ratio. This would better facilitate wildlife movement through the landscape by providing greater habitat connectivity. The proposed action would also diminish adverse edge effects that would otherwise result from a high ratio of perimeter to area under the no action alternative. Based on modeling, road miles would increase compared to the no action alternative, which could result in reduced habitat connectivity and dispersal ability for some amphibian and invertebrate species that do not tend to cross roads (Table 3.1-4).

Alternative 3: Increased Conservation

Effects on noncovered forest-dependent wildlife under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except wider riparian corridors may provide more protected habitat and a greater level of habitat connectivity for species adversely affected by timber harvest.

Alternative 4: Reduced Permit Term

Effects on noncovered forest-dependent wildlife under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term. As described under proposed action, most of the changes in habitat occur in the first 25 years.

Alternative 5: Increased Timber Harvest

Effects on noncovered forest-dependent wildlife under Alternative 5 compared to the no action alternative would be similar to those described for the proposed action, except that more forest habitat would be affected by timber harvest, since the total acres of HCAs would be reduced.

3.6.3.6 Noncovered Wildlife Species Dependent on Wetlands and Riparian Habitat

Alternative 1: No Action

Under the no action alternative, timber harvest could reduce riparian and wetland (including wet meadow) habitat function through removal of vegetation and ground disturbance. Species occurring in these habitats could be injured or killed by equipment or tree felling or could be adversely affected by temporary or permanent habitat loss. Based on modeling, harvest would affect an average of 4.2 acres of riparian habitat (forested/shrub wetland)[6] and 2.4 acres of non-riparian, non-stream wetland habitat annually over the analysis period. Effects would be temporary, and the wetlands would be expected to recover to pre-disturbance condition over time. Effects of harvest and thinning on wetlands would be minimized through compliance with Oregon Administrative Rule 629-655 and management prescriptions described in the Northwest Forests Management Plan (ODF 2010).

Timber harvest under the no action alternative would likely increase sedimentation in wetlands and increase water temperature, as described above for streams. For wetlands that occur outside of riparian buffers (RMAs), vegetation removal could occur up to the edge of the wetland.

ODF would not conduct the following activities in wetlands because they would result in conversion to uplands: road construction, quarry and auxiliary facility construction and maintenance, water drafting, and recreational infrastructure development and maintenance. Prescribed burns have the potential to reduce riparian and wetland (including wet meadow) function through removal of vegetation and to injure or kill wildlife occurring in these habitats. Effects from prescribed burns would be nominal, however, based on current regulatory guidance and forest management practices.

Alternative 2: Proposed Action

Effects on noncovered riparian and wetland (including wet meadow) species under the proposed action would be the same as described for the no action alternative, except that the modeled acreage of impacts from timber harvest is greater. Based on modeling, harvest under the no action

[6] These effects would be in wetlands outside of the RMAs where harvest is restricted.

alternative would affect an average of 5.3 acres of riparian habitat (forested/shrub wetland)[7] and 2.3 acres of non-riparian, non-stream wetland habitat annually over the permit term.

Alternative 3: Increased Conservation

Effects on noncovered riparian and wetland (including wet meadow) species under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that road vacating requirements under Alternative 3, as described for salmonids, would increase beneficial effects for wetland species by improving water quality.

Alternative 4: Reduced Permit Term

Effects on noncovered riparian and wetland (including wet meadow) species under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on noncovered riparian and wetland (including wet meadow) species under Alternative 5 compared to the no action alternative would be similar to those described for the proposed action, except that the modeled acreage of impacts from timber harvest would be slightly greater. Based on modeling, harvest under the no action alternative would affect an average of 5.4 acres of riparian habitat and 2.5 acres of non-riparian, non-stream wetland habitat annually over the permit term.

3.6.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* that would overlap with impacts of the proposed action and alternatives on fish and wildlife species.

Climate change will have effects throughout the plan area. In streams and rivers, climate change is predicted to lower low summer flows, reducing habitat quantity and quality for fish and stream-dependent species, and reducing quality and quantity of drinking water for terrestrial species. Elevated stream temperatures caused by increased air temperatures, especially during summer months, will increase thermally unsuitable habitat for many native fish and stream-dependent wildlife, further restricting their range and making headwater areas even more important, as they often have cooler water temperature and, assuming they have sufficient flow, are less likely to become thermally unsuitable as quickly as other areas. Warm water invasive aquatic species and fish diseases are also likely to increase under climate change conditions. Increased water temperatures could also exceed some wetland species' thermal tolerance or cause some wetlands to dry down completely, diminishing habitat. Changing storm patterns (larger floods with shifted seasonality) will increase scour and sediment input to streams, decreasing fish and stream-dependent wildlife survival and altering the temporality of flows to which populations are adapted. Climate effects in the ocean could compound effects to native anadromous fish, including listed salmonids in the study area.

Terrestrially, increased periods of drought due to climate change could result in prolonged heat waves, causing widespread tree mortality and decreasing in tree growth, which is likely to diminish

[7] These effects would be in wetlands outside of the RCAs where harvest is prohibited.

suitable habitat for wildlife dependent on late-seral forests, as described in Section 3.5. Changes in the timing of seasonal conditions and associated biological events such as migration, reproduction, and flowering, could lead to mismatches in the life cycles of interdependent species, adversely affecting these species. Some terrestrial species will be forced to shift to new locations or adapt in place to shifting climate conditions, which may be made more difficult by habitat fragmentation. Populations that fail to move or adapt are likely to decline.

Increased frequency, intensity and duration of disturbance events will have adverse effects on fish and wildlife species. Increased disturbance event frequency, intensity, and duration will affect forest stand type and structure as described in Section 3.5, diminishing habitat for species dependent on late-seral forests.

Native animals are adapted to the project area's historic disturbance regime and the projected rate of increasing disturbance events will likely outpace the ability of these animals to adapt.

Landslides and storms will increase sedimentation and debris flow into streams, and increase disturbance of terrestrial areas, resulting in immediate effects that include loss or smothering of habitat, scour, high flows, or floods, potentially causing direct injury or mortality of species. In the long-term, these events can introduce large wood to streams, which is beneficial to habitat for fish and stream-dependent wildlife, but they also introduce additional fine sediment, decreasing habitat quality for fish and stream-dependent wildlife.

Wildfires are expected to become more frequent, more intense, and larger and some areas are likely to burn repeatedly, which could cause direct mortality and decrease habitat quality for any native species in the area. Wildfires will alter or completely remove habitat for terrestrial wildlife. Increased wildfires could also introduce additional fine sediment to streams, decreasing habitat quality.

Like wildfires, windstorms may level large swaths of forest land, removing habitat for forest-dependent species. Some species populations will move from degraded habitat to surviving areas of intact habitat; others will simply decline in degraded areas. If not harvested, burned areas may include green trees and large numbers of snags, and so retain appreciable habitat value for some terrestrial species; due to these legacies, regeneration of forests in burned areas usually produces high-value habitat substantially more quickly compared to regeneration in clearcut areas.

Increases in number and extent of invasive species would have adverse effects on native species. Invasive species can cause direct mortality to native organisms through predation, can out-compete native species for food and habitat, cause deleterious shifts in the food web having cascading ecosystem effects, and introduce disease. Barred owl population expansion is expected to result in an overall decline in northern spotted owl populations. Competition with barred owls may be the primary cause of northern spotted owl population declines across their range.

Forest management adjacent to the plan area would reduce habitat quality for fish and wildlife species in these areas. The integrity of terrestrial and riparian areas would be reduced, affecting connectivity of habitat for species. These activities would also affect forest structure and type, potentially affecting special-status wildlife with home ranges overlapping the plan area. Specific effects on forest structure and type would vary depending on management practices of adjacent land managers, some of which are more protective than others. These activities could also change stream flows and increase sedimentation, which would constitute adverse effects on species.

Agricultural activities adjacent to the plan area could adversely affect terrestrial wildlife habitat by reducing habitat. Increased agricultural activities would adversely affect fish, stream-dependent, and wetland wildlife in the study area due to decreases in habitat quality from decreased low flows, increased sedimentation, increased nutrients or pollutants in streams, and potentially reduced integrity of riparian areas. Timber harvest, reforestation, road construction, controlled burns, water drafting, recreation, and quarry and auxiliary facility development would overlap with the effects of agricultural activities.

Development near the study area would remove terrestrial wildlife habitat and increase spread of invasive species. It would also cause adverse effects on fish and stream-dependent wildlife due to decreases in habitat quality. Increased impervious surfaces would cause an increase in scouring peak flows. Development could introduce contaminants, pollutants, and fine sediment to the stream system, reducing habitat quality and potentially causing direct effects on animal physiology and health. Development near aquatic habitat could reduce the quantity of riparian habitat and the benefits provided to streams by riparian areas.

Recreational activities could degrade or remove habitat for terrestrial species and essential breeding, feeding, or sheltering behaviors could be altered as a result of noise and other human disturbances, and wildlife could be injured or killed by recreational vehicles. Recreational activities in and adjacent to the plan area could decrease water quality through increased sedimentation or contamination and result in vegetation disturbance or removal, sedimentation, and altered hydrology. Decreasing water quality in the plan area would adversely affect fish and stream-dependent and wetland species. Increased recreation could also cause disturbance and increased harassment of fish and stream-dependent and wetland species.

Restoration activities in stream and riparian areas would have a beneficial effect on fish and stream- and riparian-dependent species by improving habitat quality and quantity. Riparian restoration projects would improve habitat characteristics such as stream temperature, wood recruitment, and food availability. Floodplain reconnection projects would increase habitat quantity and overall aquatic ecosystem health through improved nutrient distribution and flood retention capability. Culvert removals or repairs would increase habitat availability and connectivity. Large wood addition would increase habitat complexity important to many native fish and stream-dependent wildlife.

3.7 Air Quality

3.7.1 Methods

The study area for air quality consists of the areas where air quality could be affected by the proposed action and alternatives, including nonattainment and maintenance areas that overlap the plan area.

For covered activities that have differing intensity across alternatives, the analysis assessed air quality impacts using a modeled activity metric at the years 2023, 2048, 2073, and 2093 to compare the magnitude of air pollutant emissions and corresponding air quality effects, assuming rough proportionality between activity metrics and emissions. For timber harvest activities, reforestation, and young stand management, this analysis used the modeled volume of timber harvest. For road construction, this analysis used the modeled miles of roads constructed. The remaining covered activities would have no or negligible difference in activity intensity among alternatives; the associated emissions processes and pollutant types were qualitatively characterized, as applicable.

3.7.2 Affected Environment

EPA has established national ambient air quality standards (NAAQS) for six air pollutants determined to be criteria pollutants (commonly emitted air contaminants that affect human health), including carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter smaller than 10 and 2.5 microns (PM10 and PM2.5), and sulfur dioxide (EPA 2021a:1-3). Air quality is determined by measuring ground-level ambient (outdoor) air pollutant concentrations over certain time periods.

EPA designates geographic regions as nonattainment areas when measured concentrations of these air pollutants exceed the NAAQS for specific pollutants and time periods, and as attainment areas when pollutant levels are less than the NAAQS. EPA designates former nonattainment areas that have reduced pollutant levels below the NAAQS as maintenance areas. The only nonattainment area in the study area is Lane County for PM10 (moderate). There are no air quality maintenance areas in the study area (EPA 2021b:1).

Some pollutants, particularly particles emitted by fires, can affect air quality by contributing to regional haze and reduced visibility. The Clean Air Act lists other pollutants known as hazardous air pollutants (HAPs), which are pollutants known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. The Oregon Department of Environmental Quality (ODEQ) Air Quality Division implements EPA's air quality regulations, including the NAAQS. ODEQ has delegated smoke management responsibilities to ODF. ODF has developed the *Oregon Smoke Management Plan*, which requires dispersion, dilution, and avoidance techniques to minimize smoke impacts on mandatory Class 1 areas,[1] designated air quality nonattainment and maintenance areas, and Smoke Sensitive Areas.[2] There are no mandatory Class 1 areas or Smoke Sensitive Areas in the study area (ODF 2019:4).

[1] Mandatory Class 1 areas are areas, such as designated Wilderness Areas, identified under the Clean Air Act as requiring the highest level of protection.

[2] A Smoke Sensitive Area is an area that has the highest level of protection under the Oregon Smoke Management Plan due to a history of smoke incidents, its population density, or from a legal protection related to visibility.

ODEQ and Lane Regional Air Protection Agency collect criteria pollutant data from monitoring stations throughout the state. Given the relevance of particulate matter to air quality conditions in the study area, as evidenced by Lane County's PM10 nonattainment status, the analysis evaluated the ambient PM2.5 concentrations from relevant city or area stations[3] to determine if they exceeded the NAAQS PM2.5 24-hour average threshold for the most recent 3 years with reported data (2017–2019). Of the 2,630 days with station data provided, only 54 days (2 percent) experienced a PM2.5 exceedance (ODEQ 2020:69-74).

3.7.3 Environmental Consequences

The types of air quality impacts would be common to all alternatives. All covered activities would use vehicles and equipment that emit air pollutants, including criteria pollutants and HAPs from engine exhaust and fugitive particulate matter (dust) from roads and disturbed earth surfaces. Effects would tend to be localized and specific to the conditions and equipment in use. Timber harvest, reforestation and young stand management, and road system management would result in the highest level of vehicle and equipment use from the covered activities under all alternatives.

Although the level of activities would vary across the alternatives, covered activities would be distributed across the permit area over the analysis period. Vehicle and equipment use typically would be short term and intermittent at any one location, depending on the work schedule and the specific equipment in use. Continued compliance with ODEQ requirements for fugitive emissions (OAR 340-208-0210) would ensure that dust emissions are suppressed with watering or chemical control. Ongoing maintenance of vehicles and equipment would keep equipment emissions in compliance with their emission certification standards. Therefore, these activities are not likely to cause a violation of ambient air quality standards or have an adverse effect on long-term air quality in the study area.

Controlled burning for fire management would cause emissions through the combustion of biomass. Although they have the potential to emit air pollution at sufficient levels to affect locations outside of the permit area, controlled burns are intentionally kept small and controlled and do not affect the overstory and, therefore, do not have regional effects. Continued compliance with required prescribed burning regulations under the *Oregon Smoke Management Plan* would ensure that smoke emissions from controlled burns do not violate ambient air quality standards or impair visibility within or outside of the study area, consistent with the EPA Regional Haze Program and Oregon's Visibility Protection Plan.

3.7.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* that would overlap with impacts of the proposed action and alternatives on air quality. Forest management adjacent to the plan area could include prescribed burns and adjacent agricultural activity could include field burning, which would overlap with the same effects as prescribed burning under the proposed action and alternatives. Adjacent land managers would be required to comply with prescribed burning regulations under the *Oregon Smoke Management Plan* would ensure that smoke emissions from controlled burns do not cause a violation of ambient air quality standards or impair visibility.

[3] The analysis includes the following city or area stations, which best represent the study area: Sweet Home, Grants Pass, Florence, Coos Bay, and Forest Grove.

3.8 Aesthetics and Visual Resources

3.8.1 Methods

Aesthetic and visual resources are all objects (artificial and natural, moving and stationary) and features (e.g., landforms, waterbodies) visible on a landscape. The study area for aesthetics and visual resources consists of areas with views of the plan area and includes areas within 0.5 mile of the plan area that may have foreground views of the plan area.

The analysis evaluates potential effects on aesthetics and visual resources from alteration of existing terrain, vegetative cover, other natural or built features; alteration of the overall visual quality of a site or the region; introduction of incompatible visual elements; elimination of visual resources; and obstruction or permanent reduction of visually important features. The analysis considered changes to waterways, vegetation, and recreational experiences, described in Sections 3.4, *Water Resources,* 3.5, *Vegetation*, and 3.9, *Recreation*, respectively.

3.8.2 Affected Environment

3.8.2.1 Visual Character

The study area's visual landscape comprises mountain ranges covered predominantly with Douglas-fir and mixed conifer forests with a complex understory. There is a complex network of rivers and streams that wind through the landscape to create corridors and canyons of varying sizes, in addition to ponds, lakes, and emergent wetlands. Terrain, evergreen forests, and waterways are the primary features associated with the study area. Forest management activities result in a visual landscape that ranges from dense forested terrain with little views to the forest floor to areas where canopies have undergone clearcutting or thinning for timber harvest and forest management and where terrain, tree stumps, slash, and skid trails can be seen. Other areas are being reforested through plantings and may primarily consist of saplings or even-aged stands, or they may include a mix of mature trees interspersed with saplings. Therefore, views associated with the forest are dynamic.

Natural events, such as wildfires, extreme storms (e.g., ice, wind, snow), and invasive species and disease, can result in large-scale changes to the forest landscape, as described in Appendix 3.2, *Disturbance and Climate Change,* and HCP Chapter 7, *Assurances*. These events lead to forested landscapes and mountains that have some areas with healthy, dense forests; large areas with landscape scars of burnt, blown down, and dying forests; and areas of forest in the process of recovering. Climate change can contribute to slowly changing the visual landscape of the forest not only through severe weather events, but by changing climatic conditions, making forests more compatible for growing different species. This results in a slowly evolving landscape with changing species composition and densities.

This dynamic landscape provides high-quality scenic views, which have been the subject of federal and state actions to create national forests, scenic designations, and natural areas that protect large areas of land (Figure 3.9-1). The study area includes 0.29 mile of designated state bikeways, 15.3 miles of All-American Roads, 2.8 miles of National Scenic Byways, 3.15 miles of state scenic byways, 3.38 miles of Oregon Tour Routes, and 14.4 miles of Federal Wild and Scenic River segments. The plan area contains two designated state scenic waterways: the Nestucca River Scenic Waterway in the Forest Grove and Tillamook Districts and the Nehalem River Scenic Waterway in the Astoria and Tillamook Districts (State of Oregon 2021). Natural areas that protect large areas of land include the Lewis and Clark National Wildlife Refuge; the Willamette, Siuslaw, Umpqua, Mount Hood, and Rogue River-Siskiyou National Forests; Bureau of Land Management lands associated with the Northwest Oregon, Coos Bay, Roseburg, and Medford Districts; and various state, county, and city parks.

The River Democracy Act of 2021 seeks to designate an additional 4,700 miles of rivers throughout Oregon as Federal Wild and Scenic Rivers, which is likely to include rivers in the study area. The Siletz Reservation comprises a very small part of the study area in Lincoln County where several tribal parcels border the permit area and one tribal parcel falls within the plan area near State Route (SR) 410, SR 411, and SR 180, in the general area of Logsden.

Numerous public recreational facilities in the study area, such as campgrounds, multi-purpose trails, and overlooks, as identified in Section 3.9, provide views to the study area. Elevated vantage points offer panoramic scenic vista views and include views over the natural landscape toward the many hills, mountains, and valleys. Waterways, where present, contribute to these scenic views. Population in the study area is largely centralized along major transportation corridors. In the state forests, there are no residential areas that provide views of the plan area. Mostly low-density residential areas border forest lands and have limited views of the plan area.

3.8.2.2 Affected Viewers

Affected viewers are defined by their relationship to the study area, visual preferences, and sensitivity to changes. Visual preferences define the study area’s visual quality, which serves as the baseline for determining the nature and magnitude of visual impacts. A project can affect two overarching groups of viewers: neighbors, who have views *of* an affected area from adjacent areas, and users, who have views *from within* an affected area. Visual sensitivity for neighbors and users ranges from moderate to high based on having shorter- or longer-term views and vested interest in the affected lands. Residents and recreationists tend to have longer-term views and more of a vested interest in views and, therefore, higher visual sensitivity than roadway travelers and workers who tend to have shorter-term views and less vested interest in views (FHWA 2015:5-6–5-10).

3.8.3 Environmental Consequences

3.8.3.1 Vegetation Patterns

As described in Section 3.5, forest management activities (e.g., timber harvest through clearcutting or thinning, reforestation, young stand management, salvage harvest, prescribed burns) would reduce the total area of late-seral forest in the permit area; focus on the removal and retainment of certain-sized tree species to ensure dominance of a specific species; and replant specific species to determine the species composition and speed up reforestation. These practices result in a highly manipulated forest structure with reduced overstory and understory biodiversity compared to forests undergoing natural succession. ODF would continue to manage the forest to create desired forest structure and biodiversity outcomes. In addition, ODF would manage portions of the forest for conservation and not harvest those areas. Under the no action alternative, ODF would continue to avoid harvest in areas occupied by listed species, which would result in protected areas fragmented across the permit area. Protection of large, interconnected patches of late-seral forest for the length of the permit term under the proposed action and Alternatives 3 through 5, would result in a more connected network of conservation lands. However, differences in connectivity would generally not be discernable to viewers. Viewers are accustomed to current forest management practices, where the location of harvest (including areas of clearcut and thinning) fluctuates over time, and this fluctuation would continue under the proposed action and alternatives.

As summarized in Section 3.5, based on modeling, Douglas-fir forests would no longer dominate the study area as western hemlock increases to become equally prominent to Douglas-fir and mixed-conifer forests in the study area by the end of the analysis periods. Based on modeling, the proposed action and all alternatives would result in less mid-seral and more late-seral forests than existing conditions. The no action alternative would have a greater reduction of mid-seral forest and a greater increase in late-seral forest than the proposed action and Alternatives 3 through 5.

Based on modeling, forest stands would become older and have more old-growth forest and complex understory development than current conditions under the proposed action and all alternatives. At the permit-area scale, visual changes to the landscape would result in a gradual shift in forest structure that would not likely be perceptible to viewers that frequent the forest, due to the growth rates of trees. Therefore, visual changes would be most noticeable to a visitor that comes to the forest periodically, and after extended periods of time in between visits, so that the visual shift is more apparent. However, such visual changes are expected and consistent with and typical of what viewers would experience in a forested landscape, which is dynamic by nature.

In general, visual changes under the proposed action and all alternatives would result from localized changes in the landscape where views may become more open and sunnier to more closed and shaded due to forest management activities. In addition, these activities could reduce or remove features such as downed logs, snags, or green trees or introduce new features through plantings and the improvement and development of new recreation facilities. Under the proposed action and all alternatives, ODF would continue to manage forests to protect views in areas identified as visually sensitive, per its forest management plans (FMPs).[1] These areas include lands with established, high-public-use vistas, viewpoints, or natural features; designated campgrounds; and lands visible from urban areas (ODF 2010a, 2010b).

3.8.3.2 Visual Access

ODF would continue to manage the forests in the permit area under the proposed action and all alternatives to preserve and protect the resources surrounding fixed recreational features (e.g., campsites, boat ramps, designated hiking trails). Therefore, ODF would retain visual access to these recreational areas and protect the quality of views associated with them. Changes to visual access would primarily result from the modification of forest road systems (i.e., construction, use, vacating, closure) used for dispersed recreation. These modifications would occur under the proposed action and all alternatives and would cause minor shifts in visual access for recreational viewers using forest roadways for dispersed recreation. Based on modeling, the road network would increase under the proposed action and all alternatives but would increase more under the proposed action and Alternatives 3 through 5 than under the no action alternative (Table 3.1-4). To the extent that this road network is retained and accessible to the public over the analysis period, it would result in potentially greater access for recreational viewers. Some access for recreational viewers may be

[1] Although the proposed action and alternatives would be managed under an updated forest management plan, the updated plan is expected to maintain current protections for visually sensitive areas.

removed due to road closure and vacating under the proposed action and all alternatives. Under Alternative 3, road vacating goals in the RCAs and HCAs could reduce recreational access in these areas compared to the no action alternative.

3.8.3.3 Wild and Scenic Rivers

The Oregon Parks and Recreation Department only allows timber harvest near Wild and Scenic Rivers when topography or existing vegetation would substantially screen changes from view from the river. However, as determined by OAR 736-040-0041 and 736-040-0120, projects may be permitted if vegetation is established that would substantially screen the project within a reasonable timeframe (e.g., 4 to 5 years). In addition, development for public outdoor recreation and resource protection or enhancement projects are permitted to be visible from the river, but the projects must blend into the natural landscape. ODF would continue to manage forest lands near visually sensitive Wild and Scenic Rivers in the same manner under the proposed action and all alternatives. Therefore, it is not anticipated that any of the alternatives would substantially alter or degrade views associated with Wild and Scenic Rivers.

3.8.3.4 Scenic Byways

ODF's current FMPs state that scenic buffers along scenic corridors are in place to protect immediate foreground views from these roadways. These buffers occur within 150 feet of the outermost edge of both sides of the highway and special rules apply to timber harvest in this corridor to retain scenic buffers while maintaining motorist safety (ORS 527.620.18). ODF would continue to manage forest lands near visually sensitive scenic byways in the same manner under the proposed action and all alternatives. Therefore, it is not anticipated that any of the alternatives would substantially alter or degrade views associated with scenic byways.

3.8.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* that would overlap with impacts of the proposed action and alternatives on aesthetic and visual resources. Increased frequency, intensity, and duration of disturbance events by climate change could result in large-scale visual changes and landscape scarring from flooding, mudslides, wildfire, and invasive species and disease outbreaks that destroy vegetation and change forest structure. This would degrade visual quality in the study area. Forest management and development adjacent to the plan area and recreational activities in and adjacent to the plan area could degrade the visual character and quality of public views, reduce visual access, or affect scenic resources in the study area. Resource protection, enhancement, and restoration activities would improve the quality of habitat and the visual diversity of views within and adjacent to the study area.

3.9 Recreation

3.9.1 Methods

The study area for recreation covers western Oregon (Figure 3.9-1). This geography captures the supply of recreation on ODF lands in the permit area and other forestlands adjacent to the permit area, including developed recreation sites and areas used for dispersed recreation (i.e., any area where recreation is an allowable use). Western Oregon also captures where most people who recreate in the permit area come from, and the supply of recreation sites on non-ODF public and private lands that are substitutes for or complements to ODF recreation resources.

This analysis identifies how forest and recreation management practices along with their effects on forest characteristics would affect the supply of recreation infrastructure, demand for recreation activities, and the value of recreation in the permit area under the proposed action and alternatives.

3.9.2 Affected Environment

3.9.2.1 Current Inventory (Supply) and Use

Developed Recreation Infrastructure

Developed recreation infrastructure in the study area includes campgrounds, day-use facilities, parking lots, trailheads, boat launches, designated shooting lanes, and interpretive centers on lands managed by federal, state, local, and private landowners (Figure 3.9-1). People use developed recreation infrastructure for hiking, camping, off-highway vehicle (OHV) use, horseback riding, target shooting, fishing, hunting, foraging, wildlife viewing, picnicking, biking, and scenic driving. The permit area includes 82 ODF-managed developed recreation sites. Most sites are in the Astoria, Forest Grove, and Tillamook Districts. ODF does not collect and report data from developed sites in the Western Lane, and Southwest Districts sites. The permit area contains approximately 497 motorized and 140 nonmotorized trail miles (Table 3.9-1). On a per-acre basis, the Forest Grove and Tillamook Districts have the highest density of trail miles, while trail miles are present but much less dense in the North Cascade, Astoria, and West Oregon Districts.

Light janitorial maintenance occurs on many ODF developed recreation sites on a frequent (daily or weekly) basis. More involved maintenance occurs in the fall and spring, after and before the opening of the heavy recreation use season. ODF expects to expand recreation infrastructure in the future to ease some of its existing capacity constraints. Specific capital expansion plans regarding recreation facilities have not been developed. Although ODF-managed lands comprise only about 2.5 percent of the study area (Figure 3.9-1), they play an important role in the overall recreation landscape. This is especially true in the northern portion of the study area where, for example, 44 percent of lands in Tillamook County are managed by the state (USGS 2021). Many visitors consider nearby forest recreation sites to be substitutes when their primary recreation area is closed. The 2016 National Visitor Use Monitoring survey for the Siuslaw National Forest shows that approximately 70 percent of visitors would travel to a different site to participate in a recreation activity if their site was closed, and 67.9 percent of these visitors would be willing to drive over 25 miles to the nearest substitute site (USFS 2021:28).

Figure 3.9-1. Recreation Facilities in the Study Area

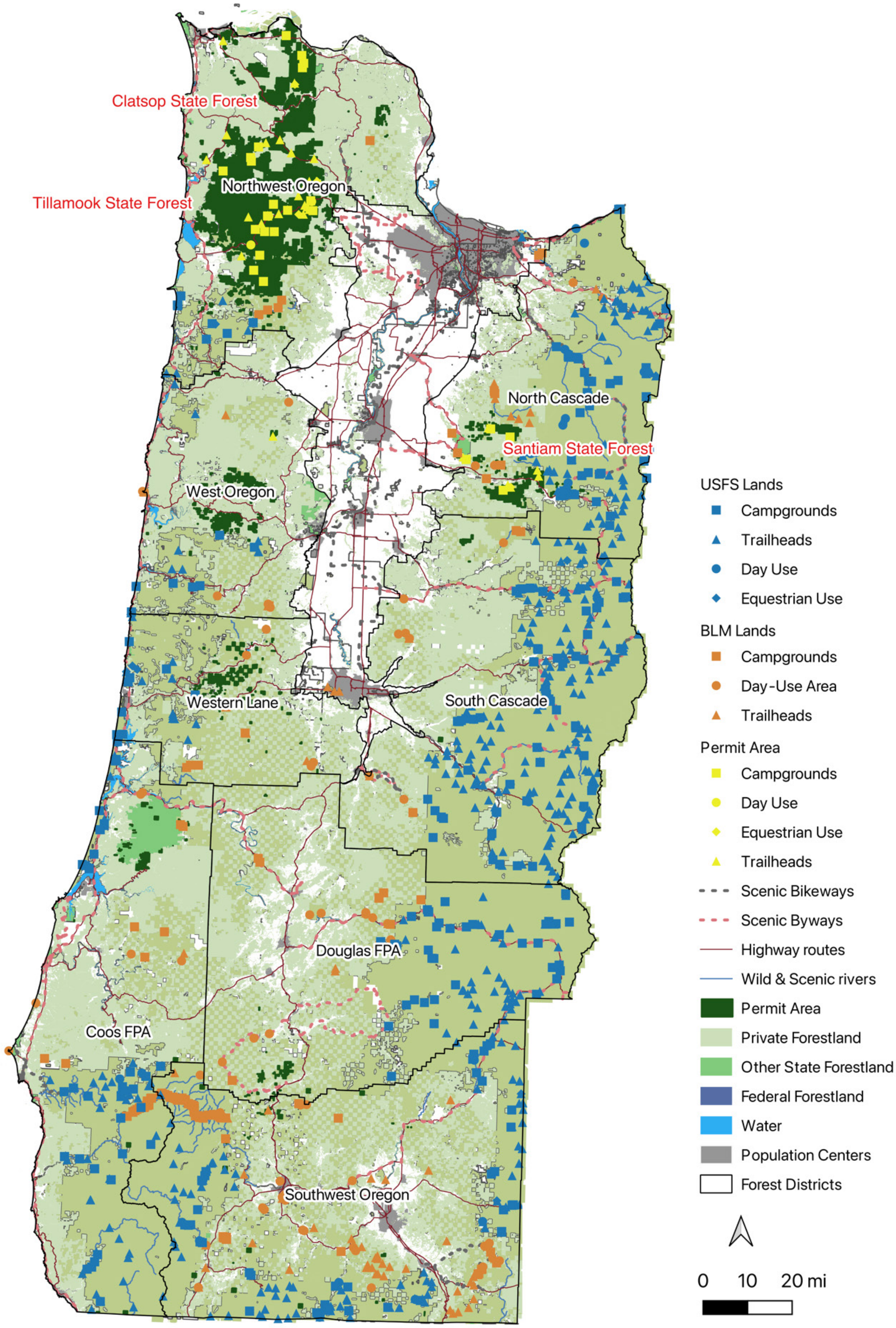


Table 3.9-1. Recreation Facilities and Trail Miles in the Permit Area by ODF District

District	Acres	Number of Developed Sites	Motorized Trail Miles	Nonmotorized Trail Miles	Total Trail Miles per 1,000 Acres
Astoria	137,000	16	25	20	0.33
Forest Grove	115,000	23	99	66	1.44
North Cascade	47,600	13	5	19	0.51
Tillamook	251,000	27	366	27	1.57
West Oregon	53,600	3	2	8	0.18
Western Lane	36,700	-	-	-	-
Southwest	16,800	-	-	-	-
Total	**657,700**	**82**	**497**	**140**	**1.06**

Source: ODF 2020a, 2020b

Dispersed Recreation Activity

The permit area is open to the public and may be used for recreation wherever visitors can access the land. Dispersed recreation activities—occurring on lands often accessible from roads developed for forest management—include hunting, fishing, forest product harvest and collection, OHV use, target shooting, and camping outside designated sites. Dispersed activities primarily occur in the spring and summer, with hunting occurring mostly in the late summer and fall. The most popular areas for dispersed use are located along the corridors of Highway 22 in the Santiam State Forest, Highway 6 in the Tillamook State Forest, and the Nehalem River Road in Tillamook and Clatsop State Forests (Peterson pers. comm.). Dispersed use is heaviest in Tillamook, Clatsop and Santiam State Forests. It likely occurs throughout the entire permit area but is generally more limited on lands where access is more remote, particularly in the Western Lane and Southwest Oregon Districts.

3.9.2.2 Current and Future Use (Demand)

Developed Recreation

ODF tracks recreation use through the collection of user fees. ODF collects fees at developed campgrounds, but generally not at most trailheads and day use sites, so ODF measures level of use primarily by the number of campers in each district. The availability of developed recreation sites is highest in the Tillamook District, with 98 campsites. The North Cascade District has the fewest at 25. Table 3.9-2 shows campground use in 2019 in each of the four districts where data are collected.

Developed recreation facilities typically operate at full capacity during most summer weekends, and at half to three-quarters capacity during summer weekdays. The majority of users either reside within the western Oregon study area, which includes the urban centers of Portland, Salem, and Eugene, or travel from southwest Washington (Peterson pers. comm.). While ODF does not collect visitation data for day use sites, day use visits to six Oregon State Parks near State Forests in the study area show an increasing trend in park usage (Oregon Parks and Recreation Department 2021). Day use visitation across the six parks increased by 36 percent between 2015 and 2019, with the level of use typically highest in July and August and lowest December through February.

Table 3.9-2. ODF-Managed Campsites, Level of Use, and Revenue, Fiscal Year 2019

	Forest Grove District	Tillamook District	Astoria District	North Cascade District
Number of campsites	90	98	61	25
Total campers	9,891	13,281	10,743	549
Total visitor nights	17,383	22,947	15,821	8,089
Total revenue collected from camping fees	**$96,757**	**$133,880**	**$85,958**	**$5,336**

Source: ODF 2019

Dispersed Recreation

Dispersed recreation is heaviest in the northern four districts: Astoria, Forest Grove, Tillamook, and North Cascade. Recreation is less common in the districts of West Oregon, Western Lane, and Southwest Oregon (Peterson pers. comm.). Although ODF does not collect data on dispersed recreation use, it is likely to be highest where access and opportunity are most concentrated and closer to larger population centers, consistent with the use patterns ODF staff observe.

Future Trends in Demand

Demand for forest recreation is increasing overall nationally. Nation-wide participation in some activities (e.g., hiking, equestrian use, and visiting interpretive sites) is increasing while for others it is decreasing (e.g., hunting, fishing, and OHV use) (Cordell 2012:1). Recreation in Oregon has generally followed these trends but registrations for OHVs have increased in Oregon over the last three decades suggesting OHV use may not be on the same declining trend as the rest of the country (Lindberg and Bertone-Riggs 2015:2–4; ODFW 2020:3).

3.9.2.3 Recreational Use Value and Spending

Recreation use of the permit area lands generates economic benefits in two ways: (1) people—especially those traveling from outside the study area—spend money in local communities that supports employment and income (White 2017:1); and (2) people enjoy value from their experience in excess of what they spend to participate. The latter value is called consumer surplus and reflects the range of benefits one might enjoy from engaging in outdoor recreation such as the inherent value placed on aesthetic beauty or the enjoyment of a wilderness experience (Rosenberger 2018:4). Per-trip spending and consumer surplus vary by activity. Spending on things like gas, food, and supplies ranges from about $12 to $30 per person per trip, with backpacking at the low end and hunting at the high end. Consumer surplus—the additional value people enjoy from their experience—ranges from about $25 to $140 per trip, with backpacking at the low end and mountain biking and nonmotorized boating at the high end (Rosenberger 2018; White 2017).

Forest composition can affect the consumer surplus value people derive from their experience. Some users, particularly those who engage in hiking, camping, backpacking, and wildlife viewing, tend to favor (i.e., more highly value) old-growth forests or forests with fewer signs of visible disturbance from timber harvest activities (Shelby et al. 2005; Kearney et al. 2010; Boxall and Macnab 2000). Hunters may experience relatively less loss in value from timber harvest disturbance than these other types of users (Boxall and Macnab 2000).

3.9.3 Environmental Consequences

3.9.3.1 Supply of Recreation

Alternative 1: No Action

Access

ODF generally manages harvests to minimize impacts on developed recreation and is expected to continue this practice under the no action alternative. ODF would retain existing roads in the permit area that facilitate recreation access, including roads used for harvest (Table 3.1-5). Depending on timing and location, harvest activities may temporarily restrict access to recreation sites. ODF would develop new spur roads for forest management over the analysis period, primarily in years 1 through 25 (Table 3.1-4). This increase in road miles could expand access, particularly for dispersed recreation where new roads are retained and left open to the public.

Facility Maintenance and Development

Under the no action alternative, ODF would retain existing recreation infrastructure according to its current plans and operating practices. Development of new recreation facilities would occur subject to recreation management plans, forest management practices, and budget constraints. ODF has no restrictions on where future recreation infrastructure may be sited, though they generally steer development of recreation facilities other than trails and boat ramps outside of riparian areas.

Alternative 2: Proposed Action

The types of effects on the supply of recreation under the proposed action would be the same as described for the no action alternative.

Access

Under the proposed action, ODF would retain existing roads in the permit area that facilitate recreation access, including roads used for harvest (Table 3.1-5), to developed recreation sites and would build new roads that may be used to access dispersed recreation areas (Table 3.1-4). Based on modeling, total road miles would increase under the proposed action relative to the no action alternative. To the extent that this road network is retained and accessible by the public over the permit term, it would increase recreation access in the permit area compared to the no action alternative.

Facility Maintenance and Development

Conservation Action 10 has the potential to delay annual maintenance of public recreation facilities in the spring by limiting when heavy construction activities may occur. This could temporarily reduce access to developed recreation sites during the early part of the season when use is less intense. Because developed recreation sites are more concentrated in the Tillamook and Forest Grove Districts, this impact is more likely to occur in those areas.

Conservation Action 12 would restrict siting of certain recreational infrastructure in RCAs and HCAs. Restriction of new target shooting lanes HCAs would affect the location of new lanes but is unlikely to reduce the number built compared to the no action alternative. Prohibition of new recreational facilities other than boat ramps and trail segments and limitations on nonmotorized trails within 35 feet of water and motorized trails in broader RCAs would affect location of these facilities and reduce access near water but is not expected to affect the overall supply compared to the no action alternative.

Alternative 3: Increased Conservation

Effects on the supply of recreation under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except for the following. More stringent requirements related to road vacating could reduce operational roads in the HCAs and RCAs compared to the proposed action and no action alternative, which could reduce recreational access in those areas. Wider RCAs on some stream types may also further limit the siting of motorized trails near streams.

Alternative 4: Reduced Permit Term

Effects under Alternative 4 compared to the no action alternative would be the same as the proposed action through year 50.

Alternative 5: Increased Timber Harvest

Effects on the supply of recreation under Alternative 5 compared to the no action alternative would be the same as described for the proposed action, except for the following. Based on modeling, the miles of roads used for harvest would increase, which could further increase access to dispersed recreation (Table 3.1-5). The reduced area of HCAs would limit effects of Conservation Action 12 restrictions on the location of target shooting lanes compared to the proposed action.

3.9.3.2 Quality or Value of Recreation

Alternative 1: No Action

Changes in forest structure and composition during the analysis period would affect how and where people enjoy recreation in the permit area. This would affect the value of the recreation in both developed and dispersed settings. Under the no action alternative, ODF would minimize harvest activities and protect views associated with developed recreation sites, including viewpoints and campgrounds, minimizing the impact of forest management activities on the quality of recreation experiences (Section 3.8, *Aesthetics and Visual Resources*). Restrictions on the type and intensity of management activities around Wild and Scenic Rivers and Scenic Byways would also maintain the existing quality of recreation related to protected river corridors and scenic routes (Section 3.8).

Depending on where harvest occurs and where forests are allowed to mature, recreation use and value may change over time and across the permit area. Under the no action alternative, based on modeling, forest stands, on average, would become older and have more old-growth forest and complex understory development than existing conditions. This would likely increase the value of recreation for people who hike and backpack.

Where clearcut harvest occurs, it would remove mid- to late-seral forest stands and reduce downed wood, adversely affecting wildlife species that depend on this habitat type during at least part of their lifecycle. Similarly, reforestation would benefit species dependent on early-seral habitat where it occurs. Based on modeling, late-seral and early seral forests would increase over the analysis period, which would benefit species dependent on these habitats over the analysis period. These effects could have both beneficial and adverse effects on wildlife watching and hunting of species like elk and deer that depend on a variety of habitat.

Based on modeling, habitat for listed terrestrial species would increase, which would benefit some species populations. However, habitat fragmentation and lack of monitoring and adaptive management could result in adverse impacts (Section 3.6, *Fish and Wildlife*). Overall, adverse impacts on recreation would be limited since encounters with listed terrestrial species are already rare. However, when encounters occur, they may be highly valuable—especially when people know what they are looking at—because of their rarity.

The no action alternative would adversely affect most fish species of recreational value by degrading habitat quality through temperature increases, sedimentation, and lowered wood recruitment in river passages without riparian buffers (RMAs) (Section 3.6). Decline in habitat quality could adversely affect participation in, and the value of, recreational fishing in the permit area. Restrictions on timber harvest and management activities would benefit habitat quality inside RMAs. Harvest, road development, and other management activities could produce short- and long-term localized beneficial and adverse changes in water quality. Overall, this would have a minimal effect on the quality of water-based recreation.

As forest structure changes over time across the permit area, the location of recreation activities could shift geographically. Localized changes could occur in the type and amount of recreation use in the permit area. Overall levels of recreation activity throughout the permit area would be more heavily influenced by factors other than forest management, including demographic changes and availability of substitute recreation resources.

Alternative 2: Proposed Action

The types of effects on the visual quality of the landscape for developed recreation sites and scenic routes would be the same as described for the no action alternative. ODF would continue to manage the forest to maintain the landscape in visually sensitive areas like campgrounds and established hiking trails.

Clearcut harvest and reforestation would have the same effects described for the no action alternative. On average across the permit area, based on modeling, the proposed action would result in younger stands with more mid-seral forests with complex understory development (Section 3.5, *Vegetation*). There would be comparatively less late-seral forest across the permit area and similar amounts of old growth as the no action alternative. On average, this would increase the value of recreation for people who prefer younger stands and reduce the value for people who prefer older stands (e.g., hikers, backpackers). All types of forest would be available for recreation across the permit area, but the spatial distribution of recreation activities may change over time compared to the no action alternative.

Modeled increases in harvest and road construction would increase adverse effects on fish and wildlife, but conservation actions would minimize and mitigate these effects resulting in negligible impacts for most species and beneficial impacts for some species. Continued availability of a variety of habitat with greater habitat connectivity relative to the no action alternative could favor elk and deer populations but is unlikely to result in noticeable changes in hunting opportunities. Beneficial effects on habitat for most fish species of recreational value (e.g., steelhead) would benefit recreational anglers through increased quality of fishing. Similar to the no action alternative, the proposed action would produce both beneficial and adverse impacts on water quality, which would have minimal impacts on water-based recreation. Similar to the no action alternative, localized changes in forest structure would shift recreation use geographically, but overall changes in recreation would depend on other factors like demographic shifts and trends in recreation preferences.

Alternative 3: Increased Conservation

Effects of Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that expanded riparian protection could improve water quality and habitat for aquatic species that would experience a beneficial impact under the proposed action. Depending on the localized effects, this could improve the recreation experience for users downstream engaged in water-based recreation and fishing compared to the proposed action and no action alternative.

Alternative 4: Reduced Permit Term

Effects under Alternative 4 compared to the no action alternative would be the same as described for the proposed action through year 50.

Alternative 5: Increased Timber Harvest

Effects under Alternative 5 compared to the no action alternative would be similar to those described for the proposed action. All types of forest stands would be available for recreation users. Increased harvest would increase related adverse effects on fish and wildlife but is not anticipated to result in noticeable differences in effects on fishing, hunting, and wildlife viewing. While the distribution of recreation activities may change compared to the proposed action with differences in timing and location of harvest activities, the overall impact on recreation would be similar.

3.9.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions,* that would overlap with impacts of the proposed action and alternatives on recreation resources.

Increased frequency, intensity, and duration of disturbance events (e.g., flooding, mudslides, wildfire, and invasive species and disease outbreaks) with climate change could result in large-scale visual changes and landscape scarring, temporarily reducing access to developed sites and dispersed recreation areas and affecting the quality of recreation activity across the permit area.

Forest management and development adjacent to the plan area could affect visual, habitat, and water resources that influence the quality of recreation within the plan area.

Recreation infrastructure development or habitat change on lands adjacent to the plan area could shift where people prefer to recreate, raising or lowering the relative value of recreation in the plan area compared to nearby sites. Increased demand for recreation activities and development of the outdoor recreation sector in western Oregon would increase supply of recreation in the study area.

Resource protection, enhancement, and restoration activities would improve the quality of habitat and visual resources, thereby increasing the quality of recreation opportunities.

3.10 Cultural Resources

3.10.1 Methods

For purposes of this analysis, cultural resources are defined as archaeological resources, buildings, structures, districts, objects, and traditionally important places on the landscape. These resources may be historic properties as defined in 36 CFR 800, listed on a state or local historic register, or identified as being important to a particular group through consultation. Section 3.11, *Tribal Resources*, further considers effects on other resources of cultural importance, such as traditionally important plants and animals.

The study area for cultural resources is also known as the area of potential effects (APE). APEs associated with a potential undertaking (such as the proposed incidental take permits [ITPs]) are defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR 800.16(d)). The APE for this undertaking encompasses the plan area, which is where covered activities under the proposed action and alternatives would result in ground disturbance or other impacts.

The study area covers several climatic and geological zones ancestrally used by numerous bands and tribes in the region. Many descendants of these groups are affiliated with federally recognized tribes throughout the Pacific Northwest. NMFS is engaging in consultation with the following tribes: the Elk Valley Tribe; Burns Paiute Tribe; Coquille Indian Tribe; Cow Creek Band of Umpqua Tribe of Indians; Cowlitz Indian Tribe; Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians; Confederated Tribes of the Grand Ronde Community of Oregon; Klamath Tribes; Shoalwater Bay Tribe; Confederated Tribes of the Siletz Indians of Oregon; Smith River Rancheria; Confederated Tribes of the Umatilla Indian Reservation; Confederated Tribes of the Warm Springs Reservation; Confederated Tribes and Bands of the Yakama Nation. For more information, see Section 3.11, Appendix 3.11, *Tribal Resources Technical Supplement,* and Appendix 3.10, *Cultural Resources Technical Supplement*.

This analysis evaluates potential effects of the proposed action and alternatives on cultural resources in the APE under NEPA. It does so by considering the locations of known or potential precontact and historic archaeological sites and built resources relative to the type and extent of management activities considered under the proposed action and alternatives. The evaluation also considers the existing regulations, policies, and procedures in place to mitigate effects.

3.10.2 National Historic Preservation Act Consultation

Compliance with Section 106 of the National Historic Preservation Act, as amended, is required by law for all federal undertakings. In this case, the federal undertaking is issuance of ITPs for the covered activities. Section 106 requires federal agencies to consider the effects of the undertaking when there is a potential to affect a historic property—a district, site, building, structure, or object—that is listed in, or eligible for listing in, the National Register of Historic Places (NRHP). Section 106 contains specific consultation requirements with certain parties such as the State Historic Preservation Officer (SHPO), affected tribes, and individuals and organizations with a demonstrated interest in the undertaking. NMFS has elected to substitute the NEPA process for the Section 106 review process for this undertaking and has notified the Advisory Council on Historic Preservation (ACHP) and SHPO, as required under 36 CFR 800.8(c).

Section 106 correspondence is summarized below and presented in Appendix 3.10.

- August 6, 2021: NMFS submitted a letter to Oregon SHPO to initiate Section 106 review for the undertaking, notify them that the NEPA process would be used in lieu of the standard Section 106 review process, and designate a delegee for consultation.
- September 29, 2021: NMFS submitted letters to 14 tribes to initiate Section 106 consultation for the undertaking.
- October 15, 2021: NMFS submitted to the ACHP a letter similar to the Oregon SHPO letter.
- November 26, 2021: NMFS submitted a letter to the Oregon SHPO regarding the Finding of Effects determination for the undertaking.

On January 29, 2021, prior to publishing the Notice of Intent to prepare an EIS, NMFS contacted nine tribes through outreach letters.

3.10.3 Affected Environment

This section describes known archaeological and built environment resources in the APE. To provide further context about the cultural setting of the APE, a precontact, ethnographic, and historical context statement is provided in Appendix 3.10. As of the writing of this document, no Traditional Cultural Properties or other cultural resources of traditional importance have been identified by the consulting tribes.

3.10.3.1 Archaeological Resources

There are 164 previously conducted archaeological investigations documented on the Oregon SHPO's Oregon Statewide Inventory associated with the APE. Many of these studies are the result of timber sale surveys. The surveys for these sales were only conducted for sample portions of the sale areas. The majority of the areas surveyed are outside of the APE. Appendix 3.10, Table 1, lists the results of these studies.

There are 23 previously documented archaeological resources identified within the APE. Of these, eight were precontact lithic scatters. Another 14 of the resources were historic, including homesteads, mining and logging camps, railroad grades, and an historic cemetery, which contains up to 26 individuals. One surface-exposed midden contained both precontact and historic-age artifacts. None of the resources identified has been evaluated for listing in the NRHP. Appendix 3.10, Table 2, describes these previously documented resources.

3.10.3.2 Built Environment Resources

Within the APE, record searches identified five built environment resources categorized as NRHP eligible/contributing.[1] These resources include the Yunker & Wicks Logging Camp, Camp Nehalem, the architectural ruin of Hembre Lookout, West Creek Skid Road Tunnel, and portions of the Port of Tillamook Bay Railroad (Oregon Historic Sites Database 1966, 1992a, 1992b, 1992c, 2009). A portion of the Applegate route, a section of the California National Historic Trail, intersects with the

[1] No properties were listed as unevaluated.

APE east of Interstate 5 north of Sunny Valley, Oregon; this section of the trail has been assumed eligible for listing in the NRHP for the purposes of this analysis, but existing documentation does not specify if the portion of the trail in the APE retains historic integrity or is designated as part of the California National Historic Trail for commemorative purposes only (National Park Service National Trails Intermountain Region 2017; NPS 2019). Additional built environment resources that are 50 years old or older but are not currently identified and recorded could be present in the APE. Appendix 3.10, Table 3, lists the five previously documented built environment resources identified in Oregon Historic Sites Database with location, year built, and eligibility status.

3.10.4 Environmental Consequences

ODF's forest and recreation management activities under the proposed action and all alternatives, including the no action alternative, would cause ground disturbance or changes to the setting and have the potential to result in adverse effects on cultural resources. These potential effects on cultural and historic resources would be similar under all alternatives. Although the precise location and timing of the activities may differ depending on the alternative, ODF would consistently follow the applicable federal and state regulations and ODF policies and procedures described below.

ODF policy is to preserve and protect archaeological and cultural resources and sites during forest management activities according to state law and the Memorandum of Agreement between ODF and SHPO (ODF 2002). ODF's procedures relating to cultural resources are outlined in the *ODF Procedure Document Cultural Resources – Review and Protection*, which requires, prior to any ground-disturbing activity on State Forest lands, coordination with a qualified archaeologist to ensure known cultural or archaeological resources are not disturbed or damaged (ODF 2016b). This procedure document describes the responsibilities of ODF staff for cultural resources review and protection as part of annual operations planning as well as projects outside of annual operations planning. ODF complies with the following agency guidance documents related to inadvertent discovery of a cultural resource: *Inadvertent Discovery of Archaeological Resources and Human Remains During Emergency Operations* (ODF no date[a]) and *Inadvertent Discovery of Archaeological Resources and Human Remains During Non-Emergency Operations* (ODF no date[b]). ODF also complies with the *Cultural Resources Handbook for Operations Planning on Oregon's State Forests* (Barnes 2008).

Potential effects on cultural resources from forest and recreation management activities under the proposed and action alternatives would be similar to under the no action alternative. In addition, ODF will follow applicable regulations, policies and procedures under all alternatives. For these reasons, the proposed action and action alternatives would not result in effects on cultural resources that differ from those that would occur under the no action alternative.

3.10.5 Trends and Planned Actions

As discussed in Section 3.10.4, *Environmental Consequences*, the proposed action and alternatives would have no effect on cultural resources compared to the no action alternative. Therefore, the proposed action and Alternatives 3, 4, and 5 would not have the potential for overlapping effects with the effects of reasonably foreseeable trends and planned actions.

3.11 Tribal Resources

Western Oregon has long been inhabited by Native American peoples. Through treaties, executive orders, judicial decisions, and legislation, the tribes ceded most of their territory to the United States. Treaties reserved certain rights, such as hunting, fishing, and gathering in their usual and accustomed grounds and stations, including ancestral lands that lie outside their reservations. This section identifies the tribes potentially affected by the proposed action and alternatives and their ancestral and current relationships to the region. This section highlights the United States' trust responsibilities and the relationships with the tribes over the years and stresses the importance of tribal perspectives.

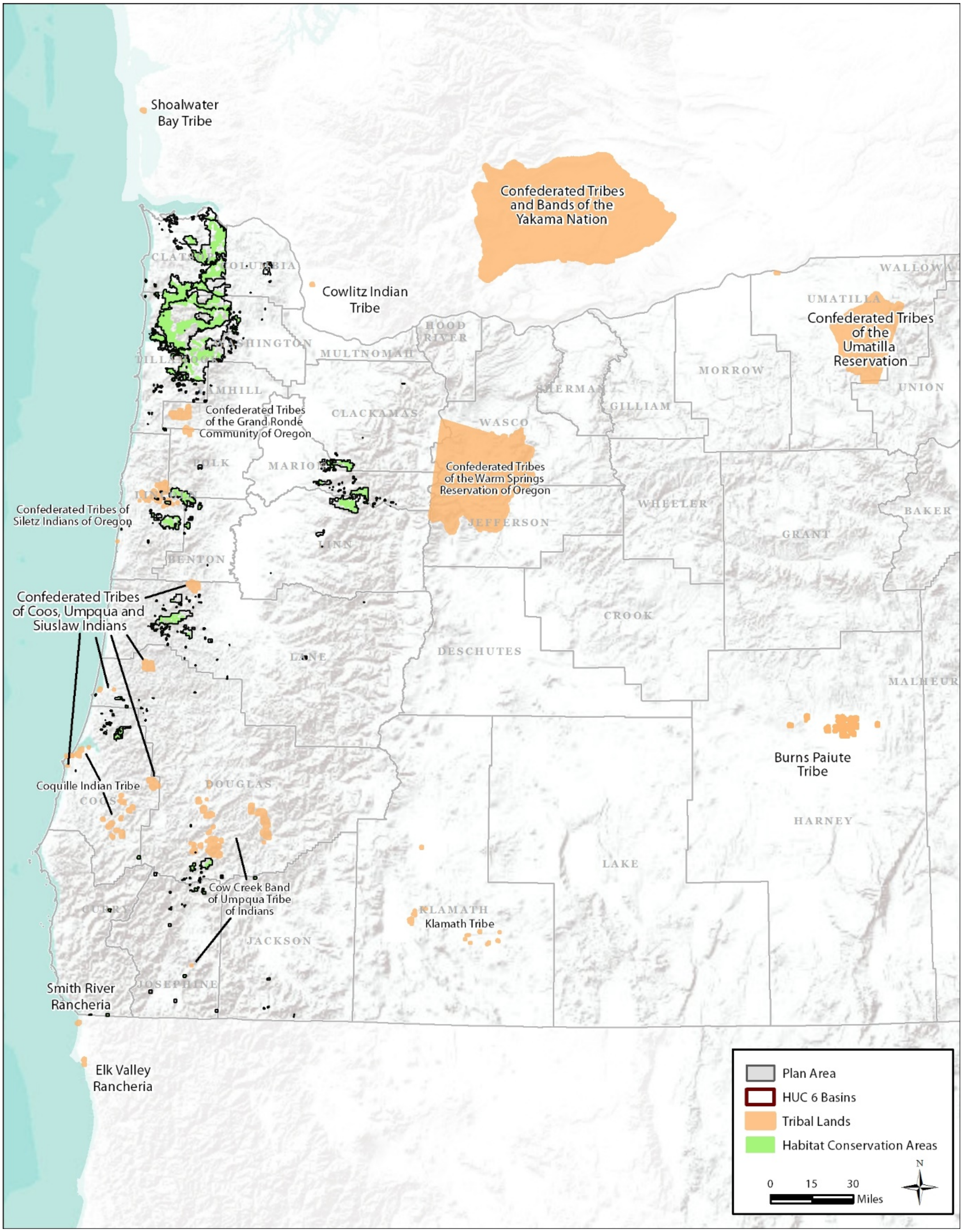
The Services recognize the sovereign status of tribal governments and the obligation to offer pre-decisional government-to-government consultation. NMFS's policies are to offer government-to-government consultation at the earliest practicable time it can reasonably anticipate that a proposed policy or initiative may have tribal implications (NMFS 2013). This means tribal consultation must include "early notification, early opportunities for technical briefings/discussions, and an opportunity for formal input in the Federal process to the extent practicable and consistent with Federal law." It is NMFS's obligation to provide early notice of such actions and provide opportunity for meaningful input from interested tribal nations. The Services recognize that each federally recognized tribe is unique and sovereign and may have different treaties and other agreements with the United States (NMFS 2013; DOI 2011). NMFS, on behalf of the Services, has sought and continues to seek involvement of the tribes to gain understanding of the tribes' perspective on potential impacts of the proposed action and alternatives and tribal management of the resources that may be affected.

As the lead federal agency under NEPA and for consultation under the National Historic Preservation Act (Section 3.10, *Cultural Resources*), NMFS is leading consultation with 14 potentially affected tribes on behalf of FWS as a cooperating agency. NMFS will continue to interact with the tribes to identify those aspects of the proposed action and alternatives with the potential to affect tribal resources, tribal rights, and Indian lands. Appendix 3.10, *Cultural Resources Technical Supplement*, presents copies of Section 106 consultation with the tribes; Appendix 3.11, *Tribal Resources Technical Supplement*, presents letters NMFS sent to tribes outside of the Section 106 process.

3.11.1 Methods

The study area for tribal resources encompasses the area where the proposed action and alternatives could affect tribal cultural use and access to natural resources. Specifically, the study area comprises fish and wildlife species occupying lands, rivers, and streams that may be affected by land disturbances, changes in access to areas, and changes to use of forest resources in the plan area under the proposed action and alternatives. The study area includes portions of trust lands, ceded ancestral lands, and reserved treaty rights to usual and accustomed grounds and stations of 14 federally recognized tribes (study area tribes). Figure 3.11-1 shows locations of the tribal reservations and trust lands within and adjacent to the plan area. Ancestral use covers all of western Oregon, and treaty-ceded lands are not mapped.

Figure 3.11-1. Tribal Reservations and Trust Lands in the Study Area



The description of the affected environment for tribal resources was based on a review of information about the tribes and their ancestral, current, and future use of resources in the study area that could be affected by the proposed action and alternatives. To support the consultation process, the analysis describes effects of the proposed action and alternatives on resources relevant to the tribes.

Consultation is being conducted in accordance with Executive Order 13175, Department of Commerce Administrative Order 218-8, NOAA Procedures for Government-to-Government Consultation with Federally Recognized Indian Tribes and Alaska Native Corporations (November 13, 2013), and U.S. Fish and Wildlife Service Native American Policy (January 20, 2016), described in Appendix 3.1-A, *Regulatory Environment*.

3.11.2 Affected Environment

This section describes tribal coordination, provides an overview of the study area tribes' treaties and federal recognition, and summarizes tribal resources based on past, current, and anticipated use of the study area.

3.11.2.1 Tribal Coordination

NMFS contacted all study area tribes to offer consultation. These tribes are listed in Table 3.11-1 along with the location of their trust lands.

Table 3.11-1. Overview of Indian Tribes Contacted by NMFS

	Location Trust Lands	
Tribe	**Region**	**Oregon, Washington, California Counties**
Confederated Tribes of the Grand Ronde Community of Oregon	Western Oregon	Yamhill and Polk Counties in Oregon
Confederated Tribes of Siletz Indians of Oregon	Western Oregon	Lincoln County in Oregon
Coquille Indian Tribe	Western Oregon	Coos County in Oregon
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians	Western Oregon	Lane, Douglas, and Coos Counties in Oregon
Cow Creek Band of Umpqua Tribe of Indians	Western Oregon	Douglas County in Oregon
Klamath Tribes	Southern Oregon	Klamath County in Oregon
Confederated Tribes of Warm Springs	Central Oregon	Wasco, Jefferson and Clackamas Counties in Oregon
Confederated Tribes of the Umatilla Reservation	Eastern Oregon	Umatilla County in Oregon
Burns Paiute Tribe	Eastern Oregon	Harney County in Oregon
Confederated Tribes and Bands of the Yakama Nation	Central Washington	Yakima and Klickitat Counties in Washington
Shoalwater Bay Tribe	Southwest Washington	Pacific County in Washington
Cowlitz Indian Tribe	Southwest Washington	Cowlitz County in Washington

Tribe	Location Trust Lands	
	Region	Oregon, Washington, California Counties
Smith River Rancheria	Southern Oregon and Northern California	Del Norte County in California
Elk Valley Rancheria	Northern California	Del Norte County in California

BIA = Bureau of Indian Affairs; PL = Public Law

Coordination and information sharing with the tribes included but was not limited to the following.

- Initial consultation letter informing tribes of the intent to prepare an EIS and inviting them to an information-sharing webinar (January 2021). These letters are presented in Appendix 3.11.
- General informational webinar with tribes to initiate consultation (February 24, 2021). The Coquille Indian Tribe; Cow Creek Band of Umpqua Tribe of Indians; Confederated Tribes of Grande Ronde Community of Oregon; Confederated Tribe of Coos, Lower Umpqua, and Siuslaw Indians; and FWS were in attendance.
- Communication with Tim Suto, Bureau of Indian Affairs (September 7, 2021) and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians for location of Indian trust lands in the study area (email from Colin Beck, Forester, Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, August 30, 2021).
- Email correspondence to Jason Robison, Natural Resources Director with the Cow Creek Band of Umpqua Tribe of Indians for additional information about natural resource use by tribal members [email sent August 24, 2021]. Email was sent to this tribe for additional information as the website for the tribe did not have documents for reference.
- Sharing of a preliminary description of the affected environment for tribal resources on December 28, 2021, in response to request to review.

3.11.2.2 Northwest Indian Treaties and Federally Recognized Tribes

This section provides an overview of the study area tribes' resources. Appendix 3.11 provides details on each tribe, including its organization, federal recognition, ratified and unratified treaties, ceded lands, treaty reserved rights, case law, federal trust doctrine, and use of study area resources.

The tribal organizations in the study area include bands, tribes, and confederations of tribes. The term *tribe* is used generally when referencing a tribal entity, recognizing that many of the Oregon tribes are a confederation of multiple bands and tribes with, in some cases, different backgrounds and differing uses of cultural and natural resources in the study area.

Northwest Indian treaties and federally recognized tribes in the study area include tribal groups who have used the region from ancestral to contemporary times. The ethnographic and archaeological records support a long and intensive record of habitation in western Oregon; Appendix 3.10 summarizes this record of habitation.

In 1855, Washington Territorial Governor Isaac Stevens, representing the United States, negotiated treaties with many Indian tribes living in the Pacific Northwest, including those with ancestral ties to portions of the study area. Accordingly, these treaty tribes secured both reserved lands on which to live and reserved off-reservation rights for access and subsistence, comprising the collection of fish, game, roots, berries, and forage for their horses. Treaty tribes that have reserved fishing rights on the Columbia River and co-management for the entire Columbia Basin include the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs Reservation, and Nez Perce Tribe of Idaho.[1]

Multiple treaties were negotiated with Oregon Indian tribes and bands from 1853 to 1855. The United States Senate ratified several of these treaties but many commitments made in the treaties were never met. In addition, not all government-negotiated treaties with the tribes were ratified by the United States Senate. In these cases, the majority were never paid for their lands and the tribes were not provided with tribal reservations (Zucker et al. 1983).

The U.S. government ceased recognition of Indian Tribes in 1871, ending the practice of treaty making between the United States and Indian Tribes. Subsequent Indian reservations were generally established and designated by Executive Order, and land adjustments in Indian lands and allotments were made by acts of Congress. The 1855 treaties with northwest tribes established tribal sovereignty status and were sustained by the Indian Reorganization Act of 1933, which offered tribes a road to self-governance. Many, but not all, federally recognized tribes reorganized under this Act.

Passage of the Western Oregon Termination Act (Public Law 83-588) in 1954 terminated federal recognition and lands of five of the tribes west of the Cascade Range: Confederated Tribes of the Grand Ronde Community of Oregon, Confederated Tribes of Siletz Indians of Oregon, Coquille Indian Tribe, Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, and the Cow Creek Band of Umpqua Tribe of Indians. Federal recognition of the Klamath Tribe ended in 1954 with the Klamath Termination Act (Public Law 83-587). Federal recognition was not restored until the 1970s and 1980s. All the western Oregon tribes have programs to restore their land base through federal actions (e.g., Western Oregon Tribal Fairness Act, Public Law 115-103) and land purchases. The tribes are using their expanded land base to reestablish tribal management of these lands. Some of these lands are forestlands managed for forest resources for the benefit of members and the tribe's economic wellbeing. The tribes remain dependent on the management and access of public lands (federal and Oregon state) for fishing, hunting, gathering of cultural plants, and cultural sites. Several tribes have consent decrees with the State of Oregon and the United States of America that define tribal hunting, fishing, trapping, and animal gathering rights on federal and state lands. The consent decrees are implemented through tribal ordinances to provide members' access to cultural hunting and fishing in portions of their ancestral lands.

3.11.2.3 Tribal Resources

Tribal members from all of the study area tribes are closely associated with the natural resources of the region. Many of the tribes have only recently acquired forestlands and, thus, have been and continue to be dependent on access to public lands, including ODF forestlands (Beck pers. comm.). The tribes' traditional cultures are closely tied to abundant populations of fish and wildlife, the availability and access to public lands to gather traditional plants, and other forest resources such as cedar bark and grasses for traditional basketry. Tribal members hunt for deer and elk and fish for salmon and steelhead. Plant life was and remains an important source of food, medicine, and raw

[1] Case law has been used to define the treaty and sovereign rights of tribes in conflicts with the states. *United States v. Washington,* 384 F. Supp. 312 (W.D. Wash. 1974), *aff'd*, 520 F.2d 676 (9th Cir. 1975), commonly known as the Boldt Decision, reaffirmed the rights of tribes to co-manage and continue to harvest salmon and other fish under the terms of the treaties with the United States government.

materials for the making of traditional goods (Long et al. 2018). In addition to gathering huckleberries, blackberries, and blackcaps, other culturally important plants are tarweed, hazel and chinquapin nuts, wild onions, Indian lettuce, acorns, camas, mushrooms, and lambs quarters. Huckleberry patches in the study area are a source of food and medicine to the tribes. Baskets are made of wild-hazel bark, bear grass and maidenhair fern stems. Tribal members have a strong cultural use of plants for medicinal purposes. Snakeweed is used for burns, cuts, and blood poisoning. Mullein leaves are steeped and made into cough syrup. Wild ginger teas cure fevers. Use of raw materials from the forest for the making of traditional goods is an ever-expanding activity promoted by the tribes (Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians no date). Tribal members are teaching new generations of tribal members traditional woodworking skills to continue the traditional construction of canoes from cedar trees and the making of other traditional goods for personal use, sharing, and selling at art galleries (Coquille Indian Tribe 2022; Beck pers. comm.).

The study area tribes also look to the forest for resources that support commercial activity. The tribes with trust forestlands manage their lands for economic value (Coquille Indian Tribe 2022). Tribal forestlands are not large enough to support a timber industry absent harvest on non-tribal forestlands. This includes the management of tribal lands, a market for timber from tribal lands, and a work force to support timber harvest (Beck pers. comm.). The economic value of tribal forestlands is dependent on thriving timber industry supported by ODF forests. Finally, tribal members work in the timber industry supported by ODF forestlands.

3.11.3 Environmental Consequences

This section describes potential effects of the proposed action and alternatives on resources relevant to the tribes (e.g., fish, wildlife, water, and vegetation) by highlighting and building on the analysis of impacts described in those sections with a focus on distinct considerations associated with tribal resources and access, tribal sovereign self-governance, and Indian lands.

3.11.3.1 Fish and Wildlife Species

Alternative 1: No Action

As discussed in Section 3.6, *Fish and Wildlife,* fish populations and habitat have been affected by past forest practices that included removal of in-stream wood, narrow or nonexistent riparian corridor protection, road construction in riparian corridors, road construction methods that led to greater failure and impacts on hydrology and sediment to streams, and inadequate structures at road-stream crossings blocking fish passage to upstream habitats and floodplain habitats. As described in Section 3.6*,* effects on salmonid species (and because of similar habitat use, Pacific lamprey) eulachon, and other fish species would be both beneficial and adverse over much of the permit area. Over the analysis period, forest management activities could increase the amount of fine sediment to streams, locally increase stream temperatures, confine streams, decrease habitat connectivity and beaver activity, decrease steam flows, decrease wood recruitment, reduce canopy cover, and disturb species. Some forest management activities (e.g., road vacating and culvert improvements) would improve habitat connectivity and accessibility for fish. Continuation of existing riparian protections would help filter out contaminants that would otherwise enter the aquatic environment, provide shade to cool stream temperatures, and increase large wood recruitment over the analysis period. However, riparian buffers (RMAs) would not fully protect all riparian ecological functions for fish-bearing streams and ground disturbance from road construction and use would continue input of fine sediments to streams.

As described in Section 3.5, *Vegetation*, and Section 3.6*,* timber harvest and reforestation and young stand management under the no action alternative would be the primary drivers of changes in forest structure and type. Deer and elk utilize all forest stages for various needs. They occupy early-seral stages of the forest for forage while using older late-seral forests for hiding and concealment cover (Kie et al. 2008). Clearcut harvest would remove mid- to late-seral forest in the study area as described in Section 3.5. Reforestation and management for mid-seral forests would result in dense forests with closed canopies and little or simple understory structures. Timber harvest, which would occur on land between sites occupied by federally listed species, would reduce habitat connectivity and result in more perimeter to area and potentially harmful edge effects, negatively affecting deer and elk forage and cover. Removal of late-seral, multilevel forest structure and loss of habitat connectivity would potentially adversely affect deer and elk. However, although harvest activities would affect the amount and distribution of these habitat types over the analysis period, all types would continue to be available in the study area.

The adverse effects of timber harvest would likely occur in each ecoregion but would be more pronounced in the northern portion of the Coast Range (Wilson, Trask, Stott Mountain, Alsea, and Siuslaw wildlife management units), affecting deer and elk harvested by members of the Grand Ronde, Siletz, Coos, Lower Umpqua and Siuslaw, Coquille, and Cow Creek Tribes. Effects would also be adverse, but to a lesser extent, in the Santiam wildlife management unit in the Cascades ecoregion.

Forest roads on state lands provide important access for tribal members to hunting areas, fishing sites, and places for the gathering of plants on state lands and may be used to access tribal forestlands. ODF would retain existing roads in the permit area that provide access for tribal members. Depending on timing and location, harvest activities may temporarily restrict access to recreation sites. ODF generally manages harvests to minimize impacts on developed recreation and is expected to continue this practice. New spur roads would be developed for forest management purposes over the analysis period, primarily in years 1 through 25 (Table 3.1-4). This increase in road miles could expand access, particularly for dispersed hunting opportunities where they are retained and left open to tribal members.

Alternative 2: Proposed Action

The types of effects related to fish and wildlife species used by the tribes under the proposed action would be the same as described for the no action alternative. Based on modeling, timber harvest would increase under the proposed action, increasing associated adverse effects on fish populations, including salmonids, harvested by tribal members. However, as discussed in Section 3.6 and Appendix 3.6, the proposed action would have expanded riparian buffers (RCAs) compared to the no action alternative, which would be more protective of streams and fish populations than the no action alternative by increasing recruitment of large wood to streams over the analysis period. Expanded RCAs would further reduce sediment inputs to streams—providing more shade and, thus, decreasing temperature effects—and improve overall water quality and food for fish. As described in Section 3.6*,* commitments to stream-enhancement projects and fish-passage barrier removals (Conservation Actions 3 and 4) would provide long-lasting beneficial effects on habitat for fish and fish populations and would benefit fish populations and improve access to habitat for fish species that are of cultural value to the tribes or are harvested by tribal members. Projects would be located in areas where covered activities are occurring, with most work focused in the northwest portion of the permit area (i.e., Clatsop and Tillamook State Forests).

As described in Section 3.5, and Section 3.6, the covered activities under the proposed action would have the same types of effects on wildlife species as described for the no action alternative. Based on modeling, overall habitat trends would be similar to those described for the no action alternative, except that the permit area would have fewer large, older trees and more mid-seral forests. Wider riparian buffers would benefit deer and elk populations by providing a greater level of habitat connectivity between riparian corridors used for cover and upland forage areas. HCAs would protect larger, more interconnected late-seral forest habitat than the no action alternative, measured in terms of patch size, distance between patches, and interior to perimeter ratio. This would benefit elk and deer movement through the landscape by providing greater habitat connectivity but would also decrease the amount of edge and open habitat used for forage within the large, protected areas, potentially adversely affecting deer and elk populations.

As under the no action alternative, ODF would retain existing roads in the permit area that provide tribal access to hunting, fish, and gathering sites. Total road miles are expected to increase under the proposed action relative to the no action alternative (Table 3.1-4), which could increase tribal access.

Alternative 3: Increased Conservation

As discussed in Section 3.6, effects on fish and wildlife species used by the tribes under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, except that additional road vacating requirements, including drainage improvements, vacating-related target setting, compliance reporting, and improved best management practices, would increase beneficial effects for fish species. Expanded RCAs under Alternative 3 compared to the proposed action would provide more protected habitat around streams and would be beneficial to fish populations. Expanded RCAs would also benefit deer and elk populations by providing more habitat connectivity between riparian corridors and areas used for forage.

Alternative 4: Reduced Permit Term

Effects on fish and wildlife species used by the tribes under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term. As described under proposed action, most of the changes in habitat occur in the first 25 years.

Alternative 5: Increased Timber Harvest

Effects on fish and wildlife species used by the tribes under Alternative 5 compared to the no action alternative would be the same as described for the proposed action, except that more forest habitat would be affected by timber harvest, since the total acres of HCAs would be reduced.

3.11.3.2 Availability of or Access to Plants

Alternative 1: No Action

As described in Section 3.5, ongoing timber harvest and reforestation and young stand management would be the primary drivers of changes in forest structure and type, which would affect the availability of plants accessed by the tribes. Over the analysis period, clearcut harvest would occur mostly outside of the riparian areas and in a mosaic pattern throughout the permit area. The majority of clearcut harvests would occur in the Tillamook and Astoria Districts and, to a lesser extent, Forest Grove District during the analysis period. Removal of mid- and late-seral forest, the associated multilevel forest structure with harvest, and ground disturbance during harvest would adversely affect understory plants collected by the tribes for food, medicine, and raw materials for cultural goods such as baskets.

Timber harvest would be fragmented within the plan area, potentially limiting the availability of and access to plant species that require large, contiguous areas. Areas occupied by listed species and thus excluded from harvest would experience an increase in understory structure complexity as these areas transition to late-seral forests through the analysis period when compared to existing conditions. Over time, gaps would develop in the canopy as a result of natural disturbance or management activities. These gaps would create opportunities for horizontal growth plants (e.g., vine maple, salal, huckleberries, and beargrass) and vertical growth plants (e.g., western hemlock and Sitka spruce seedlings), increasing availability of these plant species and other species used by tribes that are dependent on late-seral forest.

As described in Section 3.5, clearcut harvest, thinning, salvage, and prescribed burns would occur in a small amount of National Wetland Inventory mapped wetlands (primarily riverine wetlands). This would have an adverse effect on availability of wetland plant species used for baskets (e.g., cattails, sedges, and willows).

Continued implementation of more protective and wider riparian buffers (RMAs) compared to past practices would support more opportunities for riparian-dependent plants used by tribes (e.g., salmonberry and thimbleberry) compared to existing conditions.

As described previously for fish and wildlife species valued by tribes, road access would not change under the no action alternative.

Alternative 2: Proposed Action

The types of effects under the proposed action would be the same as described for the no action alternative. As described in Section 3.5, covered activities would drive changes in forest structure and type. Clearcut harvests would increase compared to the no action alternative throughout the permit term and occur primarily outside of the HCAs and entirely outside of the riparian buffers (RCAs) with most activity in the same districts as under the no action alternative.

Under the proposed action mid-seral forests would decrease over the permit term and late-seral forest would increase compared to existing conditions. However, the amount of mid-seral forest would increase, and the amount of late-seral forest would decrease compared to the no action alternative, so the proposed action would result in fewer large, older trees and less open canopy to promote understory plants of value to tribal members compared to the no action alternative. Management of HCAs for species habitat goals during the first 30 years of the permit term would disturb understory growth, adversely affecting understory plant species of cultural value to the tribes (e.g., huckleberries, native blackberries, beargrass). In HCAs, understory growth and plants used by the tribes would improve later in the permit term with managed gaps in the canopy and gaps created from natural disturbances. Within the proposed action's larger riparian buffers, understory growth would increase over the permit term. There would be a smaller area of late-seral forest over the permit term compared to the no action alternative, reducing the availability of late-seral-dependent plant species. There may be fewer large trees available to the tribes for carvings and canoe construction. However, the amount of old-growth forest would not change under the proposed action compared to the no action alternative.

Effects of clearcut harvest activities on wetland plant species would be the same under the proposed action as the no action alternative, except that affected wetland acreage would be greater.

The proposed action would have an overall beneficial effect on plants valued by the tribes because of increased riparian protections, particularly in the Oregon Coast range, and long-term benefits of large tracts of late-seral forests in HCAs.

Alternative 3: Increased Conservation

Effects on plant resources of cultural importance to the tribes under Alternative 3 compared to the no action alternative would be the same as described for the proposed action, but expanded RCAs would increase the area for plant species dependent on riparian habitat zones and decrease the potential impacts on wetland plant species. There would be a slightly greater decrease in mid-seral forests and a slightly higher increase in late-seral forests (1 percent change for each) over the permit term.

Alternative 4: Reduced Permit Term

Effects on plant resources of cultural importance to the tribes under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on plant species important to the tribes under Alternative 5 compared to the no action alternative would be similar to those described for the proposed action, except that more forest habitat would be affected by timber harvest, since the total acres of HCAs would be reduced. More area would be in mid-seral stage reducing the amount of area with plant species valued by the tribes.

3.11.3.3 Timber Harvest and Available Forest Products

Section 3.12, *Socioeconomics*, describes the economic effects of potential changes in timber harvest and availability of other forest products in the region. In addition to direct jobs and labor income in the logging and milling industries, timber harvest in the permit area supports non-forestry jobs, labor income, value added, and output through indirect and induced effects. Economic activity also arises from collection of other forest products (e.g., moss, evergreen boughs, mushrooms) for commercial and non-commercial purposes. Some of this economic activity could contribute to employment and income for tribal groups. The distribution of employment impacts on tribal groups specifically (like other specific groups) depends on contractual relationships over space and time and cannot necessarily be inferred from aggregate economic effects. See Section 3.12 for more detail on these effects for each alternative.

3.11.3.4 Minor Forest Products

Alternative 1: No Action

Projected increases in late-seral forests over the analysis period under the no action alternative (Figure 3.5-2) would favor plant species that occur in older forests with a more diverse forest structure such as mushrooms, fungi, moss, and some berries. Plant species that prefer open direct sunlight may become less abundant. Timber harvest sites would continue to provide opportunities for firewood collection although access to these sites may change over the analysis period. Construction of spur roads in harvest areas may improve access for collecting minor forest products over the analysis period.

Alternative 2: Proposed Action

Based on modeling, mid-seral forests would increase and late-seral forests would decrease under the proposed action compared to the no action alternative. The more diverse forest would provide greater variety of plant species and opportunities for harvest compared to the no action alternative. Availability of timber suitable for processing as firewood could increase with higher harvest under the proposed action. Further increased construction of spur roads in harvest areas, based on modeling, may further improve access for collecting minor forest products by tribal members compared to the no action alternative.

Alternative 3: Increased Conservation

Effects on minor forest products under Alternative 3 compared to the no action alternative would be the same as the proposed action.

Alternative 4: Reduced Permit Term

Effects on minor forest products under Alternative 4 compared to the no action alternative would be the same as described for the proposed action during the first 50 years of the permit term.

Alternative 5: Increased Timber Harvest

Effects on minor forest products under Alternative 5 would be the same as the proposed action except that increased timber harvest under Alternative 5 would increase availability of timber suitable for processing as firewood.

3.11.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions*, that would overlap with effects of the proposed action and alternatives on tribal resources in the study area.

Climate change will reduce freshwater habitat suitability for fish species and could affect the availability of plant species harvested by tribal members. Increased duration and frequency of severe heat waves and drought will result in tree mortality and decreased tree growth, diminishing suitable habitat for elk and deer in late-seral forests. Droughts and changed seasonality will adversely affect plant species in early-seral forests, altering the availability and quality of forage plants for elk and deer.

Increased frequency, intensity, and duration of disturbance events will have adverse effects on fish habitats and fish populations and will affect forest stand type and structure throughout western Oregon. Wildfires are expected to increase in frequency, intensity, and size, and some areas are likely to burn repeatedly, increasing vulnerability of elk and deer. Depending on wildfire frequency, forage for elk and deer may increase in the study area with increased fire disturbance and new growth following fire. However, fire intensity may adversely affect forest regrowth through sterilizing the forest floor, limiting recovery of open forage. Disturbance events will adversely affect the availability of and access to plant species and access to traditional hunting and fishing areas.

Increased quantities and extent of invasive species would adversely affect fish species through competition and predation. Invasive plant species would exclude traditional plants collected by tribal members.

Forest management, agricultural activities, and development adjacent to the plan area would reduce habitat quality for fish and fish populations and have mixed effects on elk and deer. Forest management may be beneficial to elk and deer by providing early-seral areas for forage. Agricultural activities adjacent to the plan area may cause elk and deer to move out of the forest to forage on agricultural lands and decrease hunting opportunities on ODF lands. Development near the plan area would decrease elk and deer habitat on lands outside of the permit area.

Stream and riparian restoration activities would benefit fish populations available for harvest by the tribes.

3.12 Socioeconomics

3.12.1 Methods

The potential socioeconomic impacts of the proposed action and alternatives would occur at several geographic scales, so this analysis uses multiple study areas. The study areas capture the geography where impacts are likely to occur and where populations that are likely to experience impacts reside. Appendix 3.12, *Socioeconomics Technical Supplement*, provides a more detailed discussion of the rationale for choosing the following study areas.

- **Income and employment**: The study area for impacts on income and employment is the regional economy, defined as western Oregon. This area is sufficiently large to capture the economic relationships between rural areas and urban centers and the majority of economic impacts likely to occur in Oregon. Data are provided at the county level, the smallest geography relevant for this analysis.
- **Government revenue**: The study area for impacts on government revenue corresponds to where timber revenue to government entities flows: the state (e.g., ODF, Oregon Department of Revenue, using relevant accounts as appropriate), counties intersecting the plan area, and taxing districts (e.g., school districts, fire districts).
- **Value of ecosystem services**: The study area for assessing impacts on the supply of ecosystem services is the plan area; the study area for assessing impacts on the demand for and value of these services is western Oregon. The analysis recognizes that demand for ecosystem services could also come from outside this study area, but the western Oregon geography captures the majority of the impact.

Each of the analyses assesses effects of the proposed action and alternatives in terms of direction, magnitude, timing, duration, and populations affected. Unless specified otherwise, all dollar amounts are in 2019 dollars.

- **Income and employment**: This analysis quantitatively evaluates direct impacts on income and employment arising from changes in timber harvest activities in the plan area over the 70-year analysis period. This analysis qualitatively describes effects from recreation activity and a collection of special forest products in the permit area. The forest model computes timber quantity and net harvest value, which are used as inputs to this analysis (Appendix 3.1-B, *Forest Model Description*). The analysis uses standard relationships between volume harvested and labor to quantify direct employment impacts, reported as average annual employment over decadal increments for the analysis period. The IMPLAN model quantifies secondary employment impacts (i.e., economic impacts that occur as money associated with direct impacts circulates through the economy, producing additional employment and income). Because IMPLAN is a static model of an economy, it is limited in the precision with which it can estimate impacts, particularly over time. To address this, the analysis reports secondary impacts for the first decade of the analysis period only. Secondary impacts include both indirect and induced effects. Key-informant interviews and other qualitative information supplement quantitative results to provide context and help clarify areas of uncertainty. Appendix 3.12 presents detailed methods and results for the quantitative analysis of income and employment.

- **Government revenue:** This analysis estimates impacts on government revenue in the study area over the analysis period. It uses output from the forest model, spatial data identifying tax districts and tax codes, and regulatory guidance dictating revenue distribution to quantify impacts at the tax-district, county, and state levels.
- **Value of ecosystem services:** Ecosystem services are the goods (e.g., firewood, mushrooms) and services (e.g., clean water, carbon sequestration, spiritual meaning) the ecosystem provides that people value. This analysis qualitatively assesses impacts on the value of ecosystem services. It identifies how changes in the availability and quality of ecosystem services in the study area (as described in other sections of the EIS) would affect their value, and whether the proposed action and alternatives are likely to affect demand for any ecosystem good or service.

3.12.2 Affected Environment

This section provides an overview of existing socioeconomic conditions in the study area, together with projected population and demographic trends over the analysis period. Much of the available data represent socioeconomic conditions in 2019 before the pandemic and the economic disruption of 2020. After deep declines in employment and disruptions due to the pandemic in income in 2020, these trends are reversing, though the pace of recovery varies by geography, sector, and wage (e.g., high-wage jobs experienced less decline and are closer to February 2020 levels than low-wage jobs). Short-term and medium-term economic trends remain uncertain due to the continuation of economic impacts from the pandemic (Lehner 2021).

3.12.2.1 Population

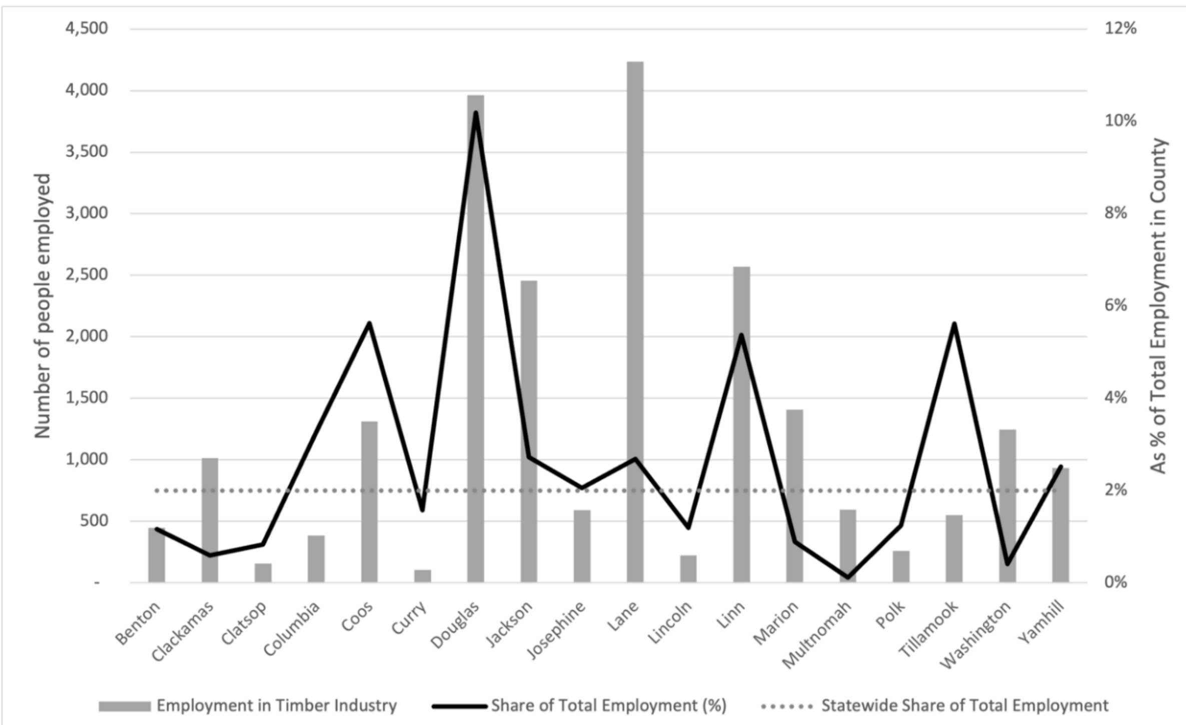
Oregon’s population was 4.1 million in 2019, an increase of 8 percent compared to 2010, and is expected to grow to 5.2 million by 2045 (U.S. Census Bureau 2010, 2021a; Portland State University 2021). The majority (87 percent) of Oregon’s population lives in the study area. Multnomah, Washington, and Clackamas Counties make up the largest share of the total state population (44 percent) as of 2019 (U.S. Census Bureau 2021a). Between 2019 and 2060 the population is expected to grow in every county except Coos, with the Portland metropolitan area and mid-Willamette Valley counties expected to grow the most (Portland State University 2021). Appendix 3.12 provides additional details on historical and future population growth in the study area.

3.12.2.2 Income and Employment

In 2019, approximately 2.6 million people aged 16 years and older were employed either full-time or part-time in the state of Oregon (U.S. Bureau of Economic Analysis 2021a). Employment in Oregon grew 20 percent between 2010 and 2019 and unemployment was low at 3.7 percent in 2019 (U.S. Bureau of Economic Analysis 2021b; U.S. Bureau of Labor Statistics 2021). Approximately 88 percent of Oregon’s employment lies in western Oregon with half of it (51 percent) concentrated in the Portland metropolitan area (Multnomah, Clackamas, and Washington Counties) (U.S. Bureau of Economic Analysis 2021a). Of the remaining 15 counties in the study area, most had a higher unemployment rate than Oregon and a lower median household income than the statewide median in 2019 (U.S. Bureau of Labor Statistics 2021; U.S. Census Bureau 2021b). Oregon’s median household income—where half of the households earn more while the other half earn less—was approximately $63,000 in 2019 (U.S. Census Bureau 2021b). Top sectors for employment in the study area are health care and social assistance, government, retail trade, manufacturing, and accommodations and food services (U.S. Bureau of Economic Analysis 2021a).

Statewide, about 2 percent of employees (about 32,700) are in the timber and related industries (i.e., forestry and logging, wood products manufacturing, and paper manufacturing industries), a rate that held steady between 2010 and 2019 (Daniels and Wendel 2020). As Figure 3.12-1 shows, compared to the 2 percent statewide share, employment in timber and related industries is higher in Columbia, Coos, Douglas, Jackson, Lane, Linn, Tillamook, and Yamhill Counties (Daniels and Wendel 2020). Employees in the forestry and logging, and wood products manufacturing sector earned approximately $1,127 per week in 2019 in Oregon (Daniels and Wendel 2020). For Oregon workers, the average weekly wages for timber-industry employees are higher than the average weekly wages in other industries (Daniels and Wendel 2020).

Figure 3.12-1. Employment in Forestry, Logging, and Wood Products Manufacturing Sector in Study Area (2019)



Source: Daniels and Wendel 2020

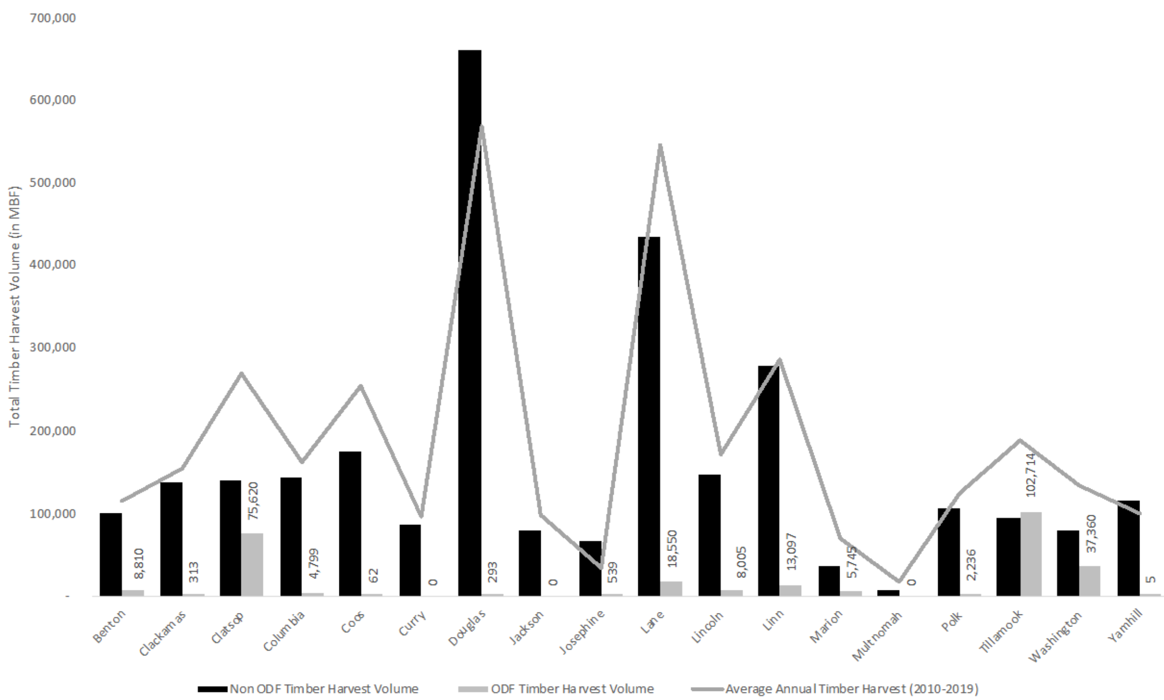
Timber Harvest

Harvest Volume

In 2019, Oregon's timber industry harvested 3,541,291 thousand board feet (MBF) of timber from federal, state, county, and private lands, a 10 percent increase from timber harvests in 2010 (University of Montana 2021). About 90 percent of that harvest in 2019 was in the study area, where harvest increased 13 percent overall compared to 2010. In the study area, Douglas and Lane Counties accounted for the greatest volume of timber harvest. Timber harvests declined in Clatsop, Coos, Jackson, Lane, Marion, Multnomah, and Washington Counties between 2010 and 2019 but increased in the remaining 11 study area counties. Figure 3.12-2 shows the amount of timber harvested on ODF land in 2019. While the timber harvested from ODF forestlands made up just 8 percent of the total timber harvested in Oregon in 2019, it accounted for large shares of timber harvested in Clatsop (35 percent), Tillamook (52 percent), and Washington (32 percent) Counties (University of Montana 2021).

Most of the timber harvested in Oregon is processed in Oregon (Simmons and Marcille 2020:11). In 2017, approximately 166 primary forest product facilities like sawmills and plywood and veneer facilities operated in the state (Simmons and Marcille 2020:3). Some of the timber is also processed in Washington, California, and Idaho (Simmons and Marcille 2020:11). According to ODF's data on log movements to scaling locations, 89 percent of timber harvested on ODF forestlands in the study area is processed in Oregon, while 11 percent is processed in Washington.

Figure 3.12-2. Timber Harvest Volumes from ODF and Other Forestlands (2019, in MBF)



Source: University of Montana 2021
Note: Curry, Jackson, and Yamhill Counties only contain Common School Fund Lands (CSFL). In 2019, no timber harvests occurred on CSFL within Jackson and Curry Counties. Multnomah County contains no ODF-managed land.

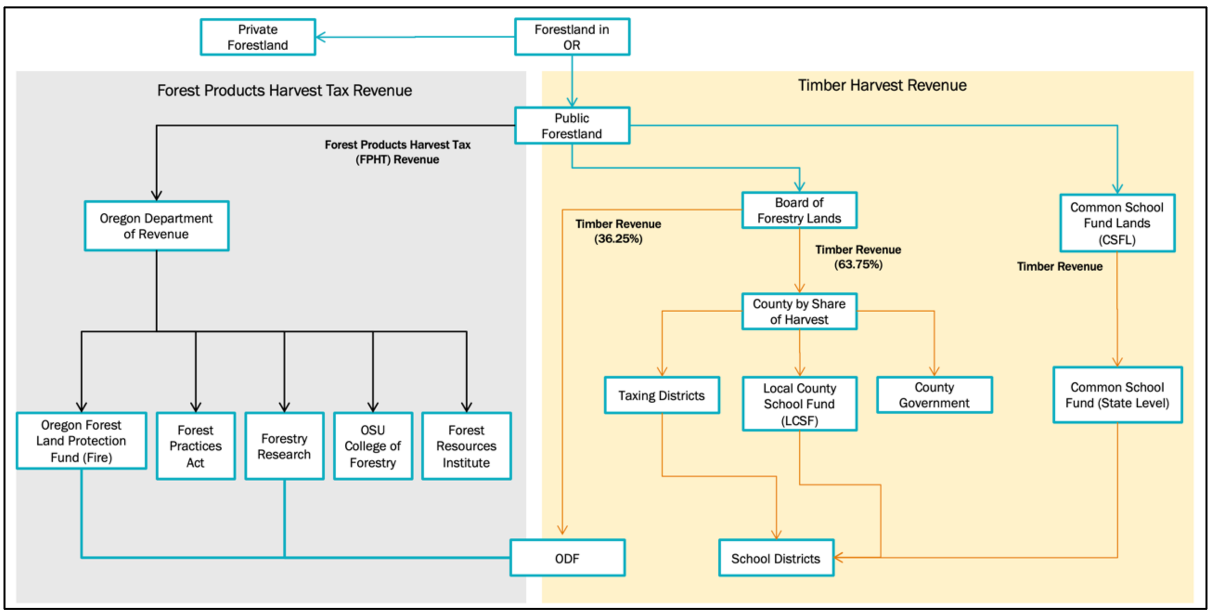
Harvest Value

Over the last 10 years, the average inflation-adjusted price for delivered logs of high-grade timber in Oregon is approximately $577 per MBF. Wood processing mills pay a range of prices for delivered logs based on the species, grade of logs, and region where the timber sale occurs. According to Forest2Market data on delivered log prices, 10-year average prices can range between $419 and $1,076 per MBF depending on species and grade. Low value species and grades can sell for as low as $110 per MBF. Prices of delivered logs fluctuate over time as well. After real log prices declined following the Great Recession in 2008, prices remained depressed throughout the last decade (Oregon Forest Resources Institute 2019:19). In early 2021, lumber prices hit record highs but have since normalized to near historical average levels (NASDAQ 2021). Although log prices also increased because of increasing lumber prices in some areas, the impact on prices of delivered logs was more muted (Giardinelli 2021). For details on delivered log prices used to model revenues from timber sales, see Appendix 3.12.

3.12.2.3 Government Revenue

The standing timber on public forestlands is sold to private companies that harvest the timber for logs and further lumber processing. Timber harvest in the permit area generates revenue for government and public services when the trees are sold, and when the harvest value is taxed. The revenue generated from timber harvests provides important sources of funding for state and local government operations and for school districts in Oregon. Revenues from timber sales on Board of Forestry Lands (BOFL) and Common School Fund Lands (CSFL) are allocated differently and this section discusses them separately. Timber harvest on both BOFL and CSFL is subject to the Forest Products Harvest Tax. Figure 3.12-3 shows how revenue is distributed and is referenced in the following discussion.

Figure 3.12-3. Ways that ODF-Managed Timber Generates Government Revenue



Source: Created by ECONorthwest based on Oregon Department of Forestry 2019a; ORS 530.115; Legislative Revenue Office 2020; Oregon Department of Revenue Research Section 2020

Board of Forestry Lands

Timber sale receipts from BOFL are an important source of revenue for both ODF (i.e., State Forests Division) and for the counties and taxing districts in the study area. ODF retains 36.25 percent of the total timber sale revenue for management expenses and accounts for 98 percent of the State Forest Division's total revenue (ODF 2019a:96). The remaining 63.75 percent is distributed to the counties where the sale occurred (ODF 2019a:96).

Revenue from sale of timber on BOFL funds both county governments and taxing districts (e.g., fire districts, school districts) where the timber harvest occurs. Counties may distribute at least 10 percent of the revenue to their general fund for administration of local government services and special capital projects, 25 percent of the remaining revenue to the local county school fund (LCSF), and the rest to taxing districts where the timber sales occur (ORS 530.115). Oregon statute requires the use of local property tax levies to determine each taxing district's share of the revenue that is generated within each tax code (ORS 530.115). Polk County does not distribute any timber revenue to its LCSF and taxing district and retains the entire sum to maintain timber routes within the county (Hansen pers. comm.). School districts receive timber sale revenues from BOFL through both direct transfers to taxing districts and distributions from the LCSF according to the district's average student enrollment. The role of timber sale revenue in funding school districts is further discussed in Appendix 3.12.

Counties' dependence on timber sale revenues varies. Counties like Clatsop and Tillamook, which receive a high and consistent stream of revenue from BOFL timber sales (Table 3.12-1), depend heavily on this revenue source (Bohn and Steele 2020:43; Blanchard 2021:9). Counties like Clackamas and Josephine do not rely very heavily on timber sale revenues because the revenue source has been sporadic over time (Nava pers. comm.; Arce pers. comm.).

Table 3.12-1. Acres and Timber Revenue Distributions of Board of Forestry Lands to Counties (2016–2020)

County	Acres	2020	Average Annual Payment 2016–2020
Benton	8,401	$1,307,952	$1,199,473
Clackamas	7,266	$707,198	$456,423
Clatsop	146,927	$22,721,180	$24,459,623
Columbia	6,459	$376,759	$1,448,596
Coos	7,244	$35,878	$7,186
Curry	0	No BOFL[a]	
Douglas	8,625	$269,661	$471,725
Jackson	0	No BOFL[a]	
Josephine	2,482	$4,479	$117,002
Lane	24,734	$5,574,416	$3,746,861
Lincoln	15,530	$1,503,690	$2,062,138
Linn	21,357	$3,289,057	$3,970,225
Marion	18,331	$539,281	$2,734,486
Multnomah	0	No BOFL[b]	
Polk	6,048	$632,096	$145,805
Tillamook	310,679	$22,230,409	$19,501,907
Washington	46,880	$8,864,702	$9,315,791
Yamhill	0	No BOFL[a]	
Total county distributions (inc. Klamath)	**729,718**	**$69,204,677**	**$71,020,909**
Distribution to ODF (36.25% of total revenue)		$38,300,000	$40,384,438

Source: Oregon Department of Forestry 2016, 2017, 2018, 2019b, 2020
[a] While these counties have no BOFL, they do have a small amount of ODF-managed CSFL, not included in this table.
[b] Multnomah County does not contain either BOFL or CSFL.

Common School Fund Lands

The revenue generated from timber harvests on CSFL contributes to the Common School Fund (CSF) that was established in 1859 to provide resources to schools in Oregon. The CSF also receives revenue from leases, property sales, gifts, and returns on investment of the fund (ORS 327.405). ODF currently manages CSFL on behalf of the Oregon Department of State Lands, and the Oregon Department of State Lands pays for the associated operating and management expenses (Oregon

Department of Forestry 2019b). The average annual distribution from CSFL to the CSF between 2016 and 2020 was $3.3 million. Historical distributions are reported in Appendix 3.12.

School districts in Oregon receive revenue from the CSF twice a year and the amount distributed to each district depends on the number of students enrolled in the district (Legislative Revenue Office 2020:5; Oregon Department of State Lands 2020). Only 3.5 percent of the CSF may be distributed to the school districts annually (Oregon Department of State Lands 2020).

Funding for School Districts

A formula that considers many factors to allocate revenue from state and local sources determines a minimum amount of funding for Oregon's school districts each year. Local sources of revenue include timber revenue from BOFL harvests within the district boundaries, BOFL revenues distributed through the LCSF, and payments to school districts from the CSF along with other sources like property taxes. These revenues vary from year to year, but the state school support distributions to each school district make up any differences to ensure the school districts receive the funding determined by the formula.[1] For districts where local revenue is higher than the formula amount, the state does not provide any funding (Legislative Revenue Office 2020:4). In 2019, Neah-Kan-Nie, Jewell, Seaside, and Nestucca School Districts in Clatsop and Tillamook Counties relied solely on local revenue, a combination of property tax and timber revenues, and did not receive state school support (Oregon Department of Education 2021). For such districts, a loss in local revenue only reduces any revenue that exceeds the state-determined annual formula amount. If local revenues decrease beyond its annual formula revenue, the state would make up any losses in local revenue to maintain its annual funding at the annual formula amount (Legislative Revenue Office 2020:3). Appendix 3.12 provides additional detail on school district reliance on BOFL and CSFL timber revenues.

Forest Products Harvest Tax

Harvests from both public and private forestlands are subject to the Forest Products Harvest Tax. The tax is applied to the volume of timber harvested by each taxpayer in a calendar year (ORS 321.015). The first 25,000 board feet of the total quantity of timber harvested by each taxpayer is exempt from the tax every calendar year (Oregon Department of Revenue Research Section 2020:376). In 2020, timber purchasers paid $4.09 (in 2019 dollars) for every MBF of non-exempt timber harvested in that year (Oregon Department of Revenue Research Section 2020:375). Between 2017 and 2019, the Oregon Department of Revenue forecasted Forest Products Harvest Tax revenue at approximately $15.1 million per year (in 2019 dollars). Assuming ODF forestlands contributed 8 percent to the total taxable volume of timber harvested during that period (equivalent to its share of total statewide harvest in 2019), ODF forestlands generated approximately $1.2 million per year (in 2019 dollars) in Forest Products Harvest Tax revenues.

The tax has five components that fund various state programs (Figure 3.12-3). Of the $4.09 per MBF, 15 percent is dedicated to the Oregon Forest Land Protection Fund, ODF's fund used to fight large fires in Oregon (ORS 321.015). A component (34 percent) of the tax funds ODF's administration of the Forest Practices Act on private forests. Two components (together 24 percent) fund forestry research and education at the Oregon State University (OSU) College of Forestry. The final

[1] State school support is made up of various income sources like personal income tax revenue, revenue from lottery tickets, etc., and is separate from timber sale revenue from BOFL and CSFL.

component (27 percent) funds the Oregon Forest Resources Institute (OFRI). While the tax rate for the fire protection fund remains constant, the legislature periodically establishes the rates for the other four components (Oregon Department of Revenue Research Section 2020:375). See Appendix 3.12 for additional detail on agencies' reliance on FPHT revenue.

Other State Taxes

Oregon applies a fuel tax on gasoline and diesel, which affects machinery and vehicles used to harvest and process timber along with other timber management activities. The weight-mile tax applies to vehicles over 26,000 pounds that are involved in commercial operations on public roads in Oregon, such as trucks used to transport timber. Haulers of logs and certain other timber-related commodities can opt to pay a flat-mileage tax in lieu of the weight-mile tax. Oregon and some cities and counties levy a lodging tax, which would apply to timber-harvest workers who stay in transient accommodations while on a job. The personal income generated by the forest management activities and timber supply chain is subject to personal income tax, while the corporate profits generated by logging and timber processing companies are subject to the corporate income tax and the corporate activity tax. The corporate activity tax is levied only on taxpayers with more than $1 million of taxable commercial activity in Oregon. See Appendix 3.12 for more details on these taxes.

3.12.2.4 Value of Ecosystem Services

Ecosystem services refer to the types of benefits that ecosystems provide to people. Forest ecosystems produce many ecosystem services that people value, including food and fiber from plants and wildlife, a setting for recreation and spiritual experience, clean water, and flood control. Table 3.12-2 presents a summary of the types of ecosystem services the permit area forests provide across four broad categories: provisioning, regulating, cultural, and supporting services.

Table 3.12-2. Ecosystem Services in Oregon Department of Forestry Forests

Type of Service	Definition	Examples in ODF Forests
Provisioning	The "products" obtained from ecosystems	Food Habitat for sensitive species Fresh water
Regulating	Benefits obtained from the regulation of ecosystem processes	Flood regulation Climate regulation Water purification
Cultural	Nonmaterial benefits obtained from ecosystems	Recreational Visual/aesthetic Spiritual Heritage Educational
Supporting	Services necessary to produce all other ecosystem services	Nutrient cycling Biodiversity Soil formation

Source: Created by ECONorthwest based on Millennium Ecosystem Assessment 2005. See also De Groot 2002.

Some services are valued as an endpoint (e.g., flood regulation and avoided flood damage) while others represent necessary intermediate processes in the production of a good or service that people ultimately care about (e.g., soil formation that leads to plant growth and food production).

This analysis focuses on five categories of goods and services that forests in the permit area produce and people value: special forest products (plants used for food and materials) and hunting and fishing; climate regulation through carbon sequestration; water quality regulation; habitat for sensitive species; and cultural services (aesthetic, spiritual, heritage, and educational value).

Value of Special Forest Products, Hunting, and Fishing

Tribes have gathered resources from forests in the permit area from ancestral to contemporary times to consume and transform into goods for personal use and trade. This relationship persists to this day for tribes and other people. The study area's population and visitors from elsewhere look to the forest for resources that support commercial activity, subsistence (personal use), and recreational activities. Collection of special forest products generates employment, income, and value, particularly for lower-income and minority communities in rural areas. Opportunities to collect special forest products can strengthen social ties, contribute to subsistence of communities, provide an economic safety net during times when participation in formal economic activity is difficult, and is frequently a major contributor to the rural lifestyle value (McLain et al. 2008).

Collection of special forest products can occur throughout the permit area but collection for commercial use requires a permit, which generates revenue for ODF. Table 3.12-3 shows the types of commercial permits commonly issued for special forest products in the permit area. Permits are issued most commonly for collection of firewood, salal, and mushrooms and for collection in Forest Grove, Astoria, and Tillamook districts.

Table 3.12-3. Commercial Non-Timber Forest Product Permits in Permit Area by District in 2019

Product	Forest Grove	Astoria	West Oregon	Tillamook	North Cascade	SW Oregon	Total
Firewood	680	833	144	569	61	2	2289
Salal	919	181	41	2	0	0	1143
Mushrooms and Fungi	120	17	8	2	0	0	147
Moss	0	35	0	81	0	0	116
All Others[a]	63	0	15	13	0	0	91

Source: ODF 2021

[a] Other permitted products include vinemaple, beargrass, ferns, sagebrush, huckleberry, truffles, Christmas trees, tree boughs, fence posts, and minerals.

Data on collection for personal use are not available since personal use does not generally require a permit. However, commercial use permits likely are indicative of the categories of products collected for subsistence and personal use for most people. Products like fibers used for basket weaving (e.g., spruce roots, hazel sprouts), cedar, foods (e.g., nuts, berries, roots, marine plants), and medicinal plants are culturally important for tribes in the study area (Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians no date). These products represent a small sample of what tribes gather from the landscape; Section 3.11, *Tribal Resources*, provides a more detailed discussion of tribal use of forest resources.

Forest structures influence the kinds of special forest products that may be available for collection. Salal, a shrub used for florist greenery, is found in early-seral to old-growth forests and can increase after timber harvest or thinning (Tirmenstein 1990). Mushrooms and fungi are found in all forest ecosystems but are most commonly associated with late-seral and old-growth forests and may decrease with timber harvest (Dreisbach 2002). Moss is also more productive in mid- and late-seral forests. Other products important for subsistence and recreational use, such as huckleberries, are present in early- to late-seral forests and are most productive in mid-seral forests (Simonin 2000).

Fishing and hunting are also important activities in the permit area that provide benefits. Meat from wildlife can be an important source of low-cost protein for households, particularly in rural areas with limited access to affordable groceries. Hunting and fishing can occur in most of the permit area where access is available with a permit through the Oregon Department of Fish and Wildlife.

Value of Climate Regulation

Trees and soils in the permit area are important carbon sinks for the region because they sequester carbon in their aboveground woody material and in their roots throughout their life cycle. Alternatively, forest disturbances can lead to the release of stored carbon (Binkley and Fisher 2019). Release of greenhouse gases such as carbon dioxide (CO_2) contributes to climate change and leads to adverse health outcomes, increased risks of natural disasters such as floods, lost agricultural productivity, and other (largely adverse) economic outcomes for local, national, and international populations. The most recent estimates suggest that the social value of an additional metric ton of CO_2 sequestration is about $48 (in 2019 dollars) (Interagency Working Group on Social Cost of Greenhouse Gases 2021).

Value of Water Quality Regulation

Forestlands play an important role in maintaining the health of watersheds and quality drinking water sources by holding soils and preventing erosion. Poor water quality can negatively affect river users such as fishers and boaters, and other downstream users such as agricultural or municipal water users. Statewide, state forests cover only about 2 percent of land above groundwater basins that provide drinking water and about 1 percent of land in surface water drinking water source areas for public water systems in Oregon (Section 3.4, *Water Resources*). Sedimentation in surface water can result in increased costs for water treatment and distribution, while changes in runoff can affect the supply of surface water delivered in drinking water source areas. For example, Warziniack et al. (2017) show that every 1 percent increase in turbidity leads to a 0.19 percent increase in water treatment costs. Keeler et al. (2012) emphasize that the benefits associated with water quality also extend well beyond treatment costs to include water-related recreation values and health impacts.

Value of Threatened and Endangered Species Habitat Protection

People value the continued existence of threatened and endangered species even species that they have never or will never see or interact with in the future. The permit area includes three wildlife species and eight aquatic species currently listed as threatened or endangered under the federal Endangered Species Act, with four additional species under review for listing. People can place a substantial value on protecting these species today and for future generations. For example, researchers have found that households would be willing to pay $104 per year to protect salmon and steelhead and $83 per year to preserve endangered owl populations (Richardson and Loomis 2009, converted to 2019 dollars). These values are not necessarily indicative of the value associated with specific management activities to protect threatened and endangered species. Actions that result in substantial reductions in risk of extinction would likely be most valuable to households. Overall, this area of economic research demonstrates that people are willing to pay for actions where the primary or only outcome is to protect threatened and endangered species.

Value of Cultural Services

Permit area forests provide several types of value related to cultural services, including aesthetic, spiritual, heritage, and educational value. Recreation is another cultural service discussed separately in Section 3.9, *Recreation*.

Numerous tribal groups have ancestral lands that overlap with the permit area, which have shaped their culture, spiritual experiences, and quality of life. Section 3.11 provides information about the potentially affected tribes and their ancestral, current, and future use of resources such as ceremonial hunting and fishing in the study area. Cultural resources, which have value for tribes and others, are located throughout the permit area (Section 3.10, *Cultural Resources*). The permit area forests are an important contributor to the maintenance of rural lifestyles, economies, and the general sense of open space. The aesthetic value of the permit area contributes to property values and is an important component of the value of recreation experience (Section 3.9).

Permit area forests provide education benefits to all who visit and interact with them. For example, the Tillamook Forest Center provides programming, events, and school field trips for students in the area, at no cost to participants. Interpretive programs through the center connect residents and visitors to the surrounding forests. The center receives over 50,000 visitors annually and is the primary educational and interpretive facility for visitors to state forests (Tillamook Forest Center 2018). Educational value can be informal as well when forests serve as a setting to engage curiosity and enrich personal experience. These cultural values are often intangible and can be difficult or inappropriate to quantify in monetary terms but are fundamental to sustaining healthy communities and economies.

3.12.3 Environmental Consequences

3.12.3.1 Income or Employment Levels

Alternative 1: No Action

Based on modeling, there would be approximately 12.2 million MBF of harvest in the permit area over the analysis period under the no action alternative. Table 3.12-4 shows the modeled harvest by decade by county.

Timber harvests in the permit area support jobs in the study area of western Oregon in the forestry sector. Table 3.12-5 shows the expected average annual jobs by decade by county. The counties with the highest levels of harvests have the most jobs in the logging industry but not necessarily the milling industry. Mills where the logs are processed are often not in the same county as the harvest. Yamhill County supports the most milling jobs in western Oregon under the no action alternative despite having low levels of harvest due to the location of mills. The location of jobs in future years will change as mills open or close in the study area and with changes to log destination locations. Changes in technology and automation in the future will also change the number of jobs associated with future harvest levels. In total these direct jobs will support approximately $3.4 billion in employee compensation, including wages and benefits, over the 70-year analysis period.

Table 3.12-4. Modeled Timber Harvest by Decade of Analysis Period under the No Action Alternative

County	Timber Harvest (MBF) by Decade							Total, All Years	Average Annual
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092		
Benton	27,992	23,621	40,407	40,426	41,816	39,461	25,473	**239,195**	3,417
Clackamas	20,240	27,553	16,810	16,160	5,880	27,313	21,219	**135,175**	1,931
Clatsop	604,686	456,856	490,784	478,624	452,740	452,743	466,644	**3,403,076**	48,615
Columbia	50,376	49,135	53,968	22,710	21,785	28,131	17,428	**243,532**	3,479
Coos	12,646	36,401	26,876	24,205	24,680	29,422	37,021	**191,251**	2,732
Curry	6,549	698	2,144	4,594	7,239	4,729	0	**25,954**	371
Douglas	3,632	10,385	22,179	30,188	26,333	18,731	17,921	**129,369**	1,848
Jackson	0	0	4,117	469	1,180	2,295	0	**8,062**	115
Josephine	13,286	8,610	1,603	1,407	1,811	6,166	5,191	**38,075**	544
Lane	93,089	86,673	85,141	88,192	85,329	86,845	84,910	**610,178**	8,717
Lincoln	67,780	109,952	106,666	118,074	108,033	101,841	109,522	**721,867**	10,312
Linn	54,107	69,902	76,393	96,918	134,830	69,156	56,770	**558,078**	7,973
Marion	99,839	78,687	80,753	65,025	28,424	71,906	97,335	**521,968**	7,457
Multnomah	No ODF-managed lands								
Polk	13,034	38,693	28,743	19,328	21,464	23,190	41,037	**185,490**	2,650
Tillamook	572,155	579,107	580,487	633,657	626,329	598,823	594,828	**4,185,387**	59,791
Washington	292,407	116,479	104,582	127,606	148,319	114,172	135,344	**1,038,909**	14,842
Yamhill	1,070	2,095	0	0	0	534	0	**3,699**	53
Total, Period	**1,932,887**	**1,694,848**	**1,721,651**	**1,767,583**	**1,736,194**	**1,675,458**	**1,710,644**	**12,239,265**	**174,847**

Note: Includes harvest on both BOFL and CSFL.

MBF = thousand board feet; ODF = Oregon Department of Forestry

Table 3.12-5. Average Annual Direct Jobs by Decade of Analysis Period under the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Analysis Period
Benton	19	25	27	28	27	26	26	25
Clackamas	9	10	9	9	7	10	9	9
Clatsop	115	87	94	92	87	87	89	93
Columbia	63	51	53	46	45	45	44	50
Coos	5	14	10	9	9	11	14	10
Curry	2	0	1	2	3	2	0	1
Douglas	4	6	8	11	10	8	7	8
Jackson	0	0	2	0	0	1	0	0
Josephine	2	1	0	0	0	1	1	1
Lane	59	59	59	60	57	59	59	59
Lincoln	11	17	17	19	17	16	17	16
Linn	37	35	37	42	48	35	34	38
Marion	16	12	13	10	5	11	15	12
Multnomah	No ODF-managed lands or log processing locations							
Polk	3	7	5	4	4	4	7	5
Tillamook	138	133	134	146	144	137	137	138
Washington	103	64	63	69	72	64	69	72
Yamhill	80	66	65	69	70	65	67	69
Total	**665**	**588**	**596**	**616**	**605**	**583**	**596**	**607**

In addition to direct jobs and labor income in the logging and milling industries, timber harvests in the permit area also support non-forestry jobs, labor income, value added, and output through indirect and induced effects. These effects do not include employment and income associated with non-harvest timber management activities conducted by ODF, recreational use, or employment supported by revenue distributed to counties to support public services (see Appendix 3.12 for a detailed discussion of these relationships). Table 3.12-6 shows the direct, indirect, and induced effects of the no action alternative for the first decade of the analysis period. Modeling these effects beyond the first 10 years is not appropriate, because indirect and induced effects can change in proportion to harvest levels as the economy changes. For example, technology shifts, firm locations, and other industry developments could significantly alter the flow of economic activity within western Oregon. Assuming that there are similar supply chain relationships and spending patterns, the indirect and induced effects for the later 60 years of the analysis period would be proportional to the level of harvest.

Table 3.12-6. Average Annual Effects under the No Action Alternative (2023–2032) (in 2019 dollars)

Effect	Jobs	Labor Income	Value Added	Output
Direct	665	$52,610,057	$115,907,486	$311,987,926
Indirect	1,385	$81,097,034	$111,204,000	$207,487,051
Induced	706	$36,429,690	$64,896,341	$109,758,417
Total	**2,757**	**$170,136,781**	**$292,007,826**	**$629,233,394**

Note: IMPLAN 2019 Model Year.

Besides harvest-related employment, the permit area would continue to support employment and economic activity associated with recreation, such as management of ODF recreation facilities and collection of special forest products for commercial use.

Alternative 2: Proposed Action

Based on modeling, there would be approximately 15.8 million MBF of timber harvest in the permit area over the permit term under the proposed action. Table 3.12-7 shows the modeled harvest by decade by county and the percent change in harvest relative to the no action alternative. Although harvest would decline for some counties in some decades compared to the no action alternative, in total over the permit term, harvest would increase by approximately 3.6 million MBF (29.1 percent increase).

Table 3.12-8 shows the expected average annual jobs by decade by county for the proposed action and the percent change relative to the no action alternative. In total these direct jobs would support approximately $4.4 billion in employee compensation, including wages and benefits, over the 70-year permit term. This level of employee compensation represents a 29.5 percent increase relative to the no action alternative. Coos, Curry, Jackson, Josephine, and Marion Counties would experience a net decrease in harvest levels and average annual jobs compared to the no action alternative (Table 3.12-9).

Table 3.12-7. Total Modeled Timber Harvest by Decade of Permit Term under the Proposed Action and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	46,814	50,905	83,815	65,890	19,570	43,641	66,107	376,741
	67%	*116%*	*107%*	*63%*	*-53%*	*11%*	*160%*	*58%*
Clackamas	47,674	9,812	29,151	30,816	28,447	14,832	20,089	180,820
	136%	*-64%*	*73%*	*91%*	*384%*	*-46%*	*-5%*	*34%*
Clatsop	798,484	552,968	347,910	460,730	650,441	520,049	375,555	3,706,137
	32%	*21%*	*-29%*	*-4%*	*44%*	*15%*	*-20%*	*9%*
Columbia	64,846	50,430	51,295	82,490	83,455	34,344	20,409	387,269
	29%	*3%*	*-5%*	*263%*	*283%*	*22%*	*17%*	*59%*
Coos	11,117	1,277	40,302	16,955	61,652	22,250	22,874	176,427
	-12%	*-96%*	*50%*	*-30%*	*150%*	*-24%*	*-38%*	*-8%*
Curry	0	0	0	0	0	0	0	0
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*	*-100%*
Douglas	4,219	4,809	17,657	19,853	18,215	36,394	48,346	149,492
	16%	*-54%*	*-20%*	*-34%*	*-31%*	*94%*	*170%*	*16%*
Jackson	0	0	0	0	0	0	0	0
	N/A	*N/A*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*	*-100%*
Josephine	566	782	0	8,138	3,146	9,932	9,444	32,008
	-96%	*-91%*	*-100%*	*478%*	*74%*	*61%*	*82%*	*-16%*
Lane	161,941	174,669	114,284	114,770	67,262	79,107	60,993	773,026
	74%	*102%*	*34%*	*30%*	*-21%*	*-9%*	*-28%*	*27%*
Lincoln	64,890	141,511	156,676	128,632	162,064	169,506	140,274	963,553
	-4%	*29%*	*47%*	*9%*	*50%*	*66%*	*28%*	*33%*
Linn	160,521	122,638	92,447	78,150	84,182	64,350	68,234	670,522
	197%	*75%*	*21%*	*-19%*	*-38%*	*-7%*	*20%*	*20%*
Marion	103,674	77,286	52,823	61,520	57,238	50,331	31,961	434,832
	4%	*-2%*	*-35%*	*-5%*	*101%*	*-30%*	*-67%*	*-17%*
Multnomah	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	36,857	50,021	35,722	45,972	38,392	35,983	49,955	292,902
	183%	*29%*	*24%*	*138%*	*79%*	*55%*	*22%*	*58%*
Tillamook	713,530	988,758	1,107,406	810,063	717,380	744,576	979,366	6,061,079
	25%	*71%*	*91%*	*28%*	*15%*	*24%*	*65%*	*45%*
Washington	291,487	226,894	268,701	307,993	133,251	229,110	137,583	1,595,019
	0%	*95%*	*157%*	*141%*	*-10%*	*101%*	*2%*	*54%*
Yamhill	0	0	0	4,567	0	0	285	4,852
	-100%	*-100%*	*N/A*	*N/A*	*N/A*	*-100%*	*N/A*	*31%*
Total, Annual	**2,506,618**	**2,452,762**	**2,398,190**	**2,236,537**	**2,124,694**	**2,054,402**	**2,031,475**	**15,804,679**
	30%	*45%*	*39%*	*27%*	*22%*	*23%*	*19%*	*29%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL.

Table 3.12-8. Average Annual Direct Jobs by Decade of Permit Term under the Proposed Action and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092
Benton	**27**	**37**	**45**	**39**	**31**	**36**	**41**
	45%	*47%*	*66%*	*40%*	*15%*	*39%*	*57%*
Clackamas	**16**	**10**	**15**	**13**	**11**	**9**	**11**
	86%	*-2%*	*68%*	*52%*	*59%*	*-14%*	*25%*
Clatsop	**152**	**107**	**69**	**89**	**124**	**100**	**73**
	32%	*22%*	*-27%*	*-3%*	*43%*	*15%*	*-18%*
Columbia	**79**	**68**	**62**	**70**	**72**	**57**	**49**
	25%	*34%*	*17%*	*51%*	*60%*	*25%*	*11%*
Coos	**4**	**1**	**15**	**7**	**23**	**9**	**9**
	-12%	*-94%*	*50%*	*-29%*	*147%*	*-22%*	*-37%*
Curry	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*
Douglas	**2**	**2**	**6**	**9**	**7**	**15**	**19**
	-54%	*-61%*	*-23%*	*-20%*	*-26%*	*86%*	*151%*
Jackson	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*
Josephine	**0**	**0**	**0**	**1**	**0**	**2**	**1**
	-96%	*-91%*	*-100%*	*478%*	*74%*	*61%*	*82%*
Lane	**93**	**100**	**80**	**76**	**57**	**62**	**55**
	56%	*70%*	*37%*	*26%*	*1%*	*6%*	*-6%*
Lincoln	**10**	**22**	**25**	**20**	**26**	**27**	**22**
	-4%	*29%*	*47%*	*9%*	*50%*	*66%*	*28%*
Linn	**68**	**55**	**46**	**42**	**39**	**34**	**34**
	87%	*54%*	*27%*	*1%*	*-20%*	*-1%*	*-1%*
Marion	**16**	**12**	**8**	**10**	**9**	**8**	**5**
	4%	*-2%*	*-35%*	*-5%*	*101%*	*-30%*	*-67%*
Multnomah	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	**7**	**9**	**7**	**8**	**7**	**7**	**9**
	150%	*31%*	*29%*	*114%*	*71%*	*54%*	*23%*
Tillamook	**172**	**223**	**244**	**185**	**167**	**171**	**216**
	25%	*67%*	*82%*	*27%*	*16%*	*25%*	*58%*
Washington	**116**	**107**	**113**	**112**	**80**	**95**	**83**
	12%	*67%*	*80%*	*61%*	*11%*	*49%*	*20%*
Yamhill	**101**	**102**	**105**	**96**	**81**	**85**	**88**
	26%	*56%*	*62%*	*39%*	*15%*	*30%*	*31%*
Total	**863**	**855**	**842**	**777**	**734**	**716**	**715**
	30%	*45%*	*41%*	*26%*	*21%*	*23%*	*20%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); total column was omitted since it is inappropriate to calculate sum of employment over the permit term.

Table 3.12-9. Change in Average Annual Harvest (MBF) and Employment under the Proposed Action Relative to the No Action Alternative

County	Average Annual Harvest (2023–2092)	% Difference in Harvest Relative to NAA	Average Annual Employment (2023–2092)	% Difference in Employment Relative to NAA
Benton	5,382	58%	37	44%
Clackamas	2,583	34%	12	36%
Clatsop	52,945	9%	102	10%
Columbia	5,532	59%	65	31%
Coos	2,520	-8%	10	-7%
Curry	0	-100%	0	-100%
Douglas	2,136	16%	9	11%
Jackson	0	-100%	0	-100%
Josephine	457	-16%	1	-16%
Lane	11,043	27%	75	27%
Lincoln	13,765	33%	22	33%
Linn	9,579	20%	45	19%
Marion	6,212	-17%	10	-17%
Multnomah	No ODF-managed lands or log processing locations			
Polk	4,184	58%	8	55%
Tillamook	86,587	45%	197	42%
Washington	22,786	54%	101	40%
Yamhill	69	31%	94	36%
Total	**225,781**	**29%**	**786**	**29%**

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL.
NAA = no action alternative; ODF = Oregon Department of Forestry

With additional harvest, there would also be more economic activity supported in western Oregon from indirect and induced effects. Due to the higher levels of harvest, all effects are larger under the proposed action compared to the no action alternative. Indirect and induced jobs are 13.2 percent higher under the proposed action compared to the no action alternative (Table 3.12-10).

Table 3.12-10. Average Annual Effects under the Proposed Action (2023–2032) (in 2019 dollars)

Effect	Jobs	Labor Income	Value Added	Output
Direct	863	$68,278,118	$160,876,435	$377,832,770
Indirect	1533	$89,731,109	$123,043,443	$229,577,363
Induced	834	$43,027,755	$76,652,418	$129,640,339
Total	**3,230**	**$201,036,982**	**$360,572,296**	**$737,050,472**

Total harvest levels are higher for all decades under the proposed action compared to the no action alternative. Accordingly, direct, indirect, and induced employment and labor income would be higher over the entire permit term and for each decade under the proposed action compared to the no action alternative. The proposed action is not expected to affect recreation activity or the collection of special forest products and the associated employment and economic activity relative to the no action alternative.

Alternative 3: Increased Conservation

Based on modeling, there would be approximately 15.7 million MBF of timber harvest in the permit area under Alternative 3 over the permit term, which is 28.0 percent higher than no action alternative and 0.9 percent lower than proposed action projections.

Table 3.12-11 shows the modeled harvest by decade by county and the percent change in harvest for Alternative 3 relative to the no action alternative.

Table 3.12-11. Total Modeled Timber Harvest by Decade of Permit Term under Alternative 3 and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	43,539	55,172	82,863	63,264	16,959	45,996	69,154	376,947
	56%	*134%*	*105%*	*56%*	*-59%*	*17%*	*171%*	*58%*
Clackamas	48,268	8,792	28,354	26,049	33,539	15,792	18,786	179,580
	138%	*-68%*	*69%*	*61%*	*470%*	*-42%*	*-11%*	*33%*
Clatsop	796,259	551,205	344,574	454,461	656,483	526,547	367,124	3,696,653
	32%	*21%*	*-30%*	*-5%*	*45%*	*16%*	*-21%*	*9%*
Columbia	64,884	50,883	45,885	90,175	79,926	35,192	20,657	387,602
	29%	*4%*	*-15%*	*297%*	*267%*	*25%*	*19%*	*59%*
Coos	10,961	1,963	40,888	23,192	53,375	18,978	26,389	175,745
	-13%	*-95%*	*52%*	*-4%*	*116%*	*-35%*	*-29%*	*-8%*
Curry	0	0	0	0	0	0	0	0
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*	*-100%*
Douglas	4,099	4,761	17,189	17,377	22,437	35,411	49,049	150,322
	13%	*-54%*	*-22%*	*-42%*	*-15%*	*89%*	*174%*	*16%*
Jackson	0	0	0	0	516	0	0	516
	N/A	*N/A*	*-100%*	*-100%*	*-56%*	*-100%*	*N/A*	*-94%*
Josephine	566	769	0	7,721	2,542	10,714	8,121	30,433
	-96%	*-91%*	*-100%*	*449%*	*40%*	*74%*	*56%*	*-20%*
Lane	161,805	171,591	114,262	111,069	68,640	81,742	57,131	766,239
	74%	*98%*	*34%*	*26%*	*-20%*	*-6%*	*-33%*	*26%*
Lincoln	63,438	139,406	151,470	145,051	157,374	159,474	137,110	953,323
	-6%	*27%*	*42%*	*23%*	*46%*	*57%*	*25%*	*32%*
Linn	160,340	122,235	92,204	74,861	82,523	60,967	67,628	660,757
	196%	*75%*	*21%*	*-23%*	*-39%*	*-12%*	*19%*	*18%*
Marion	104,986	74,949	56,030	56,849	56,454	48,212	31,106	428,586
	5%	*-5%*	*-31%*	*-13%*	*99%*	*-33%*	*-68%*	*-18%*
Multnomah	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	35,725	49,603	36,961	40,456	37,590	42,102	49,361	291,797
	174%	*28%*	*29%*	*109%*	*75%*	*82%*	*20%*	*57%*
Tillamook	705,070	977,211	1,105,739	798,126	700,416	725,643	977,675	5,989,879
	23%	*69%*	*90%*	*26%*	*12%*	*21%*	*64%*	*43%*
Washington	285,316	223,797	267,164	302,573	131,794	224,306	138,388	1,573,339
	-2%	*92%*	*155%*	*137%*	*-11%*	*96%*	*2%*	*51%*

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Yamhill	0	0	0	4,247	0	0	0	4,247
	-100%	*-100%*	*N/A*	*N/A*	*N/A*	*-100%*	*N/A*	*15%*
Total, Annual	**2,485,255** *29%*	**2,432,336** *44%*	**2,383,583** *38%*	**2,215,472** *25%*	**2,100,567** *21%*	**2,031,075** *21%*	**2,017,679** *18%*	**15,665,967** *28%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL.

Table 3.12-12 shows the expected average annual jobs by decade by county for Alternative 3 and the percent change relative to the no action alternative. In total these direct jobs would support approximately $4.3 billion in employee compensation, including wages and benefits, over the 70-year permit term. This level of employee compensation represents a 28.3 percent increase relative to the no action alternative and a 0.9 percent decrease relative to the proposed action.

Table 3.12-12. Average Annual Direct Jobs by Decade of Permit Term under Alternative 3 and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092
Benton	**25.8**	**37.7**	**44.8**	**39.1**	**29.6**	**36.6**	**41.0**
	39%	*49%*	*64%*	*41%*	*11%*	*39%*	*58%*
Clackamas	**16.4**	**9.8**	**14.3**	**12.3**	**11.9**	**9.1**	**10.8**
	85%	*-3%*	*65%*	*40%*	*70%*	*-13%*	*22%*
Clatsop	**151.2**	**106.2**	**68.0**	**87.6**	**125.0**	**100.8**	**71.8**
	32%	*22%*	*-27%*	*-4%*	*44%*	*16%*	*-20%*
Columbia	**78.5**	**67.5**	**60.6**	**71.5**	**71.2**	**56.6**	**48.4**
	25%	*33%*	*14%*	*54%*	*58%*	*25%*	*10%*
Coos	**4.2**	**1.1**	**15.5**	**8.9**	**20.1**	**7.4**	**10.1**
	-13%	*-92%*	*52%*	*-3%*	*114%*	*-33%*	*-28%*
Curry	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*
Douglas	**1.9**	**2.1**	**6.1**	**7.8**	**8.5**	**14.6**	**18.7**
	-55%	*-62%*	*-25%*	*-28%*	*-12%*	*84%*	*151%*
Jackson	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**	**0.0**
	-96%	*-91%*	*-100%*	*-82%*	*-55%*	*-95%*	*56%*
Josephine	**0.1**	**0.1**	**0.0**	**1.2**	**0.4**	**1.7**	**1.3**
	-96%	*-91%*	*-100%*	*449%*	*40%*	*74%*	*56%*
Lane	**92.1**	**98.2**	**79.7**	**74.7**	**57.3**	**62.3**	**53.8**
	55%	*68%*	*36%*	*23%*	*1%*	*6%*	*-9%*
Lincoln	**10.1**	**22.1**	**24.0**	**23.0**	**24.9**	**25.3**	**21.7**
	-6%	*27%*	*42%*	*23%*	*46%*	*57%*	*25%*
Linn	**68.2**	**54.1**	**46.7**	**40.2**	**38.1**	**32.8**	**33.3**
	86%	*53%*	*27%*	*-3%*	*-21%*	*-5%*	*-2%*
Marion	**16.6**	**11.9**	**8.9**	**9.0**	**8.9**	**7.6**	**4.9**
	5%	*-5%*	*-31%*	*-13%*	*99%*	*-33%*	*-68%*

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092
Multnomah	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	**6.3**	**8.9**	**7.0**	**7.4**	**7.0**	**7.7**	**8.9**
	143%	*30%*	*32%*	*93%*	*67%*	*76%*	*22%*
Tillamook	**170.0**	**220.8**	**243.9**	**182.1**	**163.3**	**167.1**	**215.4**
	24%	*66%*	*82%*	*25%*	*13%*	*22%*	*57%*
Washington	**114.5**	**105.6**	**112.5**	**110.0**	**79.2**	**94.0**	**82.4**
	11%	*65%*	*79%*	*59%*	*10%*	*46%*	*20%*
Yamhill	**99.8**	**101.3**	**105.0**	**94.5**	**79.8**	**84.0**	**87.5**
	24%	*54%*	*61%*	*36%*	*14%*	*28%*	*30%*
Total	**855.9**	**847.6**	**836.8**	**769.3**	**725.5**	**707.6**	**709.9**
	29%	*44%*	*40%*	*25%*	*20%*	*21%*	*19%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); total column was omitted since it is inappropriate to calculate sum of employment over the permit term.

Higher modeled harvest levels result in larger effects under Alternative 3 compared to the no action alternative. Indirect and induced jobs are 12.0 percent higher than the no action alternative (Table 3.12-13) and 1.0 percent lower than the proposed action. Alternative 3 would have the same effects on employment and economic activity associated with recreation and the collection of special forest products as the proposed action and the no action alternative (Table 3.12-14).

Table 3.12-13. Average Annual Effects under Alternative 3 (2023 to 2032) (in 2019 dollars)

Effect	Jobs	Labor Income	Value Added	Output
Direct	856	$67,677,474	$159,617,962	$374,324,104
Indirect	1,517	$88,800,450	$121,767,280	$227,196,268
Induced	826	$42,610,530	$75,909,170	$128,383,291
Total	**3,199**	**$199,088,454**	**$357,294,412**	**$729,903,663**

Table 3.12-14. Change in Average Annual Harvest (MBF) and Employment under Alternative 3 Relative to the No Action Alternative (2023–2092)

County	Average Annual Harvest	% Difference in Harvest Relative to NAA	Average Annual Employment	% Difference in Employment Relative to NAA
Benton	5,385	58%	36	43%
Clackamas	2,565	33%	12	35%
Clatsop	52,809	9%	102	9%
Columbia	5,537	59%	65	31%
Coos	2,511	-8%	10	-7%
Curry	0	-100%	0	-100%
Douglas	2,147	16%	9	11%
Jackson	7	-94%	0	-90%
Josephine	435	-20%	1	-20%
Lane	10,946	26%	74	26%
Lincoln	13,619	32%	22	32%
Linn	9,439	18%	45	17%
Marion	6,123	-18%	10	-18%
Multnomah	No ODF-managed lands or log processing locations			
Polk	4,169	57%	8	54%
Tillamook	85,570	43%	195	41%
Washington	22,476	51%	100	38%
Yamhill	61	14%	93	35%
Total	**223,800**	**28%**	**779**	**28%**

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL.

Alternative 4: Reduced Permit Term

Modeled harvest levels under Alternative 4 and related direct employment and labor income, and indirect and induced effects are the same as the first 50 years of the proposed action. Alternative 4 would have the same impacts on employment and economic activity associated with recreation and the collection of special forest products as the first 50 years of the proposed action and the no action alternative.

Alternative 5: Increased Timber Harvest

Alternative 5 would result in approximately 16.4 million MBF of timber harvest in the permit area over the permit term. The total harvest level in Alternative 5 is 33.7 percent higher than the no action alternative and 3.6 percent higher than the proposed action. Table 3.12-15 shows the expected harvest by decade by county and the percent change in harvest for Alternative 5 relative to the no action alternative. Table 3.12-16 shows the expected average annual jobs by decade by county for Alternative 5 and the percent change relative to the no action alternative. In total these direct jobs would support approximately $4.5 billion in employee compensation, including wages and benefits, over the 70-year permit term. This level of employee compensation is 34.1 percent higher than the no action alternative and 3.6 percent higher than the proposed action.

Table 3.12-15. Total Modeled Timber Harvest by Decade of Permit Term under Alternative 5 and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	42,457	59,932	78,913	58,679	19,882	63,624	72,533	396,020
	52%	*154%*	*95%*	*45%*	*-52%*	*61%*	*185%*	*66%*
Clackamas	41,590	24,730	34,203	20,911	20,838	13,750	27,326	183,347
	105%	*-10%*	*103%*	*29%*	*254%*	*-50%*	*29%*	*36%*
Clatsop	846,277	569,398	368,052	503,414	688,601	561,539	363,919	3,901,201
	40%	*25%*	*-25%*	*5%*	*52%*	*24%*	*-22%*	*15%*
Columbia	66,358	49,537	52,960	78,926	81,381	38,263	20,873	388,297
	32%	*1%*	*-2%*	*248%*	*274%*	*36%*	*20%*	*59%*
Coos	7,644	5,019	39,020	35,085	39,446	20,747	27,624	174,584
	-40%	*-86%*	*45%*	*45%*	*60%*	*-29%*	*-25%*	*-9%*
Curry	0	0	0	0	0	0	0	0
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*	*-100%*
Douglas	6,151	4,799	34,231	20,542	37,101	44,726	32,811	180,361
	69%	*-54%*	*54%*	*-32%*	*41%*	*139%*	*83%*	*39%*
Jackson	0	0	0	487	0	0	1,498	1,985
	N/A	*N/A*	*-100%*	*4%*	*-100%*	*-100%*	*N/A*	*-75%*
Josephine	1,103	782	1,296	10,926	7,418	9,011	7,026	37,563
	-92%	*-91%*	*-19%*	*677%*	*310%*	*46%*	*35%*	*-1%*
Lane	179,727	176,951	108,300	98,592	68,632	81,746	75,992	789,941
	93%	*104%*	*27%*	*12%*	*-20%*	*-6%*	*-11%*	*29%*
Lincoln	75,127	131,598	166,805	146,724	170,052	163,303	141,491	995,101
	11%	*20%*	*56%*	*24%*	*57%*	*60%*	*29%*	*38%*
Linn	161,458	117,995	95,493	72,256	103,446	69,037	57,592	677,275
	198%	*69%*	*25%*	*-25%*	*-23%*	*0%*	*1%*	*21%*
Marion	108,831	74,831	48,556	71,135	58,351	42,320	30,143	434,167
	9%	*-5%*	*-40%*	*9%*	*105%*	*-41%*	*-69%*	*-17%*
Multnomah	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	37,392	64,491	34,256	42,620	29,302	38,602	69,909	316,572
	187%	*67%*	*19%*	*121%*	*37%*	*66%*	*70%*	*71%*
Tillamook	728,589	1,032,378	1,143,400	808,202	731,299	749,359	1,037,434	6,230,661
	27%	*78%*	*97%*	*28%*	*17%*	*25%*	*74%*	*49%*
Washington	300,263	240,726	294,877	298,321	141,271	246,186	135,291	1,656,935
	3%	*107%*	*182%*	*134%*	*-5%*	*116%*	*0%*	*59%*
Yamhill	0	0	0	4,378	0	0	649	5,027
	-100%	*-100%*	*N/A*	*N/A*	*N/A*	*-100%*	*N/A*	*36%*
Total, Annual	**2,602,968**	**2,553,167**	**2,500,362**	**2,271,198**	**2,197,021**	**2,142,211**	**2,102,110**	**16,369,037**
	35%	*51%*	*45%*	*28%*	*27%*	*28%*	*23%*	*34%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL

Table 3.12-16. Average Annual Direct Jobs by Decade of Permit Term under Alternative 5 and Percent Change from the No Action Alternative

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092
Benton	**27.0**	**40.5**	**45.7**	**38.5**	**30.6**	**40.7**	**45.0**
	46%	*60%*	*67%*	*39%*	*14%*	*55%*	*73%*
Clackamas	**15.3**	**13.1**	**15.6**	**11.2**	**10.0**	**9.4**	**12.7**
	73%	*29%*	*79%*	*28%*	*42%*	*-10%*	*43%*
Clatsop	**160.7**	**109.8**	**72.5**	**96.8**	**131.1**	**107.5**	**71.3**
	40%	*26%*	*-23%*	*6%*	*51%*	*24%*	*-20%*
Columbia	**82.2**	**69.7**	**65.1**	**71.0**	**74.1**	**60.2**	**49.6**
	31%	*37%*	*22%*	*53%*	*64%*	*33%*	*13%*
Coos	**3.0**	**2.2**	**14.8**	**13.3**	**15.0**	**8.1**	**10.5**
	-38%	*-84%*	*45%*	*44%*	*60%*	*-27%*	*-24%*
Curry	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	-100%	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*N/A*
Douglas	**2.8**	**2.2**	**12.2**	**9.6**	**14.5**	**17.4**	**12.9**
	-35%	*-61%*	*50%*	*-12%*	*51%*	*120%*	*73%*
Jackson	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**	**0.0**	**0.6**
	-92%	*-91%*	*-100%*	*26%*	*-93%*	*-96%*	*2573%*
Josephine	**0.2**	**0.1**	**0.2**	**1.7**	**1.2**	**1.4**	**1.1**
	-92%	*-91%*	*-19%*	*676%*	*310%*	*46%*	*35%*
Lane	**99.9**	**101.9**	**79.4**	**70.8**	**58.7**	**64.1**	**62.3**
	69%	*74%*	*35%*	*17%*	*3%*	*9%*	*6%*
Lincoln	**11.9**	**20.9**	**26.4**	**23.2**	**26.9**	**25.9**	**22.4**
	11%	*20%*	*56%*	*24%*	*57%*	*60%*	*29%*
Linn	**69.1**	**54.4**	**47.9**	**40.7**	**43.9**	**35.0**	**31.2**
	89%	*54%*	*31%*	*-2%*	*-9%*	*1%*	*-8%*
Marion	**17.2**	**11.8**	**7.7**	**11.3**	**9.2**	**6.7**	**4.8**
	9%	*-5%*	*-40%*	*9%*	*105%*	*-41%*	*-69%*
Multnomah	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Polk	**6.6**	**11.3**	**6.6**	**7.8**	**5.7**	**7.2**	**12.2**
	155%	*64%*	*25%*	*102%*	*37%*	*63%*	*68%*
Tillamook	**176.2**	**233.0**	**252.7**	**185.1**	**170.7**	**173.2**	**227.8**
	28%	*75%*	*88%*	*27%*	*19%*	*26%*	*66%*
Washington	**120.2**	**112.0**	**120.4**	**111.3**	**83.6**	**100.5**	**84.2**
	16%	*75%*	*91%*	*61%*	*16%*	*57%*	*23%*
Yamhill	**103.9**	**107.7**	**110.0**	**96.2**	**83.3**	**88.8**	**92.2**
	29%	*64%*	*69%*	*39%*	*19%*	*36%*	*37%*
Total	**896.4**	**890.6**	**877.3**	**788.7**	**758.5**	**746.1**	**740.8**
	35%	*51%*	*47%*	*28%*	*25%*	*28%*	*24%*

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); total column was omitted since it is inappropriate to calculate sum of employment over the permit term.

Higher modeled harvest levels would result in all effects being larger under Alternative 5 compared to the no action alternative. Indirect and induced jobs are 15.7 percent higher under Alternative 5 than the no action alternative (Table 3.12-17) and 2.2 percent higher than the proposed action. Alternative 5 would have the same impacts on employment and economic activity associated with recreation and the collection of special forest products as the proposed action and the no action alternative (Table 3.12-18).

Table 3.12-17. 2023 to 2032 Average Annual Effects under Alternative 5 (in 2019 dollars)

Effect	Jobs	Labor Income	Value Added	Output
Direct	896	$70,881,988	$166,833,716	$392,498,589
Indirect	1569	$91,940,905	$126,088,957	$235,882,733
Induced	850	$43,858,710	$78,132,641	$132,143,846
Total	**3,315**	**$206,681,603**	**$371,055,314**	**$760,525,168**

Table 3.12-18. Change in Average Annual Harvest (MBF) and Employment under Alternative 5 Relative to the No Action Alternative

County	Average Annual Harvest (2023–2092)	% Difference in Harvest Relative to NAA	Average Annual Employment (2023–2092)	% Difference in Employment Relative to NAA
Benton	5,657	66%	38	51%
Clackamas	2,619	36%	12	39%
Clatsop	55,731	15%	107	15%
Columbia	5,547	59%	67	36%
Coos	2,494	-9%	10	-8%
Curry		-100%	0	-100%
Douglas	2,577	39%	10	33%
Jackson	28	-75%	0	-72%
Josephine	537	-1%	1	-1%
Lane	11,285	29%	77	31%
Lincoln	14,216	38%	23	38%
Linn	9,675	21%	46	21%
Marion	6,202	-17%	10	-17%
Multnomah	No ODF-managed lands or log processing locations			
Polk	4,522	71%	8	67%
Tillamook	89,009	49%	203	46%
Washington	23,670	59%	105	45%
Yamhill	72	36%	97	41%
Total	**233,843**	**34%**	**814**	**34%**

Note: Percentages are sensitive to baseline data and can result in rounding errors; when the baseline is 0, percentage calculation is not possible and results in N/A (not applicable); timber harvest values are from both BOFL and CSFL.
NAA = no action alternative

3.12.3.2 Government Revenue

Alternative 1: No Action

Timber Sale Revenue from BOFL

Under the no action alternative, BOFL would generate $3.8 billion (in 2019 dollars) in timber sale revenues over the 70-year analysis period, which would provide $1.4 billion in revenue to ODF's State Forests program. The remaining $2.4 billion in timber sale revenues would be distributed to the counties where the timber sales occur (Table 3.12-19). The county distributions would provide $333.7 million for county government administration, $524.6 million to LCSFs, and $1.6 billion to fund taxing districts in the study area (see Appendix 3.12 for further information on distribution within counties). Tillamook and Clatsop Counties, where much of the permit area lies, would receive 32 and 30 percent of the total county distributions, respectively. The remaining counties with BOFL would receive between 0.04 and 9 percent of the total revenue.

Table 3.12-19. Distributions of BOFL Timber Sale Revenues to Counties under the No Action Alternative (2023–2092) (in 2019 dollars)

County	BOFL Revenue	County Share of Total Revenue	Estimated Annual Payments	Variation in Annual Payments by Decade (as % of Annual Payments)
Benton	$50,716,112	2%	$724,516	28%
Clackamas	$25,430,704	1%	$363,296	35%
Clatsop	$720,733,056	30%	$10,296,187	10%
Columbia	$58,379,832	2%	$833,998	47%
Coos	$27,053,312	1%	$386,476	30%
Curry		No BOFL		
Douglas	$12,457,653	0.5%	$177,966	63%
Jackson		No BOFL		
Josephine	$1,082,600	0.04%	$15,466	159%
Lane	$129,149,496	5%	$1,844,993	9%
Lincoln	$119,642,240	5%	$1,709,175	20%
Linn	$136,869,728	6%	$1,955,282	39%
Marion	$115,106,032	5%	$1,644,372	35%
Multnomah		No BOFL		
Polk	$29,932,534	1%	$427,608	46%
Tillamook	$785,821,056	32%	$11,226,015	6%
Washington	$219,988,192	9%	$3,142,688	48%
Yamhill		No BOFL		
Study Area Total	**$2,432,362,547**	**100%**	**$34,748,036**	**7%**

BOFL = Board of Forestry Lands

Timber Sale Revenue from CSFL

Under the no action alternative, timber sale revenues from CSFL would be about $127 million over the analysis period. Revenues would fluctuate by decade but on average, timber harvests on CSFL would generate an annual revenue of $1.8 million. Since CSF receives revenue from other sources outlined in Section 3.12.2, *Affected Environment*, along with returns on the money invested from the fund in various financial instruments (Oregon Department of State Lands 2020), fluctuations in these other revenues sources could offset any dips in annual timber revenue transfers.

Forest Products Harvest Tax

Under the no action alternative, the Forest Products Harvest Tax revenue collected from timber harvests on both BOFL and CSFL would be about $49.9 million over the analysis period (in 2019 dollars) (see assumptions for this calculation in Appendix 3.12). If the tax revenue continues to be distributed among its five components according to the current shares, ODF's Oregon Forest Land Protection Fund would receive $7.6 million, ODF's Private Forests program would receive $17 million, OSU College of Forestry would receive $1.2 million, OSU's forestry research lab would receive $11 million, and the OFRI would receive $13.5 million over the analysis period (Table 3.12-20).

Table 3.12-20. Distributions of the Forest Products Harvest Tax Revenue to each Recipient under the No Action Alternative (in 2019 dollars)

Forest Products Harvest Tax Revenue Distributions	Average Annual by Decade							Analysis Period
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Oregon Forest Land Protection Fund (ODF)	$119,529	$104,771	$106,432	$109,280	$107,334	$103,568	$105,750	$7,566,645
Forest Practices Act (ODF)	$264,121	$231,509	$235,181	$241,474	$237,174	$228,853	$233,673	$16,719,844
OSU College of Forestry	$19,279	$16,898	$17,167	$17,626	$17,312	$16,705	$17,056	$1,220,427
Forestry Research (OSU)	$171,582	$150,397	$152,782	$156,870	$154,076	$148,671	$151,802	$10,861,797
Forest Resources Institute	$213,995	$187,573	$190,548	$195,647	$192,162	$185,421	$189,327	$13,546,735
Total	$788,506	$691,148	$702,110	$720,896	$708,058	$683,218	$697,609	$49,915,448

ODF = Oregon Department of Forestry

Other State Taxes

Forest management, timber harvest, and processing activities would require fuel and transportation contributing to the state fuel tax and weight-mile tax revenue collections over the analysis period. Movement of workers for these activities would also contribute to lodging tax collections. Personal income tax, corporate income tax, and commercial activity tax collections would draw on the personal and corporate incomes generated from the forest management activities and the timber supply chain.

Summary

Under the no action alternative, timber sales from BOFL and CSFL, and Forest Products Harvest Tax collections would continue to fund state agencies as well as local county governments and their districts. Timber sales on BOFL would continue to fund ODF's State Forests program, county governments, and their component taxing districts. School districts would receive revenue from timber sales on both BOFL and CSFL, in addition to other local and state revenues. While fluctuations in annual timber revenues from BOFL could result in lower direct revenue payments to school districts and less funding made available through the LCSF, other sources of local revenues and state school support would likely continue to meet annual funding formula amounts.

Alternative 2: Proposed Action

Timber Sale Revenue from BOFL

The proposed action would generate $5.1 billion in timber sale revenues from BOFL over the permit term, a 34 percent increase in revenue relative to the no action alternative. The increase in total timber revenues would also result in a 34 percent increase in funding for ODF's State Forests program as well as distributions to the counties where the harvest occurs. Over the 70 years, ODF would receive $1.8 billion in funding while counties in the study area would receive $3.3 billion in funding.

Timber sale revenue distributions would increase for all counties with BOFL except Marion County compared to the no action alternative (Table 3.12-21). Tillamook and Clatsop Counties would continue to receive most (62 percent, combined) of the revenues from the timber sales, with Tillamook County receiving a greater share of the revenue. The remaining counties would receive between 0.1 and 11 percent of the total revenues. Despite the smaller shares of the revenue, Josephine County would experience the greatest increase of 204 percent in revenues. Marion County is the only county that would experience a decrease in revenues, a drop of 14 percent in timber sale revenue distributions over the permit term.

Impacts on county payments under the proposed action would vary considerably over time. Lincoln, Polk, and Tillamook Counties are the only counties that would experience higher average annual payments during each decade (Appendix 3.12). All other counties would experience at least one decade where the average annual payments would be lower. This decrease in average annual payments would lead to a decrease in payments to the county administration and the LCSF as well.

Table 3.12-21. Distributions of BOFL Timber Sale Revenues to Counties under the Proposed Action (2023–2092) (in 2019 dollars)

County	BOFL Revenue	Share of Total Revenue	Estimated Annual Payments	Variation in Annual Payments by Decade (as % of Annual Payments)	% Change Relative to NAA
Benton	$80,124,920	2%	$1,144,642	41%	58%
Clackamas	$36,649,376	1%	$523,563	55%	44%
Clatsop	$836,389,504	26%	$11,948,421	33%	16%
Columbia	$98,422,104	3%	$1,406,030	44%	69%
Coos	$28,112,408	1%	$401,606	80%	4%
Curry			No BOFL		
Douglas	$13,687,643	0.4%	$195,538	67%	10%
Jackson			No BOFL		
Josephine	$3,286,238	0.1%	$46,946	86%	204%
Lane	$157,288,048	5%	$2,246,972	44%	22%
Lincoln	$162,893,152	5%	$2,327,045	25%	36%
Linn	$161,782,640	5%	$2,311,181	43%	18%
Marion	$98,970,872	3%	$1,413,870	48%	-14%
Multnomah			No BOFL		
Polk	$52,932,940	2%	$756,185	21%	77%
Tillamook	$1,157,964,032	36%	$16,542,343	13%	47%
Washington	$370,460,448	11%	$5,292,292	35%	68%
Yamhill			No BOFL		
Study Area Total	**$3,258,964,325**	**100%**	**$46,556,633**	**13%**	**34%**

BOFL = Board of Forestry Lands; NAA = no action alternative

Revenue to taxing districts would vary based on the spatial distribution of timber sales under the proposed action. Generally, an increase in timber sale revenues for all counties except Marion County would lead to an increase in revenue being distributed to most taxing districts in the study area during the permit term. Decades where county distributions are lower, individual taxing districts would also experience a decrease in funding.

Under the proposed action, out of a total of 210 taxing districts that overlap with the permit area, 26 districts would experience a loss in timber sale BOFL revenues. Of these 26 districts, 11 districts are in Marion County which would overall experience a loss in revenue (Table 3.12-22). Revenues would decrease for a variety of taxing districts including rural fire protection districts, school districts, ambulance districts, and law enforcement districts. The *Summary* section discusses the effects on the funding and operation of these districts.

Table 3.12-22. Taxing Districts Experiencing Reductions in BOFL Revenue under the Proposed Action (2023–2092) (in 2019 dollars)

County	Districts	BOFL Revenue	% Change Relative to the No Action Alternative	Estimated Annual Payments
Clatsop	Canyon Beach RFPD	$830	-10%	$12
Clatsop	Clatskanie School District 6J	$2,293,717	-57%	$32,767
Clatsop	Elsie Vine Maple RFPD	$1,279,407	-23%	$18,277
Clatsop	Lewis and Clark RFPD	$13,975	-19%	$200
Clatsop	Mist Birkenfeld RFPD	$444,649	-1%	$6,352
Clatsop	Westport Wauna RFPD	$0	-100%	$0
Coos	Lakeside RFPD	$5	-84%	$0
Coos	North Bay RFPD	$0	-100%	$0
Coos	North Bend School 13	$1,649,950	-30%	$23,571
Douglas	Douglas ESD	$301,139	-7%	$4,302
Douglas	Glendale Ambulance District	$665,158	-7%	$9,502
Douglas	Glendale SD 77	$2,949,948	-7%	$42,142
Douglas	Umpqua Community College	$258,777	-7%	$3,697
Lane	Swisshome Deadwood RFPD	$1,811,493	-15%	$25,878
Linn	Gates RFD	$96,985	-17%	$1,386
Marion	Chemeketa Community College	$5,337,577	-13%	$76,251
Marion	Gates FD	$101,553	-41%	$1,451
Marion	Linn-Benton-Lincoln ESD	$728,541	-32%	$10,408
Marion	Marion 4-H Ext	$301,184	-13%	$4,303
Marion	Marion County	$18,222,818	-13%	$260,326
Marion	Marion Soil and Water	$301,184	-13%	$4,303
Marion	Regional Library	$492,737	-13%	$7,039
Marion	Santiam Canyon SD	$16,821,187	-32%	$240,303
Marion	Silver Falls Library	$1,160,050	-8%	$16,572
Marion	Silver Falls School	$13,386,383	-8%	$191,234
Marion	Stayton FD	$233	-44%	$3

RFPD=Rural Fire Protection District; FD=Fire District; SD=School District; ESD=Education Service District

Timber Sale Revenue from CSFL

Under the proposed action, CSFL would generate $156.6 million in timber sale revenues across the study area over the permit term (Table 3.12-23). This represents a $29.6 million (23.4 percent) increase in the timber sale revenues from CSFL as compared to the no action alternative. The greatest increase (60 percent) in average annual revenues under the proposed action would occur during the first decade (2023–2032) of the permit term. The proposed action would result in a decrease in average annual timber sale revenues during 2063–2082.

Table 3.12-23. Timber Sale Revenues from CSFL under the Proposed Action Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Time Period	No Action Alternative	Proposed Action	Difference	Percentage
Average Annual Revenue				
2023–2032	$1,221,988	$1,950,655	$728,668	60%
2033–2042	$2,110,900	$2,585,753	$474,853	22.5%
2043–2052	$1,673,434	$2,625,146	$951,712	57%
2053–2062	$1,719,274	$2,114,912	$395,638	23%
2063–2072	$1,998,428	$1,996,493	-$1,935	-0.1%
2073–2082	$2,586,214	$2,287,097	-$299,117	-12%
2083–2092	$1,386,186	$2,102,517	$716,331	52%
Total Revenue				
2023–2092	$126,964,234	$156,625,731	$29,661,497	23%

Forest Products Harvest Tax

Timber harvests under the proposed action would generate $64.5 million in Forest Products Harvest Tax revenue over the permit term, a 29 percent increase compared to the no action alternative (Table 3.12-24). The differences would be highest during the second decade (2033–2042) and lowest during the last decade (2083–2092).

The increase in tax revenues under the proposed action would translate into a 29 percent increase in funding for each of the tax revenue recipients. The Oregon Forest Land Protection Fund would receive $9.8 million, ODF's Private Forests program would receive $21.6 million, OSU College of Forestry would receive $1.6 million, OSU's forestry research lab would receive $14 million, and the OFRI would receive $17.5 million in funding over the permit term (Appendix 3.12).

Table 3.12-24. Forest Products Harvest Tax Revenue by Decade under the Proposed Action Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Time Period	No Action Alternative	Proposed Action	Difference	Percentage
Average Annual Revenue				
2023–2032	$788,506	$1,023,162	$234,656	30%
2033–2042	$691,148	$1,001,135	$309,987	45%
2043–2052	$702,110	$978,815	$276,704	39%
2053–2062	$720,896	$912,699	$191,802	27%
2063–2072	$708,058	$866,955	$158,897	22%
2073–2082	$683,218	$838,206	$154,988	23%
2083–2092	$697,609	$828,828	$131,220	19%
Total Revenue				
2023–2092	$49,915,448	$64,497,984	$14,582,536	29%

Other State Taxes

Increase in timber harvest activities under the proposed action would increase the need for transportation, fuel, and transient lodging in the timber industry resulting in higher fuel, weight-mile tax, and transient lodging tax revenue collections from the forestry sector compared to the no action alternative. Similarly, higher timber harvest revenues would increase personal and corporate incomes associated with the forestry sector and result in higher personal income tax, corporate income tax, and commercial activity tax revenues collections from the sector. Since the workers and capital employed in the forestry sector under the proposed action are likely to have been employed in other industries under the no action alternative, the increase in timber harvest activities is not likely to result in meaningful increases in total tax collections in Oregon.

Summary

Under the proposed action, increased timber harvests in the permit area would lead to higher revenues from timber sales on both BOFL and CSFL, and tax revenues from the Forest Products Harvest Tax relative to the no action alternative. An increase in timber sale revenue from BOFL would provide higher funding for ODF's State Forests program. Higher timber sales would also increase county payments to all counties in the study area except Marion County. Higher county payments over the permit term would translate to more funding for county governments and their taxing districts.

Most school districts in the study area would receive higher timber sale revenues from both BOFL and CSFL, increasing the share of local revenues in the total pool of state and local revenues distributed to school districts in Oregon. There are five school districts where the proposed action would reduce timber sales within their boundaries relative to the no action alternative. This would result in a decrease in timber sale distributions, which are tied to the location of the sale under ORS 530.115(c). However, the decreases would be offset by funding formula-driven increases in state school support such that these districts would—all else equal—receive the same overall amount of funding.

Higher Forest Products Harvest Tax revenues under the proposed action would provide more funding for emergency fire protection in Oregon through the Oregon Forest Land Protection Fund. Higher funding may enable ODF to better manage commercial activities on private forestlands through their Private Forests program. Higher Forest Products Harvest Tax revenues would also support more education and research on Oregon's forests by increasing financial support for OSU's College of Forestry, OSU's forestry research lab, and the OFRI.

Marion County Government, Marion LCSF, and 26 taxing districts, 11 of which are in Marion County, would experience a reduction in timber revenues from BOFL (Table 3.12-21 and Table 3.12-22). Lower funding for Marion County Government and its LCSF would result in less funding for county government services and lower local revenue for school districts in Marion County. School districts in Marion County and elsewhere would continue to meet their annual funding formula amounts through state school support. Although districts like rural fire protection districts receive funding from other sources like property taxes, BOFL revenue reductions could lead to reduced funding for services.

Alternative 3: Increased Conservation

Timber Sale Revenue from BOFL

Alternative 3 would generate $5.07 billion in timber sale revenues from BOFL over the permit term, a 33 percent increase in revenue relative to the no action alternative but a 1 percent decrease in revenue relative to the proposed action. The increase in total timber revenues would also result in a 33 percent increase in funding for ODF's State Forests program, as well as distributions to the counties where the harvest occurs. Over the 70 years, ODF would receive $1.84 billion in funding while counties in the study area would receive $3.23 billion in funding.

The impact on timber sale revenue distributions for all counties with BOFL and their taxing districts under Alternative 3 would be similar to the impact under the proposed action (Table 3.12-25).

Table 3.12-25. Distributions of BOFL Timber Sale Revenues to Counties under Alternative 3 (2023–2092) (in 2019 dollars)

County	BOFL Revenue	Share of Total Revenue	Estimated Annual Payments	Variation in Annual Payments by Decade (as % of Annual Payments)	% Change Relative to No Action Alternative
Benton	$80,614,328	2%	$1,151,633	41%	59%
Clackamas	$36,454,824	1%	$520,783	57%	43%
Clatsop	$834,662,592	26%	$11,923,751	33%	16%
Columbia	$98,547,456	3%	$1,407,821	46%	69%
Coos	$28,022,794	1%	$400,326	70%	4%
Curry			No BOFL		
Douglas	$13,852,806	0.4%	$197,897	69%	11%
Jackson			No BOFL		
Josephine	$3,131,095	0.1%	$44,730	90%	189%
Lane	$156,042,880	5%	$2,229,184	44%	21%
Lincoln	$161,760,208	5%	$2,310,860	25%	35%
Linn	$159,542,224	5%	$2,279,175	44%	17%
Marion	$97,585,328	3%	$1,394,076	50%	-15%
Multnomah			No BOFL		
Polk	$52,670,364	2%	$752,434	17%	76%
Tillamook	$1,144,281,984	35%	$16,346,885	13%	46%
Washington	$365,810,080	11%	$5,225,858	34%	66%
Yamhill			No BOFL		
Study Area Total	**$3,232,978,963**	**100%**	**$46,185,414**	**13%**	**33%**

BOFL = Bureau of Forests Lands

Marion County would be the only county to experience a decrease in timber sale revenue distributions over the permit term. Under Alternative 3, Josephine County would experience the greatest increase (189 percent) in revenues relative to the no action alternative but $155,143 less than the proposed action over the permit term. An increase in timber sale revenues for all counties except Marion County would lead to an increase in revenue distributed to most taxing districts in the study area during the permit term. Of the 26 taxing districts that experienced a loss under the proposed action, 25 districts would experience a loss under Alternative 3 relative to the no action alternative with the exception of Mist Birkenfeld Rural Fire Protection District. Revenues would decrease for a variety of taxing districts including rural fire protection districts, ambulance districts, and law enforcement districts. See Appendix 3.12 for additional details.

Timber Sale Revenue from CSFL

Under Alternative 3, CSFL would generate $154.8 million in timber sale revenues across the study area over the permit term. This represents a $27.8 million (22 percent) increase in the timber sale revenues from CSFL compared to the no action alternative but a 1 percent decrease compared to the proposed action. Like the proposed action, the greatest increase (60 percent) in estimated annual revenues would occur during the first decade (2023–2032) of the permit term and estimated annual timber sale revenues would decrease during 2063–2082. See Appendix 3.12 for additional details.

Forest Products Harvest Tax

Timber harvests under the Alternative 3 would generate $63.9 million (in 2019 dollars) in Forest Products Harvest Tax revenue over the permit term, a 28 percent increase compared to the no action alternative but a 1 percent decrease compared to the proposed action. The differences would be highest during the second decade (2033–2042) and lowest during the last decade (2083–2092). The increase in tax revenues under Alternative 3 would translate into a 28 percent increase in funding for each of the tax revenue recipients. See Appendix 3.12 for a detailed revenue comparison by decade and by revenue recipient.

Other State Taxes

Alternative 3 would have the same impact as the proposed action relative to the no action alternative for the following: fuel tax, weight-mile tax, transient lodging tax, personal income tax, corporate income tax, and commercial activity tax revenues collections.

Summary

Since impacts on timber sale revenue distributions from BOFL and CSFL and Forest Products Harvest Tax revenue distributions under Alternative 3 are similar to the impacts under the proposed action, the resulting impacts on government services would also be similar. Increased timber harvests in the permit area would lead to higher revenues from timber sales on both BOFL and CSFL, and tax revenues from the Forest Products Harvest Tax relative to the no action alternative. Higher revenues from BOFL and CSFL would result in higher funding for ODF, county governments, and taxing districts. Lower BOFL distributions to 25 taxing districts may reduce their revenues. Higher Forest Products Harvest Tax revenues would provide more funding for the Oregon Forest Land Protection Fund, ODF’s Private Forests program, OSU’s College of Forestry, OSU’s forestry research lab, and the OFRI.

Alternative 4: Reduced Permit Term

Under Alternative 4, impacts on government revenue during the first 50 years of the permit term would be the same as under the proposed action. However, given that the permit term is 20 years shorter and the harvest is not evenly distributed over time and space, the total revenue to taxing districts and jurisdictions would be lower compared to the proposed action.

Alternative 5: Increased Timber Harvest

Timber Sale Revenue from BOFL

Alternative 5 would generate $5.3 billion in timber sale revenues from BOFL over the permit term, a 39 percent increase in revenue relative to the no action alternative and a 3 percent increase compared to the proposed action. The increase in total timber revenues would also result in a 39 percent increase in funding for ODF's State Forests program as well as distributions to the counties where the harvest occurs. Over the 70 years of the permit term, ODF would receive $1.9 billion in funding, and counties in the study area would receive $3.4 billion in funding.

The impact on timber sale revenue distributions for all counties with BOFL and their taxing districts under Alternative 5 would be similar to the impact under the proposed action (Table 3.12-26). Marion County would be the only county to experience a decrease in timber sale revenue distributions over the permit term (-14 percent). Under Alternative 5, Josephine County would experience the greatest increase in revenues relative to the no action alternative (+247 percent). An increase in timber sale revenues for all counties except Marion County would lead to an increase in revenue being distributed to most taxing districts in the study area during the permit term. Revenues would decrease for 19 taxing districts including rural fire protection districts, school districts, ambulance districts and law enforcement districts. Appendix 3.12 provides additional details.

Table 3.12-26. Distributions of BOFL Timber Sale Revenues to Counties under Alternative 5 (2023–2092) (in 2019 dollars)

County	BOFL Revenue	Share of Total Revenue	Estimated Annual Payments	Variation in Annual Payments by Decade (as % of Annual Payments)	% Change relative to No Action Alternative
Benton	$84,712,472	3%	$1,210,178	36%	67%
Clackamas	$37,033,608	1%	$529,052	42%	46%
Clatsop	$886,059,712	26%	$12,657,996	33%	23%
Columbia	$98,639,968	3%	$1,409,142	41%	69%
Coos	$27,699,592	1%	$395,708	60%	2%
Curry			No BOFL		
Douglas	$17,180,728	1%	$245,439	58%	38%
Jackson			No BOFL		
Josephine	$3,751,396	0.1%	$53,591	76%	247%
Lane	$160,206,752	5%	$2,288,668	45%	24%
Lincoln	$168,677,984	5%	$2,409,685	25%	41%
Linn	$163,517,216	5%	$2,335,960	43%	19%
Marion	$98,653,016	3%	$1,409,329	53%	-14%
Multnomah			No BOFL		
Polk	$57,653,740	2%	$823,625	34%	93%
Tillamook	$1,182,686,848	35%	$16,895,526	14%	51%
Washington	$383,201,888	11%	$5,474,313	35%	74%
Yamhill			No BOFL		
Study Area Total	**$3,369,674,920**	**100%**	**$48,138,213**	**13%**	**39%**

Timber Sale Revenue from CSFL

Under Alternative 5, CSFL would generate $164.9 million in timber sale revenues across the study area over the permit term. This represents a $37.9 million (30 percent) increase in the timber sale revenues from CSFL as compared to the no action alternative and a 5 percent increase compared to the proposed action. Like the proposed action, the greatest increase (66 percent) in estimated annual revenues would occur during the last decade (2083–2092) of the permit term and estimated annual timber sale revenues would decrease during 2073–2082 (-10%). See Appendix 3.12 for a detailed revenue comparison by decade.

Forest Products Harvest Tax

Timber harvests under Alternative 5 would generate $66.8 million in Forest Products Harvest Tax revenue over the permit term. This represents a 34 percent increase compared to the no action alternative and a 4 percent increase compared to the proposed action. The differences from the no action alternative would be highest during the second decade (2033–2042) and lowest during the last decade (2083–2092). The increase in tax revenues under the proposed action would translate into a 34 percent increase in funding for each of the tax revenue recipients. See Appendix 3.12 for a detailed revenue comparison by decade and by revenue recipient.

Other State Taxes

Alternative 5 would have the same impact as the proposed action relative to the no action alternative for the following: fuel tax, weight-mile tax, transient lodging tax, personal income tax, corporate income tax, and commercial activity tax revenues collections.

Summary

Since impacts on timber sale revenue distributions from BOFL and CSFL and Forest Products Harvest Tax revenue distributions under Alternative 5 are similar to the impacts under proposed action, the resulting impacts on government services would also be similar. Increased timber harvests in the permit area would lead to higher revenues from timber sales on both BOFL and CSFL, and higher tax revenues from the Forest Products Harvest Tax relative to the no action alternative. Higher revenues from BOFL and CSFL would result in higher funding for ODF, county governments and taxing districts. Lower BOFL distributions to 19 taxing districts may reduce their revenues. Higher Forest Products Harvest Tax revenues would provide more funding for the Oregon Forest Land Protection Fund, ODF's Private Forests program, OSU's College of Forestry, OSU's forestry research lab, and the OFRI.

3.12.3.3 Value of Ecosystem Services

Alternative 1: No Action

Value of Special Forest Products, Hunting, and Fishing

Under the no action alternative, increase in late-seral and old-growth forests would favor abundance of mushrooms, fungi, moss, and berries. Timber harvest sites would continue to provide opportunities for firewood collection although access may change over the permit term. All forest types and associated special forest products would continue to be available, but the supply and distribution relative to existing conditions would shift as forest age and structure shifts. Increases in abundance of special forest products could increase the value people derive from the study area. Decreases in the availability of products could translate into lost income for commercial users or higher travel costs to substitute collection sites for all users including those who collect for subsistence or recreation. New spur roads developed for forest management purposes would expand access to collect special forest products where maintained and open to public access (Table 3.1-4).

Adverse impacts on habitat quality for fish species may adversely affect subsistence and commercial fishing in the permit area if it reduces harvest or increases harvest effort. Changes in forest composition would increase and decrease the kinds of habitat used by elk and deer for foraging and concealment. Changes in habitat may impact species abundance but are unlikely to have a noticeable impact on value for hunting.

Value of Climate Regulation

Based on modeling, net carbon storage—the stock of carbon in the forest—would average 571,095 metric tons carbon dioxide equivalent (MT CO_2e) per year over the analysis period under the no action alternative (Section 3.14, *Greenhouse Gas Emissions and Carbon Storage*), which would have an estimated social value of $27.4 million per year (in 2019 dollars).[2]

Value of Surface Water Quality Regulation

Under the no action alternative, harvest and road construction would degrade surface water quality somewhat due to deposition of sediment, while road closures, vacating, and reforestation would improve surface water quality. Since the region's forests cover only about 1 percent of surface drinking water source areas, both the beneficial and adverse impacts on the provision of drinking water are expected to be minimal. Discernable costs or benefits for water treatment facilities, public health outcomes, or water-based recreation are unlikely.

Value of Sensitive, Threatened, and Endangered Species Habitat Protection

Adverse effects on salmonid, eulachon, and other fish species' habitat would diminish the economic well-being of people who care about their survival. Avoidance of harvest in areas occupied by listed terrestrial species and modeled increases in terrestrial habitat would benefit these species. Habitat fragmentation and lack of long-term monitoring and adaptive management would adversely affect these species and the economic well-being of people who value their continued survival.

Value of Cultural Services

Forest visitors tend to prefer old-growth and late-seral forests that look natural and unmanaged, which would increase under the no action alternative (Shelby et al. 2005; Kearney et al. 2010). To the extent people use these forest settings to satisfy spiritual and cultural values, those benefits may increase. Existing facilities that deliver forest-based educational services within the study area would continue to operate and produce value. Potential impacts on cultural resources are described in Section 3.10.

Alternative 2: Proposed Action

Value of Special Forest Products, Hunting and Fishing

Continued availability of all types of forest structures over the permit term would result in similar levels of collection of special forest products under the proposed action as under the no action

[2] Though the International Working Group report does not provide estimates for the social cost of carbon in emissions years after 2050, we applied the current emissions year value of $51 per metric ton of carbon dioxide for the entire analysis period.

alternative. Taken together, increased mid-seral forests, decreased late-seral forests, and limitations on salvage harvests in HCAs and RCAs would increase the supply of salal and berries and decrease the supply of mushrooms and moss relative to the no action alternative. Increase in timber harvests would favor firewood collection. New spur roads developed for forest management purposes would expand access to collect special forest products where maintained and open to public access.

Based on modeling, the proposed action would favor species dependent on mid-seral forests while reducing habitat for species dependent on late-seral forests. Continued availability of all habitat types in the permit area would limit beneficial or adverse impacts on the value of hunting species like elk and deer. Modeled increases in harvest and road construction would increase associated adverse effects on fish and stream-dependent wildlife, but expanded riparian and aquatic protections would better offset these effects which could benefit recreational fishing (Section 3.6, *Fish and Wildlife*) (Tables 3.1-1 through 3.1-4).

Value of Climate Regulation

Based on modeling, net carbon storage would average 467,017 MT CO_2e per year over the permit term under the proposed action (Section 3.14), which would have an estimated social value of $22.4 million per year (in 2019 dollars). This is about $5 million less annually than under the no action alternative.

Value of Water Quality Regulation

Under the proposed action, Conservation Actions 1, 2, 3, 4, 5, and 11 would increase protection of surface water and mitigate adverse effects from increased timber harvests and road activities on water quality compared to the no action alternative. The overall impact on water quality for drinking and recreational use is expected to be similar to the no action alternative.

Value of Sensitive, Threatened and Endangered Species Habitat Protection

The proposed action would allow take of listed species and modeled habitat would decrease compared to the no action alternative. The conservation strategy, however, would minimize and mitigate these adverse impacts, and long-term monitoring and adaptive management would increase certainty that the conservation needs of the species in the study area would be met. The resulting impact on the economic wellbeing of people who care about ongoing species existence would be minimal relative to the no action alternative.

Value of Cultural Services

Based on modeling, there would be less of an increase in late-seral forests under the proposed action, which would result in adverse effects on value for forest visitors with a preference for the forest type compared to the no action alternative. Existing facilities that deliver forest-based educational services in the study area would continue to operate and produce value. Modeled increases in spur roads under the proposed action may provide increased opportunities for enjoying the cultural services ODF forests provide (Table 3.1-4). Potential impacts on cultural resources are described in Section 3.10.

Alternative 3: Increased Conservation

The impacts on ecosystem services under Alternative 3 would be similar to the proposed action. Based on modeling, Alternative 3 would result in carbon storage amounting to a social value of $23 million per year over the permit term (in 2019 dollars), a 17 percent decrease compared to the no action alternative, but a 1 percent increase relative to the proposed action. Increased aquatic protection would likely increase beneficial effects on water quality but is unlikely to affect treatment costs for drinking water or water quality for recreation. Expanded RCAs may improve habitat connectivity and benefit riparian species. Overall, however, it is unlikely that these provisions would meaningfully increase the value people derive from the ecosystem across the study area.

Alternative 4: Reduced Permit Term

The impacts on ecosystem services under Alternative 4 would be similar to the proposed action for the first 50 years.

Alternative 5: Increased Timber Harvest

The impacts on ecosystem services under Alternative 5 would be similar to the proposed action except for carbon sequestration. Based on modeling, increased timber harvest under Alternative 5 would result in carbon storage amounting to a social value of $21 million per year (in 2019 dollars) over the permit term, a 23 percent decrease compared to the no action alternative and a 6 percent decrease relative to the proposed action.

3.12.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions*, that would overlap with impacts of the proposed action and alternatives on socioeconomic conditions in the study area.

Reduced vegetation growth, increased tree mortality, and increased frequency of disturbance events with climate change will reduce available timber and projected timber harvest in the permit area. This will reduce private and public revenue generated from timber harvests, as well as the associated labor benefits.

Continued forest management adjacent to the plan area, specifically timber harvests on federal forestlands, provides government revenue to counties in the study area and will continue to provide revenue for government services in the study area

Development adjacent to the plan area will increase residential population, increasing demand for employment in local industries, including the timber industry, and demand for government services, some of which are funded by government revenue from timber harvest. Commercial development adjacent to the plan area may lead to the expansion of businesses and industries that provide the study area population with alternative sources of employment.

Increased demand for recreation activities and development of the outdoor recreation sector in western Oregon will create jobs and provide employment to the communities in the study area.

Changes in revenue distribution policy and tax policy in Oregon will change the amount of Forest Products Harvest Tax revenue available to federal agencies including ODF and the amount of revenue that counties and their taxing districts can use to fund various government services in the study area.

3.13 Environmental Justice

3.13.1 Methods

The study area for environmental justice (EJ) impacts includes all counties that overlap with the plan area (Figure 3.13-1). The study area also includes tribal nations that reside within these counties. In addition to the communities within the study area, the analysis considers impacts on people and tribal nations that do not reside within the study area but rely on or hold value for the goods and services from lands and waters in the plan area. This multi-level study area aligns with the intent of Executive Order (EO) 14008, EO 12898, and regulatory guidance (Federal Interagency Working Group on Environmental Justice and NEPA Committee 2016) that emphasizes investigating all pathways of potential impact and exposure to identify vulnerable populations (e.g., minority and low-income children, pregnant women, elderly, or groups with high asthma rates) that may experience potential disproportionately high and adverse impacts.

EO 12898 defines EJ populations as "low-income" and "minority" communities residing in the United States that relevant federal actions may affect. To identify EJ populations, this analysis used demographic and income data from the U.S. Census Bureau's 2015–2019 American Community Survey (2015–2019 ACS data).[1] "Low income" uses the Census household poverty threshold definition. Geographies where the proportion of low-income or minority populations is "meaningfully greater" than the underlying geography (e.g., the county or state that contains the geography) are EJ populations.

An EJ impact occurs when an adverse impact disproportionately affects an EJ population. The first part of this analysis identifies the EJ populations in the study area. The second part screens the adverse impacts identified throughout this EIS for disproportionate harm to EJ populations, either because the impact is concentrated in a particular geography or on a resource that EJ populations depend on and hold value for. The EJ analysis also identifies effects that are disproportionately beneficial to EJ populations.

3.13.2 Affected Environment

3.13.2.1 Environmental Justice Counties and Census Tracts

Minority and Low-Income Counties

Minority groups make up 24 percent of Oregon's population (2015–2019 ACS data). Compared to the state of Oregon, the minority population is higher in the following counties in the study area: Marion (34 percent), Multnomah (30 percent), and Washington (34 percent) (Table 3.13-1). These counties are likely to contain EJ populations and are shown in Figure 3.13-1 as blue and green.

About 13 percent of Oregon's population reported annual household incomes lower than the Census poverty threshold. In the study area, 10 counties have a higher share of the population below this threshold compared to the state: Benton (19 percent), Coos (16 percent), Douglas (15 percent),

[1] Since 2015–2019 American Community Survey data for census block groups has large margins of error, census tracts were chosen as the smallest geography for identifying EJ populations.

Jackson (16 percent), Josephine (18 percent), Lane (18 percent), Lincoln (16 percent), Linn (13 percent), Marion (14 percent), and Multnomah (14 percent) (Table 3.13-1). These counties are shown in Figure 3.13-1 as yellow and green.

Minority and Low-Income Census Tracts

There are 709 census tracts within the study area, of which 424 (60 percent) meet the criteria for EJ populations, either for minority population, low-income status, or both indicators. Thirty-six tracts have a minority population above 50 percent. Including these, 308 tracts had higher shares of minority populations than their respective counties. Compared to county populations with annual household income lower than the Census poverty threshold, 302 census tracts are considered EJ populations for income. About 44 percent of the identified tracts—186 tracts—meet EJ criteria for both minority populations and income (Table 3.13-2). Tracts in Figure 3.13-1 that meet EJ criteria for minority populations are shown with dots. Tracts that meet EJ criteria for low-income populations are shown with diagonal lines. These overlap for tracts that meet both criteria. The U.S. Census Bureau derives demographic data at the tract level statistically, and these estimated data are somewhat uncertain. However, inclusion of all tracts meeting threshold criteria in this analysis represents a conservative approach.

Table 3.13-1. Summary of Minority and Low-Income Populations in the Study Area

Geography	Total Population	Minority		Low-Income	
		Population	Percentage	Population	Percentage
Oregon	4,129,803	1,003,961	24%	533,527	13.17%
Benton County [a]	91,107	18,024	19.78%	16,319	19.09%
Clackamas County	410,463	74,243	18.09%	32,603	8.00%
Clatsop County	39,102	5,662	14.48%	3,864	10.03%
Columbia County	51,375	5,897	11.48%	5,928	11.66%
Coos County [a]	63,686	9,390	14.74%	10,111	16.15%
Curry County	22,650	3,114	13.75%	2,796	12.43%
Douglas County [a]	109,114	13,272	12.16%	15,801	14.65%
Jackson County [a]	216,574	41,516	19.17%	33,234	15.52%
Josephine County [a]	86,251	11,298	13.10%	15,384	18.12%
Lane County [a]	373,340	67,887	18.18%	64,457	17.62%
Lincoln County [a]	48,547	8,513	17.54%	7,794	16.27%
Linn County [a]	125,048	18,865	15.09%	16,376	13.27%*
Marion County [a, b]	**339,641**	117,287	34.53%	**46,970**	**14.23%**
Multnomah County [a, b]	**804,606**	243,844	30.31%	**108,947**	**13.79%**
Polk County	83,037	18,200	21.92%	10,263	12.64%
Tillamook County	26,389	4,131	15.65%	3,365	13.11%
Washington County [b]	**589,481**	202,025	34.27%	**52,106**	**8.92%**
Yamhill County	104,831	23,872	22.77%	12,117	12.14%
Total Counties	2,847,395	387,499	26%	387,499	14%
Total Census Tracts	2,210,069	662,099	30%	349,466	16%

Source: U.S. Census Bureau 2021a, 2021b

[a] (Grayed cell) Counties with percentage of low-income population greater than Oregon’s.

[b] (Bolded) Counties with percentage of minority population greater than Oregon’s.

Figure 3.13-1. Counties and Census Tracts with Environmental Justice Populations

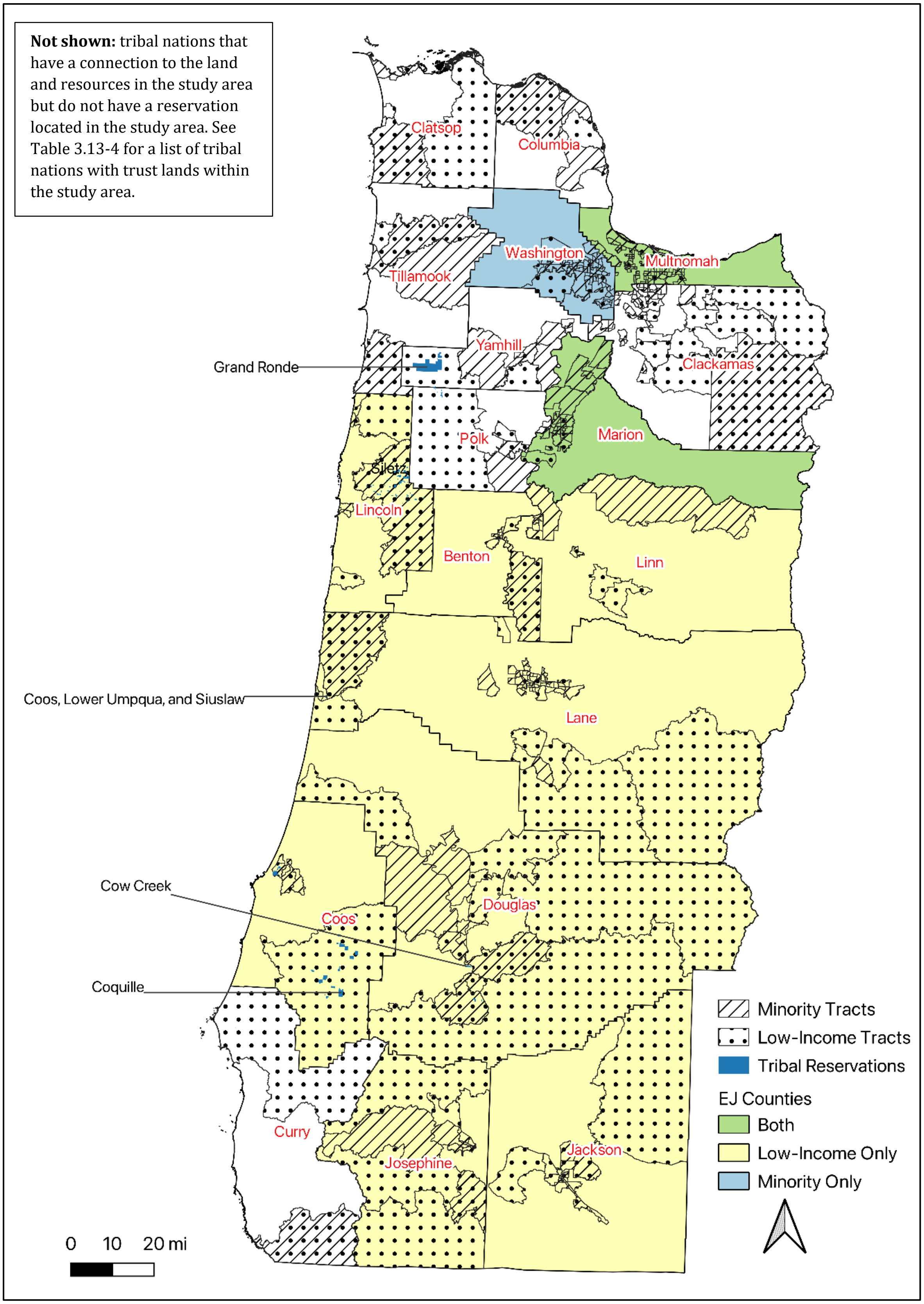


Table 3.13-2. Number of Counties and Census Tracts in the Study Area that Meet the Criteria for Minority and Low-Income Populations

	Number of Geographies			
Geographies	**Minority Only**	**Low-Income Only**	**Both**	**Total**
Counties	1	8	2	11
Census Tracts	122	116	186	424

3.13.2.2 Tribal Nations

Tribal nations included in the EJ analysis represent both tribes with reservations within the study area (Table 3.13-3) and tribes that have a connection to the land and resources in the study area as described in Section 3.11, *Tribal Resources*.

Table 3.13-3. Summary of Low-Income Populations in Tribes with Reservations or Trust Lands in the Study Area or with connections to the Study Area

Tribal Area	County	Total Population	Percentage below Poverty Level
Confederated Tribes of Siletz Indians Reservation and Off-Reservation Trust Land	Lincoln	689	26.5%
Confederated Tribes of the Grand Ronde Community of Oregon	Polk, Yamhill	586	33.4%
Coquille Indian Tribe Reservation	Coos	448	18.4%
Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians; Reservation and Off-Reservation Trust Land	Coos, Curry, Lane	166	15.9%
Cow Creek Band of Umpqua Tribe of Indians Reservation and Off-Reservation Trust Land	Douglas	194	26.7%
Klamath Tribes	Klamath	38	71.1%
Confederated Tribes of the Umatilla Indian Reservation and Off-Reservation Trust Land	Umatilla	2,836	16.6%
Confederated Tribes of the Warm Springs Reservation and Off-Reservation Trust Land	Clackamas, Gilliam, Hood River, Jefferson, Sherman, Wasco	4,188	32.3%
Burns Paiute Indian Colony and Off-Reservation Trust Land	Harney	94	25%
Confederated Tribes and Bands of the Yakama Nation	Washington State	30,654	21.7%
Shoalwater Bay Indian Reservation and Off-Reservation Trust Land	Washington State	90	15.6%
Smith River Reservation and Off-Reservation Trust Land	California State	97	28.1%
Elk Valley Rancheria and Off-Reservation Trust Land	California State	77	31.2%

Source: U.S. Census Bureau 2021c

3.13.3 Environmental Consequences

3.13.3.1 Alternative 1: No Action

The impact analysis for air quality, aesthetics, and greenhouse gas (GHG) emissions and carbon storage (Sections 3.7, *Air Quality*, 3.8, *Aesthetics and Visual Resources*, and 3.14, *Greenhouse Gas Emissions and Carbon Storage*) did not identify any adverse impacts under the no action alternative. As a result, there are no adverse impacts associated with these resources that could have a disproportionate effect on the EJ populations identified in the study area. Adverse impacts on geology and soils, water resources, vegetation, fish and wildlife, and tribal resources (Sections 3.3, *Geology and Soils*, 3.4, *Water Resources*, 3.5, *Vegetation*, 3.6, *Fish and Wildlife*, and 3.11) on EJ populations in the study area are analyzed through their impacts on recreation and socioeconomic resources, specifically value of ecosystem services, in the study area.

Recreation

Under the no action alternative, ODF would continue to maintain existing developed recreational facilities and develop new recreational facilities depending on its management plans during the permit term (Section 3.9, *Recreation*). Adverse impacts on habitat quality of most fish species could adversely affect recreational fishing in the study area over the permit term (Section 3.6, Section 3.9). Since recreational fishing—distinct from its subsistence purpose described under *Value of Ecosystem Services*—does not draw a disproportionate share of minority and low-income participants in Oregon, the impacts on EJ populations are not likely to be disproportionately high and adverse (OPRD 2019).

Cultural Resources

Under the no action alternative, ODF's forest and recreational management activities could adversely affect cultural resources through ground disturbances or changes in setting (Section 3.10, *Cultural Resources*). However, ODF will comply with state law and the Memorandum of Agreement between ODF and SHPO (ODF 2002), which requires ODF to preserve and protect archaeological and cultural resources during forest management activities. ODF is also required to mitigate adverse impacts on cultural resources. Potential cultural resource impacts on EJ populations would depend on the resources affected and the extent to which EJ communities engage with that resource; however, the impacts are not expected to be high or adverse because ODF would comply with these requirements.

Socioeconomic Resources

Income and Employment

Under the no action alternative, timber harvest on BOFL and CSFL would continue to support employment and labor income over the analysis period. Harvest and associated employment and income would vary over time, with some decades experiencing higher harvests than others. Harvest and employment would also vary across the study area with some counties like Curry, Jackson, and Josephine experiencing lower levels of timber harvest and associated jobs than counties like Clatsop and Tillamook (Section 3.12, *Socioeconomics)*.

Fluctuations in levels of harvest-related employment and associated labor income would disproportionately affect households with members who are directly employed in the timber industry. These households often have fewer financial resources to absorb economic shocks like sudden loss of work. Some of these impacts may be felt in areas where processing takes place distant from state timberlands. Although the workforce in the forestry sector is predominantly non-Hispanic white, Hispanic and Latino workers are the second largest ethnic group to be employed in the sector nationally (U.S. Bureau of Labor Statistics 2021). Fluctuations in timber harvest on state lands over time may also adversely affect tribal members employed in the industry and timber available for tribal enterprises (Section 3.11). Loss of direct employment and income would also reduce expenditures on goods and services in the study area, further reducing indirect employment and income, particularly in rural areas of western Oregon where timber harvest takes place and the economy is generally less diversified (Oregon Employment Department 2017:11). These areas disproportionately overlap with the EJ census tracts that qualify based on income thresholds (Figure 3.13-1). In the long run, disproportionate impacts arising from changes in employment and income for EJ populations are less clear, as the economy will adjust to shifting trends in harvest on state lands in ways that could either amplify or minimize impacts on EJ populations, depending on underlying economic conditions.

Government Revenue

Under the no action alternative, revenue transfers from timber harvest on BOFL would continue to support county governments in all counties in the study area (Section 3.12). Decades when revenue transfers are lower than expected compared to previous decades could adversely affect public services with already limited funding like fire protection and could result in disproportionately high and adverse impacts on counties identified as EJ populations. The actual impact of changes in revenue transfers on public services would depend on revenue allocation decisions made by the affected governments and taxing districts over the permit term and as such cannot be estimated. Similarly, fluctuations in timber harvest over time may result in temporary decreases in Forest Products Harvest Tax revenue collections but the eventual impact on public services would rely on revenue allocation decisions of the funded entities and thus cannot be estimated (Section 3.12).

Value of Ecosystem Services

The no action alternative would produce both beneficial and adverse disproportionate impacts for EJ populations arising from changes in forest structure that influence the supply of ecosystem goods and services.

Modeled increase in the extent of late-seral forests, especially in areas occupied by federally listed species, would increase the productivity of some habitats and species used for subsistence by EJ communities in the study area, including mushrooms. Other materials important for cultural and spiritual value, including medicinal and basketry materials, may also become more plentiful with increases in late-seral forests. Availability of a variety of forest types used by species like deer and elk would support hunting for commercial and subsistence use. To the extent that adverse impacts on habitat quality for fish would decrease harvest or increase harvest efforts, it would represent a disproportionate effect on some EJ populations, especially tribal populations and some rural low-income residents that disproportionately rely on subsistence resources and ways of life (Section 3.12).

- Removal of mid- to late-seral forests and ground disturbance during harvest activities would reduce supply of some resources.
- Localized harvest disturbance would adversely affect some wetland species, berries, salal, evergreen boughs and floral greens, and other food, medicinal, and fiber resources.

- Declining harvest levels could result in less firewood collection areas for personal and commercial use (Section 3.11, Section 3.12).

These products are harvested for subsistence, cultural tradition, and as sources of supplemental income for local lower-income communities and tribes (Section 3.11; OFRI 2021). While timber harvest may adversely affect supply of these products in localized areas, shifting patterns of forest composition would generally ensure a continued supply of nontimber forest products in mid- to late-seral forests throughout the permit area. However, shifting distributional patterns could reduce access for some populations, producing disproportionate adverse impacts for those most dependent on the resource and least able to adapt to changes and increased travel costs. Adverse impacts would be particularly high for Grande Ronde, Siletz, Coos, Lower Umpqua and Siuslaw, Coquille, and Cow Creek Tribes in the Coast Range (Section 3.11), given that some of these resources have cultural value specific to place and tradition that is not easily substituted by resources from elsewhere or other types of resources.

3.13.3.2 Alternative 2: Proposed Action

Impacts on EJ populations under the proposed action related to geology and soils, air quality, aesthetics, cultural resources, and GHG emissions and carbon storage would be the same as described for the no action alternative. Adverse impacts on recreation and socioeconomic resources could result in disproportionate impacts for EJ populations.

Recreation

Under the proposed action, seasonal restrictions under Conservation Action 10 near habitat of federally listed species may delay maintenance of developed recreational facilities resulting in temporary adverse impacts on the supply of recreation in the permit area compared to the no action alternative (Section 3.9). If these adverse impacts occur with a high frequency in the Santiam State Forest that lies in Marion and Linn Counties—both counties with higher EJ populations—it could result in disproportionate EJ impacts. The 2019–2023 Statewide Comprehensive Outdoor Recreation Plan for Oregon conducted a survey of Oregon residents and found low-income respondents' lack of transportation options and distance to parks presented barriers for accessing outdoor recreation (OPRD 2019). Since lower-income communities are less likely to travel farther distances to access other recreational facilities due to constraints on transportation and financial resources, the proposed action could result in disproportionately high and adverse impacts on EJ populations (Lamborn et al. 2017).

Based on modeling, the supply of older (late-seral) forest stands would decrease compared to the no action alternative, which would result in lower recreational value for hikers and backpackers who prefer older forests (Section 3.5, *Vegetation*). Users may travel to other regions in the permit area or to other parks to access these older forests to maintain their enjoyment of hiking or backpacking but this travel is likely to generate additional costs of travel and higher disproportionate impacts on EJ populations. Low-income and minority communities tend to participate less in outdoor recreation than higher income and non-Hispanic white communities in Oregon (OPRD 2019), potentially a reflection of existing barriers to enjoyment stemming from low-income and minority status. The additional travel costs of accessing older forest stands would exacerbate existing inequality and deepen the gap in participation in Oregon.

Socioeconomic Resources

Income and Employment

Based on modeling, timber harvest and associated employment would increase over the permit term for the study area as a whole under the proposed action compared to the no action alternative (Section 3.12) (Tables 3.1-1 through 3.1-3). However, Coos, Jackson, Josephine, and Marion Counties are identified EJ populations that would likely experience an overall decrease in timber harvest and direct employment over the permit term (Section 3.12). In the long run, disproportionate impacts arising from changes in employment and income for EJ populations are less clear, as the economy is likely to adjust to shifting trends in harvest on state lands in ways that could either amplify or minimize adverse impacts on EJ populations, depending on underlying economic conditions.

Government Revenue

Based on modeling, increased timber harvest in the permit area compared to the no action alternative would increase government revenue, resulting in lower adverse impacts on EJ populations under the proposed action than the no action alternative (Section 3.12). Only the Marion County government and 20 taxing districts would experience an overall decrease in government revenue over the permit term. Since Marion County is an identified EJ community and 19 of the 20 adversely affected taxing districts are either located in an EJ county or overlap with an EJ census tract (Table 3.13-5), adverse impacts on public services may result in disproportionately high and adverse impacts on EJ populations. The actual impact of decreases in revenue transfers on public services would depend on revenue allocation decisions made by the affected governments and taxing districts over the permit term and as such cannot be estimated.

Table 3.13-4. Overlap of Adversely Affected Taxing Districts under the Proposed Action and Identified EJ Populations

County	Districts	EJ County	EJ Census Tract
Clatsop	Canyon Beach RFPD	No	Both Low-income and Minority
Clatsop	Elsie Vine Maple RFPD	No	Low-income
Clatsop	Lewis and Clark RFPD	No	No
Clatsop	Mist Birkenfeld RFPD	No	Low-income
Clatsop	Westport Wauna RFPD	No	Low-income
Coos	Lakeside RFPD	Yes	No
Coos	North Bay RFPD	Yes	No
Douglas	Glendale Ambulance District	Yes	*
Douglas	Umpqua Community College	Yes	*
Lane	Swisshome Deadwood RFPD	Yes	No
Linn	Gates RFD	Yes	Minority
Marion	Chemeketa Community College	Yes	*
Marion	Gates FD	Yes	No
Marion	Marion 4-H Ext	Yes	*
Marion	Marion County	Yes	*
Marion	Marion Soil and Water	Yes	*
Marion	Regional Library	Yes	*
Marion	Santiam Canyon SD	Yes	No

County	Districts	EJ County	EJ Census Tract
Marion	Silver Falls Library	Yes	*
Marion	Stayton FD	Yes	No

Source: ECONorthwest's analysis of spatial overlap between identified EJ counties and census tracts and Rural Fire Protection Districts.
* Spatial data not available for taxing district

Value of Ecosystem Services

Modeled decreases in late-seral stands over the permit term under the proposed action compared to the no action alternative would reduce the supply of mushrooms and moss, adversely affecting EJ and tribal communities. However, modeled increases in mid-seral and old-growth stands would better support supply of other special forest products relied on for subsistence (Section 3.12). Expanded protections in RCAs and habitat conservation areas would reduce adverse impacts for EJ communities by increasing supply of riparian plants and subsistence fishing (Section 3.11). Modeled increases in harvest compared to the no action alternative would maintain or increase firewood collection areas and species/resources associated with early-seral stands, although changes in the distribution of harvest across the permit area may still disproportionately affect EJ communities by increasing travel costs. Increases in timber harvest levels overall may also disrupt collection of special forest products by disrupting access to specific collection sites.

3.13.3.3 Alternative 3: Increased Conservation

Impacts on EJ populations under Alternative 3 related to geology and soils, air quality, aesthetics, cultural resources, and GHG emissions and carbon storage would be the same as described for the no action alternative. Impacts on recreation and socioeconomics would be the same as described for the proposed action with a few exceptions. One fewer taxing district (Mist-Birkenfeld Rural Fire Protection District) would experience net decreases in BOFL timber sale revenues transfers under Alternative 3 (Section 3.12) and as a result EJ populations would be less adversely affected under Alternative 3. Furthermore, larger RCAs would maintain more riparian areas with complex understories increasing supply of riparian plants and reducing adverse impacts on EJ populations, specifically tribal members (Section 3.11). Expanded riparian protections would also support improved habitat for fish and wildlife species, increasing the potential for EJ communities to fish and hunt for food and recreation in the permit area (Section 3.11).

3.13.3.4 Alternative 4: Reduced Permit Term

Effects would be the same as described for the proposed action during the first 50 years of the permit term.

3.13.3.5 Alternative 5: Increased Timber Harvest

Impacts on EJ populations under Alternative 5 related to geology and soils, air quality, aesthetics, cultural resources, and GHG emissions and carbon storage would be the same as described for the no action alternative. Impacts on recreation and socioeconomic resources would be the same as described for the proposed action except seven fewer taxing districts would experience net decreases in BOFL timber sale revenues transfers under Alternative 5 and as a result EJ populations would be less adversely affected.

3.13.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2, *Reasonably Foreseeable Trends and Planned Actions*, that would overlap with impacts of the proposed action and alternatives on EJ populations in the study area.

Climate change will slow vegetation growth and increase tree mortality, reducing available timber and thus the projected timber harvest in the permit area. Reduction in timber harvest would reduce the private and public revenue generated from timber harvest and associated labor benefits, resulting in an adverse impact on socioeconomic conditions in the study area that could result in disproportionately high and adverse impacts for EJ populations.

Increased frequency of disturbance events will increase tree mortality, reducing timber harvest in the permit area. This would reduce private and public revenue generated from timber harvest and associated labor benefits, resulting in an adverse impact on socioeconomic conditions in the study area that could result in disproportionately high and adverse impacts for EJ populations.

Forest management adjacent to the plan area (specifically on federal forestlands) provides government revenue to counties in the study area. If current forest management activities continue, timber harvest in federal forestlands would continue to be a source of revenue for government services accessed by EJ populations in the study area.

Development adjacent to the plan area would increase the resident population and commercial activity in the study area. Higher population in the study area would increase demand for employment in local industries, including the timber industry, and government services, several of which are funded by government revenue from timber harvest activities. Commercial development may result in the expansion of businesses and industries that provide the population in the study area with alternative sources of employment. Changes to private and public employment would change income and employment for EJ populations in the study area.

Changes in revenue distribution policy and tax policy in Oregon would change the amount of Forest Products Harvest Tax revenue available to federal agencies, including ODF, and the amount of revenue that counties and their taxing districts can use to fund various government services in the study area. This would change the socioeconomic conditions for the counties and any adverse impacts experienced by EJ populations in the study area.

3.14 Greenhouse Gas Emissions and Carbon Storage

3.14.1 Methods

The study area for climate change encompasses the plan area, where covered activities would result in direct emissions during construction and operations or affect carbon storage. This section, however, describes the study area considering regional and global meteorology and climatic trends.

For this document, we analyzed climate change based on the Council on Environmental Quality (CEQ) 2016 final guidance with the understanding that CEQ may update this guidance.[1] The CEQ 2016 final guidance recommends that agencies address climate change by considering (1) the effects of climate change on a proposed action and its environmental impacts, and (2) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (CEQ 2016:4). This section focuses on the potential effects of the proposed action and alternatives on climate change as indicated by assessing GHG emissions. Section 3.2, *Reasonably Foreseeable Environmental Trends and Planned Actions*, and Appendix 3.2, *Disturbance and Climate Change*, further describe the anticipated future effects of climate change. The effects of climate change on the proposed action and alternatives and their environmental impacts are described in the other resource sections within this chapter.

GHG emissions and carbon storage were quantified, based on available data, for the following covered activities: timber harvest activities, reforestation and young stand management, and road system management. Appendix 3.14, *Greenhouse Gas Emission and Carbon Sequestration Quantification Methods and Results*, presents additional detail on the quantification methods and estimates for these covered activities. For covered activities where emission data were not available or emissions were considered negligible, GHG emissions were addressed qualitatively.

3.14.2 Affected Environment

This section defines GHGs and describes the relationship between GHG emissions, carbon sequestration, and global climate. Earth absorbs heat energy from the sun as ultraviolet and visible light and returns most of this heat to space as infrared radiation. GHG molecules allow the energy from the sun to pass through the atmosphere but trap the infrared radiation, reradiating it back to Earth's surface, thereby warming the atmosphere. This process, known as the greenhouse effect, is responsible for maintaining Earth's surface temperatures at temperatures substantially higher than in the absence of GHGs. Most GHGs, including CO_2, methane (CH_4), nitrous oxide (N_2O), water vapor, and ozone (O_3), occur naturally. Human activities, such as fossil-fuel combustion and the use of several industrial gases that are GHGs, are the source of GHG emissions.

[1] On January 20, 2021, President Biden signed Executive Order 13990, which, among other things, called for the Council on Environmental Quality (CEQ) to rescind its 2019 draft guidance entitled, "Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions" and review, revise, and update its 2016 final guidance entitled, "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews" (86 FR 7037). On February 19, 2021, CEQ officially rescinded the 2019 draft guidance and reinstated the 2016 final guidance (86 FR 10252).

The Intergovernmental Panel on Climate Change (IPCC) has predicted that the increase of global mean surface temperature by the end of 2100 relative to 1850–1900 could range anywhere from approximately 1.3°C to 4.4°C, which could have substantial adverse impacts on the natural and human environments (IPCC 2021:19). This buildup of GHGs in the atmosphere is changing Earth's energy balance and causing the planet to warm, which in turn affects sea levels, precipitation patterns, cloud cover, ocean temperatures and currents, ocean acidification, polar snow and ice accumulation, and other climatic conditions.

A carbon pool (or storage) is a system that has the capacity to accumulate or release carbon. Transfer of carbon from the atmosphere to any other carbon pool is called carbon sequestration. Sequestration occurs in forests when plants absorb CO_2 through photosynthesis and convert it to carbon in plant biomass and soil. Live vegetation (e.g., trees, foliage, live roots, and understory vegetation) and the forest floor/soils typically accumulate carbon while dead vegetation (e.g., standing dead trees, dead roots, and downed wood) emits carbon into the atmosphere through cellular respiration and decomposition. The absolute quantity of carbon that has been sequestered from the atmosphere and stored within the forest ecosystem at a specified time is called forest carbon stock. A carbon pool is deemed a carbon sink if, during a given time interval, more atmospheric carbon flows into it than flows out of it.

3.14.3 Environmental Consequences

Under the proposed action and alternatives, forest and recreation management activities would result in GHG emissions related to vehicle and equipment use and controlled burns, while forest stands, vegetation, and soils would sequester carbon from the atmosphere and store carbon in the plan area. The amount of GHG emissions would vary under the proposed action and alternatives depending on the level of forest and recreation management activities. Similarly, the amount of carbon sequestered and stored in trees, vegetation, and soils would vary under the proposed action and alternatives depending on the amount of timber harvest, vegetation removal, and soil disturbance, with timber harvest being the primary driver.

GHG emissions and carbon sequestration were quantified based on available data for timber harvest activities, reforestation and young stand management, and road system management. Based on this analysis, under all alternatives for all analyzed years, the plan area would sequester much more carbon than quantified covered activities would emit (Appendix 3.14, Table 1). Even for the alternative and analysis year with the smallest increase in carbon sequestration and the highest increase in emissions (Alternative 5 in year 2023), the plan area would still sequester more than five times as much carbon as the quantified covered activities would emit, resulting in a net carbon sink. For all other alternatives and analysis years, the carbon sinks would be even larger.

GHG emissions from covered activities that were not quantified would subtract from the carbon pool under all alternatives; however, the plan area is expected to be a carbon sink, with sequestration greatly outweighing emissions, for the following reasons. Although controlled burns would emit GHGs, they are implemented in part to reduce the extent, severity, and emission intensity of future wildfires. Therefore, controlled burns are expected to result in an overall net reduction in GHG emissions over the analysis period. Emissions from vehicles and equipment exhaust from other forest and recreation management activities (i.e., minor forest-product harvest, quarries and auxiliary facilities, recreation infrastructure and maintenance, and road maintenance and vacating) would be negligible in scale relative to the quantified net sequestration. Therefore, the proposed action and alternatives would not contribute to climate change and this impact would not be adverse.

3.14.4 Trends and Planned Actions

This section describes impacts of the trends and planned actions identified in Section 3.2 that would overlap with impacts of the proposed action and alternatives on GHGs and carbon sequestration. Increased frequency of disturbance events will cause increased drought and wildfires, contributing to forest mortality. Increased forest mortality will reduce the amount of carbon stored in forest stands, affecting overall carbon sequestration.

Chapter 4
Summary of Submitted Alternatives, Information, and Analyses

This chapter summarizes the alternatives, information, and analyses submitted by state, tribal, and local governments and other public commenters during the scoping process for consideration by the lead and cooperating agencies in developing the EIS (40 Code of Federal Regulations [CFR] 11 1502.17). Comments and any supplemental materials received during scoping are included in Appendix 1-C, *Scoping Report*, Attachment A, and are available on Regulations.gov at https://www.regulations.gov/document/NOAA-NMFS-2021-0019-0001/comment. NMFS invites public comments on this summary of submitted alternatives, information, and analyses during the public review period of the Draft EIS.

Comments received during scoping included the following suggestions on alternatives.[1]

- Shorten the permit term to 30 or 50 years.
- Modify covered species to remove nonlisted species and/or species with limited data.
- Modify the aquatic conservation strategy by changing widths and applicability of riparian buffer widths, buffering additional landslide initiation sites, limiting hydrologically connected roads, and changing allowable management practices in riparian conservation areas (RCAs).
- Modify the terrestrial conservation strategy by changing the acreage included in habitat conservation areas (HCAs), changing methods for designating HCAs, and changing allowable management practices in HCAs.
- Modify management outside of RCAs and HCAs by changing the management standards and allowable practices.

The following supplemental information (i.e., supplemental materials or references) was submitted during scoping for consideration by the lead and cooperating agencies in developing the EIS.

- Expert testimony of Marwan A. Hassan, PhD from United States District Court, District of Oregon, Portland Division, Center for Biological Diversity et al., vs. Daugherty et al. and Oregon Department of Forestry Industries Council et al. regarding the impact of timber sales and roads in the Tillamook and Clatsop States Forests on Oregon coast coho salmon and their freshwater habitats.
- Expert report of Thomas P. Quinn, PhD from United States District Court, District of Oregon, Portland Division, Center for Biological Diversity et al., vs. Daughtry et al. and Oregon Department of Forestry Industries Council et al. regarding the behavior, ecology, and habitat requirements of coho salmon, particularly focused on the species' needs in the freshwater environment.
- Expert report of Joshua J. Roering, PhD from United States District Court, District of Oregon, Portland Division, Center for Biological Diversity et al., vs. Daughtry et al. and Oregon Department of Forestry Industries Council et al. regarding the impacts of logging and roads on geomorphic processes, particularly landslide and road erosion in the Oregon Coast Range.

[1] These suggestions are also included in Appendix 1-C, *Scoping Report*.

- Expert report of Kelly M. Burrnett, PhD from United States District Court, District of Oregon, Portland Division, Center for Biological Diversity et al., vs. Daughtry et al. and Oregon Department of Forestry Industries Council et al. regarding the potential of timber sales authorized by the ODF on the Tillamook and Clatsop State Forests to “take” coho salmon (*Oncorhynchus kisutch*).
- Letter to Glenn Cassamassa, Pacific Northwest Regional Forester, US Forest Service et al. from Doug Heiken, Conservation & Restoration Coordinator, Oregon Wild et al. providing comments and recommendations regarding post-fire management activities, including logging.
- Letter from Oregon Wild to NMFS in response to the Request for Information for Recommendations for More Resilient Fisheries and Protected Resources Due to Climate Change, published in the Federal Register on March 3, 2021, focusing on recommendations for enhancing the resilience of watersheds in the Pacific Northwest that are critical to conservation and recovery of salmonid evolutionarily significant units that are economically important or threatened and endangered.
- Report entitled *Conservation of Aquatic and Fishery Resources in the Pacific Northwest: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan*, prepared by the Coast Range Association presenting the results of an independent assessment by a science review panel of the Aquatic Conservation Strategy and current science.
- Report entitled *The Case of Protecting Both Old Growth and Mature Forests*, Doug Heiken, Oregon Wild, presenting information regarding the adequacy of the current level of old-growth forests and the need to grow more old-growth forests. It concludes that there is a severe shortage of old-growth forests and to address this shortfall in a timely way, it is necessary to protect mature forests and trees because (a) they already provide some values associated with old-growth forests, and b) they are poised to become old growth more quickly. The paper states that there should be recognition that old-growth forests are part of a forest development continuum, and sound forest policy requires conservation of not just existing old growth but also the ecological processes that sustain and continuously recruit old growth.
- Scoping comment attachment prepared by the Council of Forest Trust Land Counties entitled *Barred Owls Implicated in Northern Spotted Owl Decline*, summarizing research efforts exploring the effect of barred owl removal on northern spotted owl populations.

The following analyses were submitted during scoping for consideration by the lead and cooperating agencies in developing the EIS.

- Landslide buffering analysis presenting an original analysis of landslide buffering for selected ODF timber sales within the Tillamook and Clatsop State Forests intended to assess the adequacy of the HCP’s riparian buffers. The analysis used two landslide models, one that identifies areas of steep, convergent terrain and one that predicts runout length.
- Scoping comment attachment prepared by the Council of Forest Trust Land Counties entitled *Marbled Murrelet Status Brief* describing threats to marbled murrelets and possible recovery actions. It includes an analysis of how the HCP’s conservation strategy may interact and affect marbled murrelet populations.

Chapter 5
Additional Topics Required by NEPA

Per Council on Environmental Quality (CEQ) regulations this EIS must discuss any adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented. (40 Code of Federal Regulations [CFR] §1502.16(a)(2-4))

The adverse effects associated with the proposed action and alternatives are described in the *Environmental Consequences* sections in Chapter 3. Forest management activities are regulated by numerous state regulations in order to avoid, reduce, or mitigate for potentially significant adverse impacts. Unavoidable adverse effects under the proposed action and all alternatives, including the no action alternative, would include those described for geology and soils (Section 3.3), water resources (Section 3.4), vegetation (Section 3.5), fish and wildlife (Section 3.6), recreation (Section 3.9), and tribal resources (Section 3.11), socioeconomics (Section 3.12), and environmental justice (Section 3.13).

Short-term use of the environment, including timber harvest and consumption of resources such as fossil fuels, would occur under all alternatives. Long-term productivity of the environment refers to the capability to continue providing environmental resources, such as timber, species habitat, and recreational opportunity. Implementation of the HCP conservation strategy under the proposed action and Alternatives 3 through 5 along with ODF's companion Forest Management Plan is intended to ensure maintenance and enhancement of long-term productivity of the forest and its many uses, including timber harvest, species habitat, and recreation while continuing to provide stable and predictable annual timber outputs.

Irreversible commitments of resources are related to the use of nonrenewable resources such as energy, minerals, or soils, and the effect the use of these resources might have on future generations. Some covered activities would represent irreversible commitment of resources. For example, road construction is considered an irreversible action because of the long time needed for a road to revert to its preconstruction condition. Roads also require an irreversible commitment of materials such as the use of fossil fuels, rock, and gravel. Similarly, harvest of late-successional and old-growth forest is considered an irreversible action because of the long time needed for the forest to reestablish the structure complexity inherent to these stands.

Irretrievable commitment refers to the permanent loss of a resource such as destruction of a cultural resource site, loss of soil productivity, or extinction of a species. These types of impacts under the proposed action and alternatives would be avoided and minimized to the extent possible. Although mortality of individual animals during covered activities could occur, the purpose of the HCP is to ensure these losses would not result in permanent changes at the population level and would not significantly alter ecosystem structure or population dynamics.

Chapter 6
List of Preparers

Name and Organization/Entity	Project Role and Qualification
Tere O'Rourke, NMFS	Oregon Coast Branch Chief
Michelle McMullin, NMFS	Fisheries Biologist
Hova Woods, ICF	Project Director; MPA, Environmental Policy & Science, BS, Finance, 19 years of experience
Deborah Bartley, ICF	Project Manager; BA, Political Science; 21 years of experience
Lydia Dadd, ICF	Project Coordinator; BS, Environmental Studies; 2 years of experience
Matt Wood, ICF	GIS; MS, Geography; BS, Environmental Biology/Zoology; 10 years of experience
Emma Brenneman, ICF	GIS; MS, Geography; BA, Environmental Geography, 3 years of experience
Chris Earle, PhD, ICF	Disturbance and Climate Change; PhD, Forest Ecology; 26 years of experience
Ellen Berryman, ICF	Terrestrial Resources; MS, Biology; 34 years of experience
Diana Roberts, ICF	Geology and Soils; MA, Linguistics; 15 years of experience
Jennifer McAdoo, ICF	Water Resources; MS, Earth Resources and Environmental Engineering; 10 years of experience
Ingrid Kimball, ICF	Water Resources; MS, Earth Resources and Environmental Engineering; 10 years of experience
Laura McMullen, PhD, ICF	Aquatic Resources; PhD, Zoology; 9 years of experience
Greg Blair, ICF	Tribal Resources; MS, Fisheries; 29 years of experience
Elliot Wezerek, ICF	Air Quality and Greenhouse Gases; BS, Environmental Studies; 4 years of experience
Jennifer Ban, ICF	Aesthetics, BLA, Bachelor of Landscape Architecture; 21 years of experience
Tait Elder, ICF	Cultural Resources; MA, Archaeology; 16 years of experience
Sarah Reich, ECO-Northwest	Socioeconomics, Environmental Justice (EJ), and Recreation lead; MA, Urban and Environmental Policy and Planning; 14 years of experience
Shivangi Jain, ECO-Northwest	Socioeconomics, EJ, Recreation analyst; MA, Public Policy, Environmental Management; 1 year experience
Lorelei Juntenun, ECO-Northwest	Socioeconomics, EJ Recreation Senior Advisor, MA, Community and Regional Planning; MA, Public Administration; BA, English and Global Studies, 17 years of experience
Joel Ainsworth, ECO-Northwest	Socioeconomics Senior Advisor, MS, Applied Economics; BA, Economics, 10 years of experience
Laura Marshall, ECO-Northwest	Socioeconomics; EJ; Recreation Technical Analyst, MS, Applied Economics, Water Resource Policy and Management, 5 years of experience
Egan Cornachione, ECO-Northwest	Socioeconomics; EJ; Recreation Technical Analyst, MA, Economics; MS, Animal and Rangeland Science; BA, Economics, 3 years of experience
Richard Haynes	Socioeconomics Senior Advisor, PhD, Forest Economics MSc, Forest Management; BS, Forestry, 52 years of experience

Appendix 1-A
Glossary

Basal area: The area of the cross section of a tree stem near the base, generally at breast height (4.5 feet above ground) and including the bark. The basal area per acre is the total basal area of all trees on that acre.

Carbon pool (storage): A system that has the capacity to accumulate or release carbon.

Carbon sequestration: The transfer of carbon from the atmosphere to any other carbon pool.

Carbon sink: A carbon pool in which sequestration outweighs emissions.

Changed circumstances*:* "changes in circumstances affecting a species or geographic area covered by [an HCP] that can reasonably be anticipated by [HCP] developers and the Services and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events)" (50 Code of Federal Regulations 17.3).

Clearcut: Traditionally, a silvicultural system in which the entire stand of trees is cleared from an area at one time. Clearcutting and planting (if needed) results in the establishment of a new even-aged stand of trees.

Debris flow**:** Occurs when the landslide is saturated and travels across open slopes.

Debris torrent: Occurs when a landslide enters a stream channel, particularly one that is flowing, and the landslide materials mix with water.

Ecosystem services: The types of benefits that ecosystems provide to people. Forest ecosystems produce many ecosystem services that people value, including food and fiber from plants and wildlife, a setting for recreation and spiritual experience, clean water, and flood control.

Environmental impact statement: A detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources.

Forest carbon stock: The absolute quantity of carbon that has been sequestered from the atmosphere and stored within the forest ecosystem at a specified time.

Greenhouse effect: Earth absorbs heat energy from the sun as ultraviolet and visible light and returns most of this heat to space as infrared radiation. Greenhouse gas molecules allow the energy from the sun to pass through the atmosphere but trap the infrared radiation, reradiating it back to Earth's surface, thereby warming the atmosphere.

Incidental take: Take of any federally listed wildlife species that is incidental to, but not the purpose of, otherwise lawful activities.

Incidental take permit: An incidental take permit (ITP) is a federal exemption to the take prohibition of Section 9 of the ESA; an ITP is issued by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act. An ITP is also referred to as a Section 10 Permit or Section 10(a)(1)(B) Permit.

Late-seral forest: A forest that contains mature trees and understory.

Lead agency: A federal lead agency is the agency responsible for preparing an environmental impact statement for a project (40 Code of Federal Regulations 1508.1(o)).

National Environmental Policy Act: The National Environmental Policy Act (NEPA) was signed into law in 1969. NEPA requires all federal agencies to consider and analyze all significant environmental impacts of any action proposed by those agencies; to inform and involve the public in the agency's decision-making process; and to consider the environmental impacts in the agency's decision-making process.

Old growth: A forest stand whose typical characteristics are a patchy, multilayered, multispecies canopy dominated by large overstory trees, some with broken tops and decaying wood; numerous large snags; and abundant large woody debris (such as fallen trees) on the ground. In western Oregon, old-growth characteristics begin to appear in unmanaged forests at 175 to 250 years of age.

Salvage: Salvage cutting is the utilization of standing or down trees that are dead, dying, or deteriorating, for whatever reason, before the timber values are lost.

Seasonal stream: A stream with surface flow only part of the year. In the Forest Practices Act, defined as a stream that normally does not have summer surface flow after July 15.

Seral stages: Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

Shallow-rapid landslide: Landslides typically initiated by intense rainfall or rapid snowmelt, occurring within the forest rooting zone (generally less than 10 feet deep).

Slope stability: The degree to which a slope resists the downward pull of gravity. The more resistant, the more stable.

State Historic Preservation Office: Oregon's State Historic Preservation Office was created in 1966 by federal statute. It administers the Statewide Plan for Historic Preservation and submits Oregon's nominations for the National Register of Historic Places.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (Section 3(18) of the federal Endangered Species Act). Federal regulations provide the same taking prohibitions for threatened wildlife species (50 Code of Federal Regulations 17.31(a)).

Unforeseen circumstances*:* Changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Services at the time of the negotiation and development of the plan, and that result in a substantial and adverse change in the status of the covered species (50 Code of Federal Regulations 17.3).

Wetland: As defined in Oregon's Forest Practice Rules in Oregon Administrative Rules 629-24-101 (77), wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Executive Summary

ODF (Oregon Department of Forestry). 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

———. 2010b. *Southwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/Documents/AboutODF/2010FMPSouthwestOregon.pdf.

Chapter 2, Proposed Action and Alternatives

FWS and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 2016. *Habitat Conservation Planning and Incidental Take Permit Processing Handbook.* Available: https://www.fws.gov/endangered/esa-library/pdf/HCP_Handbook.pdf. Accessed: August 8, 2021.

ODF (Oregon Department of Forestry). 2000a. *State Forests Program, Forest Engineering Roads Manual.*

———. 2000b. *Forest Roads Hazard Inventory.*

———. 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

———. 2010b. *Southwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/Documents/AboutODF/2010FMPSouthwestOregon.pdf.

———. 2017. Northern Spotted Owl Operational Policy. Salem, OR.

———. 2013. Marbled Murrelet Operation Policy. Salem, OR.

ODFW (Oregon Department of Fish and Wildlife). 2008. *Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife.* Available: https://www.dfw.state.or.us/lands/inwater/Oregon_Guidelines_for_Timing_of_%20InWater_Work2008.pdf. Accessed: December 10, 2021.

Roni, P.L., T.J. Beechie, R.E. Bilby, F.E. Leonetti, M.M. Pollock, and G.R. Pess. 2002. A review of stream restoration techniques and hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. *North American Journal of Fisheries Management* 22:1–20.

Thomas, J.W., M.G. Raphael, R.G. Anthony, E.D. Forsman, A.G. Gunderson, R.S. Holthausen, B.G. Marcot, G.H. Reeves, J.R. Sedell, and D.M. Solis. 1993. Viability Assessments and Management Considerations for Species Associated with Late-Successional and Old-Growth Forests of the Pacific Northwest. The Report of the Scientific Analysis Team, U.S. Department of Agriculture. 530 p. March.

Wilson, Mike. Deputy Division Chief for Policy and Technical Support. Oregon Department of Forestry, Portland, OR. August 27, 2021—Email to Lydia Dadd, ICF, regarding current practices within riparian management areas.

Section 3.1, Introduction

ODF (Oregon Department of Forestry). 2021. Road Network GIS Data. Salem, OR.

Section 3.2, Reasonably Foreseeable Trends and Planned Actions

Lindberg, K., and T. Bertone-Riggs. 2015. Oregon Off-highway Vehicle (OHV) Participation and Priorities: Report in Support of the 2015-2024 Oregon Trails Plan. Oregon State University. Available: https://headwaterseconomics.org/wp-content/uploads/Trail_Study_116-OR-OHV-Participation-Priorities.pdf.

ODFW (Oregon Department of Fish and Wildlife). 2020. Oregon Department of Fish and Wildlife Annual Performance Progress Report. ODFW. Available: https://www.dfw.state.or.us/agency/docs/APPR_ODFW_2020-09-29.pdf.

Section 3.3, Geology and Soils

Ammann, M., A. Boll, C. Rickli, T. Speck, and O. Holdenrieder. 2009. Significance of tree root decomposition for shallow landslides. *For. Snow Landsc. Res.* 82(1):79–94. Available: https://www.dora.lib4ri.ch/wsl/islandora/object/wsl%3A15354/datastream/PDF/Ammann-2009-Significance_of_tree_root_decomposition-%28published_version%29.pdf. Accessed: April 13, 2021.

Angima, S.D., and T.A. Terry. 2011. Best Management Practices for Maintaining Soil Productivity in the Douglas-Fir Region. Oregon State University Extension Service. April. (EM 9023.) Available: https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9023.pdf. Accessed: May 21, 2021.

Benda, L., K. Andras, D. Miller, and P. Bigelow. 2004. Confluence effects in rivers: Interactions of basin scale, network geometry, and disturbance regimes. *Water Resources Research* 40:(W05402).

Benda, L. In prep. Rates of Shallow Landslides, Effects of Forest Management and Implications for the Supply of Sediment and Wood to Fish Streams.

Burnett, K.M., and D.J. Miller. 2007. Streamside policies for headwater channels: An example considering debris flows in the Oregon Coastal Province. *Forest Science* 53(2):239–253.

Burton, J.I., D.H. Olson, and K.J. Puettmann. 2016. Effects of riparian buffer width on wood loading in headwater streams after repeated forest thinning. *Forest Ecology and Management* 372(2016):247–257

Cohen, D., and M. Schwarz. 2017. Tree-root control of shallow landslides. *Earth Surface Dynamics* 5:451-477. Available: https://esurf.copernicus.org/articles/5/451/2017/esurf-5-451-2017.pdf. Accessed: August 4, 2021.

Cover, M.R., J.A. de la Fuente, and V.H. Resh. 2010. Catastrophic disturbances in headwater streams: the long-term ecological effects of debris flows and debris floods in the Klamath Mountains, northern California. *Canadian Journal of Fisheries and Aquatic Sciences* 67(10):1596–1610.

Curran, M.P., R.L. Heninger, D.G. Maynard, and R.F. Powers. 2005. Harvesting effects on soils, tree growth, and long-term productivity. In C.A. Harrington and S.H. Schoenholtz, eds. Productivity of Western forests: A forest products focus. (Gen. Tech. Rep. PNW-GTR-642.) Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 176 p. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr642.pdf. Accessed: August 27, 2021.

Department of Oregon Geology and Mineral Industries. 2008. Landslide Hazards in Oregon. Oregon Geology Fact Sheet. Available: https://www.oregongeology.org/pubs/fs/landslide-factsheet.pdf. Accessed: August 4, 2021.

Department of Oregon Geology and Mineral Industries. n.d. Landslides in Oregon. Available: https://www.oregongeology.org/Landslide/landslidehome.htm. Accessed: July 30, 2021.

Elliot, W.J. 2013. Erosion processes and prediction with WEPP technology in forests in the northwestern U.S. *American Society of Agricultural and Biological Engineers* 56(2):563–597. Available: https://www.fs.fed.us/rm/pubs_other/rmrs_2013_elliot_w001.pdf. Accessed: August 4, 2021.

EPA (U.S. Environmental Protection Agency). 2013. Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States. Available: https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states. Accessed: July 30, 2021.

Geertsema, M., L. Highland, and L. Vaugeouis. 2009. Environmental impact of landslides. In K. Sassa and P. Canuti (eds.), Landslides: Disaster Risk Reduction. Springer-Verlag, Berlin & Heidelberg. Available: https://link.springer.com/chapter/10.1007/978-3-540-69970-5_31. Accessed: April 13, 2021.

Hairiah, K., W. Widianto, D. Suprayogo, and M. van Noordwijk. 2020. Tree roots anchoring and binding soil: Reducing landslide risk in Indonesian agroforestry. *Land* 2020 9: 256. Available: https://www.mdpi.com/2073-445X/9/8/256/pdf. April 13, 2021.

Hall, F.C., L. Bryant, R. Clausnitzer, K. Geier-Hays, R. Keane, J. Kertis, A. Shlisky, and R. Steele. 1995. Definitions and Codes for Seral Status and Structure of Vegetation. (General Technical Report PNW-GTR-363.) November. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr363.pdf. Accessed: September 3, 2021.

Heninger, R.B., W. Scott, A. Dobkowski, and T.A. Terry. 2011. Managing Soil Disturbance. In S.D. Angima and T.A. Terry, eds., Best Management Practices for Maintaining Soil Productivity in the Douglas-fir Region. (EM 9023.) April. Available: https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9023.pdf. Accessed: August 3, 2021.

Independent Multidisciplinary Science Team. 1999. Recovery of Wild Salmonids in Western Oregon Forests: Oregon Forest Practices Act Rules and the Measures in the Oregon Plan for Salmon and

Watersheds. (Technical Report 1999-1 to the Oregon Plan for Salmon and Watersheds, Governor's Natural Resources Office.) Salem, Oregon. Available: https://www.krisweb.com/biblio/gen_ognro_imst_1999_1.pdf. Accessed: August 9, 2021.

May, C.L., and R.E. Gresswell. 2003. Large wood recruitment and redistribution in headwater streams in the southern Oregon Coast Range, U.S.A. *Canadian Journal of Forest Research* 33(8):1352–1362.

McNabb, D.H., and J.F. Swanson. 1990. Effects of fire on soil erosion. In: Walstad, John D.; S.R. Radosevich, D.V. Sandberg, eds. Natural and prescribed fire in the Pacific Northwest forests. Corvallis, OR: Oregon State University Press:159–176.

Miller, D.J., and K.M. Burnett. 2007. Effects of forest cover, topography, and sampling extent on the measured density of shallow, translational landslides. *Water Resources Research* 43:W03433. Available: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2005WR004807. Accessed: July 30, 2021.

Miller, D.J., and K.M. Burnett. 2008. A probabilistic model of debris-flow delivery to stream channels, demonstrated for the Coast Range of Oregon, USA. *Geomorphology* 94(2008):184–205. Available: https://www.sciencedirect.com/science/article/abs/pii/S0169555X07002504. Accessed: July 30, 2021.

Miller, D., and M. Scurlock. 2018. Application of a Landscape-Level Framework to Evaluate Potential Wood Delivery from Non-Fish-Bearing Headwater Channels to Fish-Bearing Streams. Available: http://oregon-stream-protection-coalition.com/wp-content/uploads/2019/03/Miller-Summary-of-DTS-Analysis-for-OSPC-with-Maps.pdf. Accessed: March 5, 2021.

NRCS (Natural Resources Conservation Service). 2021. Gridded Soil Survey Geographic Database. Released July 2020. Available: https://datagateway.nrcs.usda.gov/GDGHome.aspx. Accessed: July 12, 2021.

Nunamaker, C., J. LeBlanc, G. Nakamura, and Y. Valachovic. 2007. Forest Stewardship Series 17: Forest Roads. (University of California Division of Agriculture and Natural Resources Publication 8247.) Available: https://anrcatalog.ucanr.edu/pdf/8247.pdf. Accessed: September 8, 2021.

———. 2017. Forest Stewardship Series 17: Forest Roads. (Publication 8247.) University of California Division of Agriculture and Natural Resources. Available: https://anrcatalog.ucanr.edu/pdf/8247.pdf. Accessed: August 4, 2021.

ODF (Oregon Department of Forestry). 2001. *Forestry, Landslides and Public Safety*. Landslides and Public Safety Project Team. Available: https://www.oregon.gov/ODF/Documents/WorkingForests/landslidespublicsafety.pdf. Accessed: August 31, 2021.

———. 2000a. *Forest Road Management Guidebook*. Available: https://www.oregon.gov/odf/Documents/workingforests/forest-road-management-guidebook.pdf. Accessed: August 25, 2021.

———. 2000b. *Forest Roads Manual.* State Forests Program. July 2000. Salem, OR.

———. 2003a. Determination of Rapidly Moving Landslide Impact Rating. Forest Practices Technical Note Number 6, Version 1.0. September 1, 2003. Available:

https://www.oregon.gov/odf/Documents/workingforests/LandslideImpactRatingTechNote6.pdf. Accessed: July 29, 2021.

———. 2003b. High Landslide Hazard Locations, Shallow, Rapidly Moving Landslides and Public Safety: Screening and Practices. Forest Practices Technical Note Number 2, Version 2.0. January 1, 2003. Edited January 24, 2019, to recognize updated rule references. Available: https://www.oregon.gov/ODF/Documents/WorkingForests/HighLandslideHazardLocationsTechNote2.pdf. Accessed: September 7, 2021.

———. 2003c. Avoiding Roads in Critical Locations. Forest Practices Technical Note Number 7. Version 1.0 June 20, 2003. Edited January 24, 2019, to recognize updated rule references. Available: https://www.oregon.gov/ODF/Documents/WorkingForests/AvoidingCriticalRoadLocationsTechNote7.pdf. Accessed: July 29, 2021.

———. 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Structure Classes and Habitat Conservation Plan references revised April 2010. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

———. 2010b. *Southwest Oregon State Forests Management Plan*. January 2001 Plan; Habitat Conservation Plan references revised April 2010.

———. 2020. *Western Oregon State Forest Management Plan*. Available: https://www.oregon.gov/odf/board/Documents/fmp-hcp/Western-Oregon-State-Forest-Management-Plan-Final-Draft.pdf. Accessed: August 3, 2021.

———. 2021a. Route Haul Data—Alternative 1 (No Action Alternative). Salem, OR.

———. 2021b. Route Haul Data—Alternative 2 (Habitat Conservation Plan). Salem, OR.

———. 2021c. Route Haul Data—Alternative 3 (Increased Aquatic Protections Alternative). Salem, OR.

———. 2021d. Route Haul Data—Alternative 4 (50-Year Permit Term Alternative). Salem, OR.

———. 2021e. Route Haul Data—Alternative 5 (Modified Habitat Conservation Areas Alternative). Salem, OR.

Phillips, C.J., L. Basher, and M. Marden. 2012. Plantation forest harvesting and landscape response—What we know and what we need to know. *New Zealand Journal of Forestry* 56(4):4–12.

Picchio, R., P.S. Mederski, and F. Tavankar. 2020. How and how much, do harvesting activities affect forest soil, regeneration, and stands. *Current Forestry Reports* 6:115–128. Available: https://link.springer.com/content/pdf/10.1007/s40725-020-00113-8.pdf. Accessed: August 3, 2021.

Powell, D.C. 2012. A Stage is a Stage…Or Is It? Successional Stages, Structural Stages, Seral Stages. (White Paper F14-SO-WP-Silv-10.) November. Available: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5413728.pdf. Accessed: September 3, 2021.

Rachels, A.A., K.D. Bladon, S. Bywater-Reyes, and J.A. Hatten. 2020. Quantifying effects of forest harvesting on sources of suspended sediment to an Oregon Coast Range headwater stream. *Forest Ecology and Management* 466(2020):1–13.

Rice, R.M., and J. Lewis. 2016. Identifying unstable sites on logging roads. Pacific Southwest Forest and Range Experiment Station and U.S. Department of Agriculture Forest Service, Arcata, CA. In *Proceedings of Division 1, 18th International Union of Forestry Research Organization World Congress*, Volume 1, Vienna, Austria. 239-249. Available: https://www.fs.usda.gov/treesearch/pubs/8541. Accessed: September 24, 2021.

Robison, E.G., K.A. Mills, J. Paul, L. Dent, and A. Skaugset. 1999. *Oregon Department of Forestry Storm Impacts and Landslides of 1996: Final Report*. Oregon Department of Forestry, Forest Practices Monitoring Program. (Forest Practices Technical Report Number 4.) Available: https://people.wou.edu/~taylors/g407/robison_etal_1999.pdf. Accessed: May 6, 2021.

Schilirò, L., G.P. Djueyep, C. Esposito, and G.S. Mugnozza. 2019. The role of initial soil conditions in shallow landslide triggering: Insights from physically based approaches. *Geofluids* 2019. Available: https://downloads.hindawi.com/journals/geofluids/2019/2453786.pdf. Accessed: July 27, 2021.

Schmidt, K.M., J.J. Roering, J.D. Stock, W.E. Dietrich, D.R. Montgomery, and T. Schaub. 2001. The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range. *Canadian Geotechnical Journal* 38:995–1024. Available: https://www.researchgate.net/publication/228609414_Root_cohesion_variability_and_shallow_landslide_susceptibility_in_the_Oregon_Coast_Range. Accessed: July 28, 2021.

Skaugset, A.E., G.H. Reeves, and R.F. Keim. 2002. Landslides, surface erosion, and forest operations in the Oregon Coast Range. In Hobbs, S.D. (ed.) *Forest and Stream Management in the Oregon Coast Range*. Oregon State University Press. Available: https://www.fs.fed.us/pnw/lwm/aem/docs/reeves/2002_skaugset_etal_cope_ch9_forest_str_mgmt.pdf. Accessed: August 9, 2021.

Swanston, D., and F.J. Swanson. 1976. Timber harvesting, mass erosion, and steepland forest geomorphology in the Pacific Northwest. In D.R. Coates (ed.) Geomorphology and Engineering. P. 199-221. Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

TerrainWorks. 2014. Shallow Landslide Density—Hillside. Available: http://www.netmaptools.org/Pages/NetMapHelp/hillside_2.htm?mw=MjQw&q=bHMtZGVu&st=Mw==&sct=MA==&ms=AAAAAAA=. Accessed: August 13, 2021.

———. 2021. *NetMap and Wood Recruitment Modeling for the Western Oregon State Forest Habitat Conservation Plan*.

Wall, S.A., J.J. Roering, and F.K. Rengers. 2020. Runoff-initiated post-fire debris flow Western Cascades, Oregon. *Landslides* 17(7):1649–1661.

Section 3.4, Water Resources

Allen, I., S. Chin, and J. Zhang. 2019. Fire and forest management in montane forests of the Northwestern States and California, USA. *Fire* 2(17).

Boston, K. 2016. The potential effects of forest roads on the environment and mitigating their impacts. *Integrating forestry in land use planning. Current Forestry Reports* 2:215–222. Available: https://link.springer.com/content/pdf/10.1007/s40725-016-0044-x.pdf Accessed: September 2021.

Brown, A., L. Zhang, T. McMahon, A. Western, and R. Vertessy. 2005. A review of paired catchment studies for determining changes in water yield resulting from alternations in vegetation. *Journal of Hydrology* 310:28–61.

Cooper, R.M. 2002. *Determining Surface Water Availability in Oregon*. State of Oregon Water Resources Department Open File Report SW 02-002. Available: https://www.oregon.gov/owrd/WRDPublications1/DeterminingSurfaceWaterAvailabilityInOregon.pdf. Accessed: September 2021.

———. 2005. Estimation of peak discharges for rural, unregulated streams in Western Oregon: U.S. Geological Survey Scientific Investigations Report 20025-5116, 134 p. Available: https://pubs.usgs.gov/sir/2005/5116/pdf/sir2005-5116.pdf. Accessed: July 2021.

Dalton, M., and E. Fleishman (eds.). 2021. Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. Available: https://blogs.oregonstate.edu/occri/oregon-climate-assessments/. Accessed: September 2021.

Dixon, S., D.A. Sear, N.A. Odoni, T. Sykes, and S.N. Lane. 2016. The effects of river restoration on catchment scale flood risk and flood hydrology. *Earth Surface Processes and Landforms* 41(7):997–1008.

Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner. 2017. Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

FEMA (Federal Emergency Management Act). 2021. Flood Insurance Rate Map Database. Available: https://www.fema.gov/flood-maps/national-flood-hazard-layer. Accessed: July 2021.

Goeking, S., and D. Tarboton. 2020. Forests and water yield: A synthesis of disturbance effects on streamflow and snowpack in Western coniferous forests. *Journal of Forestry* 118(2):172–192.

Grant, G.E., S. Lewis, F. Swanson, J. Cissel, and J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: A state-of-science report for Western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr760.pdf. Accessed: August 2021.

Groom, J.D., L.J. Madsen, J.E. Jones, and J.N. Giovanini. 2018. Informing changes to riparian forestry rules with a Bayesian hierarchical model. *Forest Ecology and Management* 419:17–30.

Ice, G.G., D.G. Neary, and P.W. Adams. 2004. Effects of wildfire on soils and watershed processes. *Journal of Forestry* 102(6):16–20.

Kastridis, A. 2020. Impact of forest roads on hydrological processes. *Forests* 11(11):1201.

Keith, R.M., T.C. Bjornn, W.R. Meehan, N.J. Hetrick, and M.A. Brusven. 1998. Response of Juvenile Salmonids to Riparian and Instream Cover Modifications in Small Streams Flowing Through Second-Growth Forests of Southeast Alaska. *Transactions of the American Fisheries Society* 127:889–907.

Lakel, W.A., W.M. Aust, M.C. Bolding, C.A. Dolloff, P. Keyser, R. Feldt. 2010. Sediment trapping by streamside management zones of various widths after forest harvest and site preparation. *Forest Science* 56(6):541–551.

Leinenbach, Peter. 2016. Review of literature describing the relationship between stream shade loss and the subsequent stream temperature increase. Memorandum to Terasa Kubo, USEPA. January 12, 2016. 6 pp.

———. 2021. Initial comments/suggestions on the draft Western Oregon State Forest HCP "Riparian Conservation Area and Temperature Protection" document. August 28, 2020.

Liebowitz, S.G., R.L. Comeleo, P.J. Wigington Jr., C.P. Weaver, P.E. Morefield, E.A. Sproles, and J.L. Ebersole. 2014. Hydrologic landscape classification evaluates streamflow vulnerability to climate change in Oregon, USA. Hydrology and Earth System Sciences. 18:3367-3392. Available: https://www.researchgate.net/publication/262802095_Hydrologic_landscape_classification_assesses_streamflow_vulnerability_to_climate_change_in_Oregon_USA. Accessed: September 2021.

MacDonald, J.S., J.C. Scrivener, D.A. Patterson, A. Dixon-Warren. 1998. Temperatures in aquatic habitats: the Impacts of Forest Harvesting and the Biological Consequences to Sockeye Salmon Incubation Habitats in the Interior of B.C. Pages 267–282 in M.K. Brewin and D.M.A. Monita (tech. coord.), *Forest–Fish Conference: Land Management Practices Affecting Aquatic Ecosystems. Proceedings of the Forest-Fish Conference, 1–4 May 1996, Calgary, Alberta.* Can. For. Serv. North. For. Res. Cent. Inf. Rep. Nor-X356.

Moore, D.R., and S.M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: a review. *Journal of the American Water Resources Association* 41(4):763–784.

Natural Resources Conservation Service (NRCS). 2019. Gridded Soil Survey Geographic by State. Available: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628. Accessed: July 15, 2021.

NOAA (National Oceanic and Atmospheric Administration). 2021a. Peak Flows for Flood of February 1996. Available: https://www.nwrfc.noaa.gov/floods/feb_1996/pf_flood_1996.shtml. Accessed: October 2021.

———. 2021b. Storm Events Database. Available: https://www.ncdc.noaa.gov/stormevents/. Accessed: October 2021.

ODEQ (Oregon Department of Environmental Quality). 2004. Southern Willamette Valley Groundwater Summary Report. Available: https://www.oregon.gov/deq/FilterDocs/gw-swvgwma-summaryrpt.pdf. Accessed: August 2021.

———. 2005. Source Water Assessment Inventory Results. Available: https://www.oregon.gov/deq/FilterDocs/SWAInvResultsSummary.pdf. Accessed: September 2021.

———. 2014. Final Oregon Nonpoint Source Management Program Plan. Available: https://secure.sos.state.or.us/oard/viewReceiptPDF.action?filingRsn=47884 Accessed: October 2021.

———. 2019. Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters.

———. 2020. Integrated Report Database. Available: https://www.oregon.gov/deq/wq/Pages/epaApprovedIR.aspx. Accessed: September 2021.

ODEQ (Oregon Department of Environmental Quality) and Oregon Health Authority. 2017. Oregon Public Water Systems Groundwater Resource Guide for Drinking Water Source Protection. Version 1.0. Available: https://www.oregon.gov/deq/FilterDocs/gwresguide.pdf. Accessed: August 2021.

ODF (Oregon Department of Forestry). 2000. *Forest Roads Manual.* State Forests Program. July 2000. Salem, OR.

———. 2020. Oregon state forest management activity modeling. Salem, OR.

OWRD (Oregon Water Resources Department). 2015. Statewide Long-term Water Demand Forecast. Available: https://www.oregon.gov/OWRD/wrdpublications1/OWRD_2015_Statewide_LongTerm_Water_Demand_Forecast.pdf. Accessed: September 2021.

———. 2017. Oregon's 2017 Integrated Water Resources Strategy. Available: https://www.oregon.gov/owrd/programs/Planning/IWRS/Pages/Project-Documents.aspx. Accessed: September 2021.

Perry, T.D., and J.A. Jones. 2017. Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. *Ecohydrology* 10:e1790.

Reid, L.M., N.J. Dewey, T.E. Lisle, and S. Hilton. 2010. The incidence and role of gullies after logging in a coastal redwood forest. *Geomorphology* 117:155–169.

Ryan, S.E., E. Bishop, and J.M. Daniels. 2014. Influence of large wood and channel morphology and sediment storage in headwater mountain streams, Fraser Experimental Forest, Colorado. *Geomorphology* 217(2014):73–88. Available: https://www.fs.fed.us/rm/pubs_other/rmrs_2014_ryan_s001.pdf. Accessed: August 2021.

Segura, C., K.D. Blandon, J.A. Hatten, J.A. Jones, V.C. Hale, G.G. Ice. 2020. Long-term effects of forest harvesting on summer low flow deficits in the Coast Range of Oregon. *Journal of Hydrology* 585(124749). Available: https://oregonstate.app.box.com/s/n6y9n3bu65mhuueeeudy1gb457xnmjzd Accessed: October 2021.

Smerdon, B.D., T.E. Redding, and J. Beckers. 2009. An overview of the effects of forest management on groundwater hydrology. *BC Journal of Ecosystems and Management* 10(1):22–44.

Stednick, J.D. 2010. Effects of Fuel Management Practices on Water Quality. Cumulative Watershed Effects of Fuel Management in the Western United States. Chapter 8. Available: https://www.fs.fed.us/rm/pubs/rmrs_gtr231/rmrs_gtr231_149_163.pdf. Accessed: November 2021.

TerrainWorks. 2020. *NetMap and Wood Recruitment Modeling for the Western Oregon State Forest Habitat Conservation Plan*.

USGS (U.S. Geological Survey). 1994. Ground Water Atlas of the United States Segment 7: Hydrologic Investigations Atlas. 730-H. 33 p.

———. 2000. Principal Aquifers of the 48 Conterminous United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands, Version 1.0. Available: https://water.usgs.gov/GIS/metadata/usgswrd/XML/aquifers_us.xml#stdorder. Accessed: July 2021.

———. 2021a. Watershed boundary dataset.

———. 2021b. Digital elevation model dataset.

Vose, R.S., D.R. Easterling, K.E. Kunkel, A.N. LeGrande, and M.F. Wehner. 2017. Temperature changes in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 185-206. doi: 10.7930/J0N29V45.

Waswa, G.W., and S.A. Lorentz. 2019. Dynamics of groundwater flow and upwelling pressure heads at a wetland zone in a headwater catchment. Springer Nature Applied Sciences. Available: https://link.springer.com/content/pdf/10.1007/s42452-019-1052-9.pdf. Accessed: January 2022.

Wilkerson, E., J.M. Hagan, D. Siegel, and A.A. Whitman. The Effectiveness of Different Buffer Width for Protecting Headwater Stream Temperature in Maine. *For. Sci.* 52(3): 221–231. Available: https://www.manomet.org/wp-content/uploads/old-files/Wilkerson_etal-2006-For_Sci-Buffer_strips.pdf Accessed: October 2021.

Zwieniecki, M.A., and M. Newton. 1999. Influence of Streamside Cover and Stream Features on Temperature Trends in Forested Streams of Western Oregon. *Western Journal of Applied Forestry* 14(2):106–113. Available: https://academic.oup.com/wjaf/article/14/2/106/4741246?login=true Accessed: October 2021.

Section 3.5, Vegetation

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available: https://www.fws.gov/wetlands/documents/classwet/index.html#contents. Accessed: August 6, 2021.

ODF (Oregon Department of Forestry). 2000. *Forest Roads Manual.* State Forests Program. July 2000. Salem, OR.

———. 2003. Forest Practices Technical Note Number 7: Avoiding Roads in Critical Locations. Edited 2019. Available: https://www.oregon.gov/ODF/Documents/WorkingForests/AvoidingCriticalRoadLocationsTechNote7.pdf. Accessed: September 8, 2021.

———. 2021. North Cascade District, 2021 Annual Revised Operations Plan. Available: https://www.oregon.gov/odf/Documents/aboutodf/2021-aop-north-cascade-district-revised.pdf. Accessed: May 11, 2021.

ODFW (Oregon Department of Fish and Wildlife). 2016. Oregon Conservation Strategy, Chapter 3, Ecoregions. Available: https://www.oregonconservationstrategy.org/media/kalins-pdf/ecoregion.pdf. Accessed. September 8, 2021.

Oregon Biodiversity Information Center. 2019. Rare, Threatened and Endangered Species of Oregon. Institute for Natural Resources, Portland State University, Portland, OR.

Oregon Department of Agriculture. 2014a. Kincaid's lupine (*Lupinus oreganus*). Available: https://www.oregon.gov/oda/shared/Documents/Publications/PlantConservation/LupinusOreganusProfile.pdf. Accessed: August 5, 2021.

Oregon Department of Agriculture. 2014b. Coast Range fawn lily (*Erythronium elegans*). Available: https://www.oregon.gov/oda/shared/Documents/Publications/PlantConservation/ErythroniumElegansProfile.pdf. Accessed: August 4, 2021.

Pacific Northwest Research Station. 2007. Science Update: Managing Forests After Fire. Issue 15, Summer 2007.

Seybold, S.J., S.J. Frankel, D.H. Olson, R. Flitcroft, B.K. Kerns, J.C. Lee, K.L. Ripley, and A.S. Munson. 2021. Northwest Region. Pages 352–377 in Poland, T.M., T. Patel-Weynand, D.M. Finch, C.F. Miniat, D.C. Hayes, and V.M. Lopez (Eds.). Invasive Species in Forests and Rangelands of the United States: A Comprehensive Science Synthesis for the United States Forest Sector. Springer International Publishing, Cham. doi:10.1007/978-3-030-45367-1.

Stokes, D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest forest. *Northwest Science* 88(2):75–93. doi:10.3955/046.088.0204.

Thorn, S., B. Claus, R. Brandl, P.J. Burton, R. Cahall, J.L. Campbell, J. Castro, C.Y. Choi, T. Cobb, D.C. Donato, E. Durska, J.B. Fontaine, S. Gauthier, C. Hebert, T. Hothorn, R.L. Hutto, E. Lee, A.B. Leverkus, D.B. Lindenmayer, M.K. Obrist, J. Rost, S. Seibold, R. Seidl, D.T., Kaysandra Waldron, B. Wermelinger, M. Winter, M. Zmihorski, and J. Müller. 2018. Impacts of salvage logging on biodiversity: A meta-analysis. *J Appl Ecol* 55:279–289. doi: 10.1111/1365-2664.12945.

Thorson, T.D., S.A. Bryce, D.A. Lammers, A.J. Woods, J.M. Omernik, J. Kagan, D.E. Pater, and J.A. Comstock. 2003. Ecoregions of Oregon. Available: https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/or/or_eco_lg.pdf. Accessed: September 8, 2021.

Section 3.6, Fish and Wildlife

Altman, B., and J. Hagar. 2006. Rainforest Birds: A Land Manager's Guide to Breeding Bird Habitat in Young Conifer Forests in the Pacific Northwest. U.S. Department of Interior and U.S. Geological Survey Scientific Investigations Report 2006-5304.

Clayton, D.R. and D.H. Olson. 2007. Conservation assessment for the Oregon slender salamander. USDA Forest Service Region 6 and USDI Bureau of Land Management. March.

Davis, R.J., B. Hollen, J. Hobson, J.E. Gower, and D. Keenum. 2016. Status and Trends of Northern Spotted Owl Habitats. General Technical Report PNW-GTR-929. USFS. March.

Emel, S.L., D.H. Olson, L.L. Knowles, and A. Storfer. 2019. Comparative landscape genetics of two endemic torrent salamander species, *Rhyacotriton kezeri* and R. variegatus: Implications for forest management and species conservation. *Conservation Genetics* 20(4):801–815.

Hagar, J. 2007. Key elements of stand structure for wildlife in production forests West of the Cascade Mountains. USDA Forest Service, General Technical Report PNW-GTR.

Howell, M.D., M.D. Romano, and T.A Rien. 2001. Outmigration timing and distribution of larval Eulachon, *Thaleichthys pacificus*, in the lower Columbia River, spring 2001. Washington Department of Fish and Wildlife, Olympia.

Kauffman, J.B. Boone, M. Mahrt, L.A. Mahrt, and W.D. Edge. 2001. *Wildlife of Riparian Habitats.* In Wildlife-habitat Relationships in Oregon and Washington. D. Johnson and T. O'Neil (eds.). Corvalis, OR. Oregon State University Press.

Master, L.L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk. NatureServe, Arlington, VA.

National Marine Fisheries Service (NMFS). 2017. Endangered Species Act Recovery Plan for the Southern Distinct Population Segment of Eulachon (*Thaleichthys pacificus*). Available: https://repository.library.noaa.gov/view/noaa/15989.

ODF (Oregon Department of Forestry). 2010. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

———. 2016. Marbled Murrelet Policies and Procedures

———. 2017. Northern Spotted Operational Policies.

ODFW (Oregon Department of Fish and Wildlife). 2016. Oregon Conservation Strategy. Salem, OR. Available: https://www.oregonconservationstrategy.org/overview/.

———. 2019. 2019 Fish Passage Priority List. Available: https://www.dfw.state.or.us/fish/passage/docs/2019%20Prioritization%20List.xlsx.

Olson, D.H., and G. Weaver. 2007. Vertebrate assemblages associated with headwater hydrology in western Oregon managed forests. *Forest Science* 53(2):343–355.

Olson, D.H., and J.I. Burton. 2019. Climate associations with headwater streamflow in managed forests over 16 years and projections of future dry headwater stream channels. *Forests 10*(11):968.

Oregon Natural Heritage Information Center. 2021. Special Status Species. Available: https://oe.oregonexplorer.info/wildlife/wildlifeviewer/. Accessed: July 24, 2021.

Pacific States Marine Fisheries Commission. 2021. StreamNet. Available: https://www.streamnet.org/. Accessed: September 2021.

Rose, C.L., B.G. Marcot, T.K. Mellen, J.L. Ohmann, K.L. Waddell, D.L. Lindley, and B. Schreiber. 2001. *Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management.* In Wildlife-habitat Relationships in Oregon and Washington. D. Johnson and T. O'Neil (eds.). Corvalis, Oregon State University Press.

Schweigert, J., C. Wood, D. Hay, M. McAllister, J. Boldt, B. McCarter, and H. Brekke. 2012. Recovery potential assessment of eulachon (*Thaleichthys pacificus*) in Canada. *DFO Can Sci Advis Secr Res Doc* 98.

Spies, T.A., P.A. Stine, R.A. Gravenmier, J.W. Long, and M.J. Reilly. 2018. Synthesis of science to inform land management within the Northwest Forest Plan area. Gen. Tech. Rep. PNW-GTR-966. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 1020 p. 3 vol.

Spies, T.A., and J.F. Franklin. 1991. *The Structure of Natural Young, Mature, and Old-Growth Douglas-Fir Forests in Oregon and Washington.* In: Ruggiero, L.F., Aubry, K.B., Carey, A.B., Huff, M.H. (Eds.), Wildlife and Vegetation of Unmanaged Douglas-fir Forests. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-285, pp. 91–110.

Wiens, J.D., K.M. Dugger, D.B. Lesmeister, K.E. Dilione, and D.C. Simon. 2019. Effects of barred owl (*Strix varia*) removal on the population demography of Northern Spotted Owls (*Strix occidentalis caurina*) in Washington and Oregon, 2015-18. USGS Open-File Report 2019-1074.

Wilson, Mike. Deputy Division Chief for Policy and Technical Support, Oregon Department of Forestry, Portland, OR. August 27, 2021—Email to Lydia Dadd, ICF, regarding current practices within riparian management areas.

Section 3.7, Air Quality

EPA (U.S. Environmental Protection Agency). 2021a. *NAAQS Table.* Available: https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed: August 2021.

———. 2021b. *Oregon Whole or Part County Nonattainment Status by Year Since 1992 for all Criteria Pollutants.* Available: https://www3.epa.gov/airquality/greenbook/phistory_or.html. Accessed: August 2021.

ODEQ (Oregon Department of Environmental Quality). 2020. *Oregon Air Quality Monitoring Annual Report: 2019.* Available: https://oraqi.deq.state.or.us/Pagesfiles/2019%20Oregon%20Air%20Quality%20Monitoring%20Annual%20Report.pdf. Accessed: August 2021.

ODF (Oregon Department of Forestry). 2019. *Oregon Smoke Management Annual Report.* Available: https://www.oregon.gov/odf/Documents/fire/SMR2019.pdf. Accessed: August 2021.

Section 3.8, Aesthetics and Visual Resources

FHWA (Federal Highway Administration). 2015. *Guidelines for the Visual Impact Assessment of Highway Projects*. (FHWA-HEP-15-029.) U.S. Department of Transportation. Washington, DC. January 2015.

ODF (Oregon Department of Forestry). 2019. *Western Oregon Forest Management Plan 2020.* Salem, OR.

State of Oregon. 2021. *Oregon's State Scenic Waterways*. Available: https://www.oregon.gov/oprd/BWT/Pages/SSW-list.aspx. Accessed: September 7, 2021.

Section 3.9, Recreation

Boxall, P.C., and B. Macnab. 2000. Exploring the preferences of wildlife recreationists for features of boreal forest management: a choice experiment approach. *Canadian Journal of Forest Research* 30(12):1931–1941.

Cordell, H.K. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: US Department of Agriculture Forest Service, Southern Research Station. Pages 1–167. Available: https://www.fs.usda.gov/treesearch/pubs/40453.

Kearney, A.R., J.R. Tilt, and G.R. Bradley. 2010. The effects of forest regeneration on preferences for forest treatments among foresters, environmentalists, and the general public. *Journal of Forestry* 108(5):215–229.

Lindberg, K., and T. Bertone-Riggs. 2015. Oregon Off-highway Vehicle (OHV) Participation and Priorities: Report in Support of the 2015-2024 Oregon Trails Plan. Oregon State University. Available: https://headwaterseconomics.org/wp-content/uploads/Trail_Study_116-OR-OHV-Participation-Priorities.pdf.

ODF (Oregon Department of Forestry). 2002. Memorandum of Agreement between Oregon Department of Forestry and the Oregon State Historic Preservation Officer. On file with Oregon Department of Forestry, State Forests Division.

———. 2019. Board of Forestry Recreation Accomplishments (FY 2019). ODF. Available: https://www.oregon.gov/odf/Documents/workingforests/BOFRecreationAccomplishmentsFY19.pdf.

———. 2020a. ODF Trails Data.

———. 2020b. ODF Developed Recreational Facility Data.

ODFW (Oregon Department of Fish and Wildlife). 2020. Oregon Department of Fish and Wildlife Annual Performance Progress Report. Available: https://www.dfw.state.or.us/agency/docs/APPR_ODFW_2020-09-29.pdf.

Oregon Parks and Recreation Department. 2021. Monthly Visitation to Oregon State Parks. Accessed: August 12, 2021.

Peterson, Randy. 2021. ODF Recreation Program Manager. August 6, 2021—Personal communications.

Rosenberger, R.S. 2018. Total Net Economic Value from Residents' Outdoor Recreation Participation in Oregon. In: 2019–2023 Oregon Statewide Comprehensive Outdoor Recreation Plan Supporting Documentation. Available: https://www.oregon.gov/oprd/PRP/Documents/SCORP-2018-Total-Net-Economic-Value.pdf.

Shelby, B., J.R. Thompson, M. Brunson, M. and R. Johnson. 2005. A decade of recreation ratings for six silviculture treatments in Western Oregon. *Journal of Environmental Management* 75(3):239–246.

USFS (U.S. Forest Service). 2021. Visitor Use Report: Siuslaw NF. USDA Forest Service Region 6. Available: https://apps.fs.usda.gov/nvum/results/ReportCache/2016_A06012_Master_Report.pdf.

USGS (U.S. Geological Survey). 2021. Protected Areas Database. Department of the Interior, as reported in Headwaters Economics' Economic Profile System (headwaterseconomics.org/eps). Available: https://headwaterseconomics.org/apps/economic-profile-system/.

White, E. 2017. Spending Patterns of Outdoor Recreation Visitors to National Forests. U.S. Forest Service. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr961.pdf.

Section 3.10, Cultural Resources

Barnes, John. 2008. *Cultural Resources Handbook for Operations Planning on Oregon's State Forests*. January. Prepared for Oregon Department of Forestry. Salem, OR.

National Park Service National Trails Intermountain Region. 2017. California National Historic Trail. National Park Service, National Trails Intermountain Region. Available: https://irma.nps.gov/DataStore/Reference/Profile/2238903. Accessed: October 8, 2021.

NPS (National Park Service). 2019. Revised Feasibility and Suitability Study for Additional Routes of the Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails. National Park Service, U.S. Department of the Interior. Available: https://parkplanning.nps.gov/document.cfm?documentID=100108. Accessed: October 8, 2021.

ODF (Oregon Department of Forestry). 2002. Memorandum of Agreement between Oregon Department of Forestry and the Oregon State Historic Preservation Officer. On file with Oregon Department of Forestry, State Forests Division.

———. 2016b. Oregon Department of Forestry Procedure Document, Cultural Resources – Review and Protection. March. On file with Oregon Department of Forestry, State Forests Division.

———. n.d.(a). *Inadvertent Discovery of Archaeological Resources and Human Remains During Emergency Operations*. On file with Oregon Department of Forestry, State Forests Division.

———. n.d.(b). *Inadvertent Discovery of Archaeological Resources and Human Remains During Non-Emergency Operations*. On file with Oregon Department of Forestry, State Forests Division.

Oregon Historic Sites Database. 1966. Oregon Historic Site Record 651907, West Creek Skid Road Tunnel. June. On file with Oregon State Historic Preservation Office.

———. 1992a. Oregon Historic Site Record 34204, Yunker & Wicks Logging Camp. February. On file with Oregon State Historic Preservation Office.

———. 1992b. Oregon Historic Site Record 38173, Camp Nehalem. February. On file with Oregon State Historic Preservation Office.

———. 1992c. Oregon Historic Site Record 38176, Hembre Lookout. February. On file with Oregon State Historic Preservation Office.

———. 2009. Oregon Historic Site Record, 673779. Port of Tillamook Bay Railroad. March. On file with Oregon State Historic Preservation Office.

Section 3.11, Tribal Resources

Confederated Tribes of Coos, Lower Umpqua and Siuslaw. No date. Abundance StoryMap. Available: https://ctclusi.org/abundance-storymap/. Accessed: January 19, 2022.

Coquille Indian Tribe. 2022. Our Lands - Living the Culture. Available: https://www.coquilletribe.org/?page_id=53. Accessed: January 19, 2022.

Beck, Colin. Forest Lands Manager. Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians. Coos Bay, OR. January 26, 2022—Phone conversation with Greg Blair, ICF, regarding management of tribal trust lands and use of natural resources by tribe.

DOI (U.S. Department of the Interior). 2011. Secretarial Order No. 3317, Department of the Interior Policy on Consultation with Indian Tribes. December 1, 2011.

Kie, J., T. Bowyer, and K. Stewart. 2003. Ungulates in western coniferous forests: Habitat relationships, population dynamics, and ecosystem processes. In C. Zabel & R. Anthony (eds.). Mammal Community Dynamics: Management and Conservation in the Coniferous Forests of Western North America (pp. 296–340). Cambridge: Cambridge University Press.

Long, J., F.K. Lake, K. Lynn, and C. Viles. 2018. Chapter 11: Tribal ecocultural resources and engagement. In: Spies, T.A.; Stine, P.A.; Gravenmier, R.; Long, J.W.; Reilly, M.J., tech. coords. 2018. Synthesis of science to inform land management within the Northwest Forest Plan area. Gen. Tech. Rep. PNW-GTR-966. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 851-917.

NMFS (National Marine Fisheries Service). 2013. NOAA Procedures for Government-to-Government Consultation With Federally Recognized Indian Tribes and Alaska Native Corporations. November 12, 2013.

Zucker, J., K. Hummel, and B. Hogfoss. 1983. Oregon Indians: Culture, History & Current Affairs, an Atlas & Introduction. Portland, OR: Oregon Historical Society Press.

Section 3.12, Socioeconomics

Arce, Eve. Treasurer/Tax Collector. Josephine County, OR. July 8, 2021—Meeting.

Binkley, D., and R.F. Fisher. 2019. *Ecology and Management of Forest Soils*. John Wiley & Sons.

Blanchard, S. 2021. Tillamook County Budget 2021–2022. Available: https://www.co.tillamook.or.us/treasurer/page/budget.

Bohn, D., and M. Steele. 2020. Adopted Budget FY 2020-21. Prepared for Clatsop County, OR. Available: https://www.co.clatsop.or.us/finance/page/clatsop-county-budget.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw. n.d. Abundance StoryMap. Available: https://ctclusi.org/abundance-storymap/. Accessed: September 15, 2021.

Daniels, J., and K. Wendel. 2020. Table 20: Total statewide employment and proportion of employment in forest products industries in all western states, 1990–2019. *Production, prices, employment, and trade in Northwest forest industries: 1958–2019*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

De Groot, R.S., M.A. Wilson, and R.M. Boumans. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41(3):393–408. Available: https://www.sciencedirect.com/science/article/pii/S0921800902000897.

Dreisbach, T. 2002. *Importance of Fungi in Forest Ecosystems.* April. Available: https://apps.fs.usda.gov/r6_decaid/views/fungi.html.

Giardinelli, C. 2021. Lumber cost at all time high while local log price has seen little increase; here's why. KTVL.com. Available: https://ktvl.com/news/local/lumber-cost-at-all-time-high-while-local-log-price-has-seen-little-increase-heres-why. Accessed: August 18, 2021.

Hansen, Greg. Administrative Officer. Polk County, OR. July 15, 2021—Email.

Interagency Working Group on Social Cost of Greenhouse Gases. 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. February. Available: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf?source=email.

Kearney, A.R., J.R. Tilt, and G.R. Bradley. 2010. The effects of forest regeneration on preferences for forest treatments among foresters, environmentalists, and the general public. *Journal of Forestry 108*(5):215–229.

Keeler, B.L., S. Polasky, K.A. Brauman, K.A., Johnson, J.C. Finlay, A. O'Neill, K. Kovacs, and B. Dalzell. 2012. Linking water quality and well-being for improved assessment and valuation of ecosystem services. *Proceedings of the National Academy of Sciences* 109(45):18619–18624. Available: https://www.pnas.org/content/109/45/18619?etoc=&utm_source=TrendMD&utm_campaign=Proc_Natl_Acad_Sci_U_S_A_TrendMD_1&utm_medium=cpc.

Legislative Revenue Office. 2020. K-12 and ESD School Finance: State School Fund Distribution.

Lehner, J. 2021. Oregon Employment, 2021. Oregon Office of Economic Analysis. August 17. Available: https://oregoneconomicanalysis.com/2021/08/17/oregon-employment-july-2021/.

McLain, R.J., S. Alexander, and E.T. Jones. 2008. *Incorporating understanding of informal economic activity in natural resource and economic development policy*. USDA For. Serv., Pac. Northw. Res. Stn. GTR-PNW-755. 53 p. Available: https://www.arlis.org/docs/vol1/237002619.pdf.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC. Available: http://www.millenniumassessment.org/documents/document.356.aspx.pdf.

NASDAQ. 2021. Lumber (LBS) Market Activity: 1Y. Nasdaq.com. Available: https://www.nasdaq.com/market-activity/commodities/lbs. Accessed: October 15, 2021.

Nava, Brian. Treasurer. Clackamas County, OR. June 29, 2021—Meeting.

Oregon Department of Education. 2021. State School Support and Local Revenue Distributions Dataset. Accessed: July 7, 2021.

ODF (Oregon Department of Forestry). 2016. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2016. Prepared for the Association of Oregon Counties.

———. 2017. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2017. Prepared for the Association of Oregon Counties.

———. 2018. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2018. Prepared for the Association of Oregon Counties.

———. 2019a. 2019–2021 Legislatively Adopted Budget Narrative.

———. 2019b. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2019. Prepared for the Association of Oregon Counties.

———. 2020. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2020. Prepared for the Association of Oregon Counties.

———. 2021. Miscellaneous Forest Products Commercial Permits: 2018–2021 data. Accessed: July 29, 2021.

Oregon Department of Revenue Research Section. 2020. State of Oregon Tax Expenditure Report: 2021–2023 Biennium. Oregon Department of Administrative Services: Salem, OR.

Oregon Department of State Lands. 2020. Common School Fund Benefits Oregon Schools: A Fact Sheet.

Oregon Forest Resources Institute. 2019. The 2019 Forest Report: Forest Resources and Markets – Trends and Economic Impacts.

Portland State University. 2021. Population Forecasts. Available: https://www.pdx.edu/population-research/population-forecasts.

Richardson, L., and J. Loomis. 2009. The total economic value of threatened, endangered, and rare species: an updated meta-analysis. *Ecological Economics* 68(5):1535–1548.

Shelby, B., J.R. Thompson, M. Brunson, M. and R. Johnson. 2005. A decade of recreation ratings for six silviculture treatments in Western Oregon. Journal of Environmental Management 75(3):239–246.

Simmons, E., and K. Marcille. 2020. Oregon forest products industry and timber harvest, 2017: Highlights and summary data tables. University of Montana, Forest Industry Research Program. Available: http://www.bber.umt.edu/pubs/forest/fidacs/OR2017%20Tables.pdf.

Simonin, K.A. 2000. Vaccinium membranaceum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: www.fs.fed.us/database/feis/plants/shrub/vacmem/all.html. Accessed: September 14, 2021.

Tillamook Forest Center. 2018. *Tillamook Forest Center*. Available: https://tillamookforestcenter.org/.

Tirmenstein, D. 1990. Gaultheria shallon. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).

U.S. Bureau of Economic Analysis. 2021a. Table SAEMP25N: Total Full-Time and Part-Time Employment by NAICS Industry. Available:

https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=24&isuri=1&tableid=30&category=430&area_type=0. Accessed: July 14, 2021.

———. 2021b. Table CAEMP25N: Total Full-Time and Part-Time Employment by County. Available: https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=24&isuri=1&tableid=33&category=733&area_type=4. Accessed: July 14, 2021.

U.S. Bureau of Labor Statistics. 2021. Local Area Unemployment Statistics Series ID: LASST410000000000003. Accessed: July 14, 2021.

U.S. Census Bureau. 2010. Table 12. Available: https://data.census.gov/cedsci/table?text=sex%20by%20age&g=0500000US41003.150000,41005.150000,41007.150000,41009.150000,41011.150000,41015.150000,41019.150000,41027.150000,41033.150000,41039.150000,41041.150000,41043.150000,41047.150000,41051.150000,41053.150000,41057.150000,41067.150000,41071.150000&tid=DECENNIALSF12010.P12&hidePreview=true. Accessed: July 14, 2021.

———. 2021a. Table S0101: Age and Sex. *2015–2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/table?q=ACSST1Y2019.S0101&text=s0101&g=0400000US41_0500000US41003,41005,41007,41009,41011,41015,41019,41029,41033,41039,41041,41043,41047,41051,41053,41057,41067,41071&y=2019&tid=ACSST5Y2019.S0101&hidePreview=true. Accessed: July 14, 2021.

———. 2021b. Table B19013: Median Household Income. *2015-2019 American Community Survey 1-Year Estimate*. Available: https://data.census.gov/cedsci/table?q=B19013%3A%20MEDIAN%20HOUSEHOLD%20INCOME%20IN%20THE%20PAST%2012%20MONTHS%20%28IN%202019%20INFLATION-ADJUSTED%20DOLLARS%29&text=sex%20by%20age&g=0400000US41_0500000US41003,41005,41007,41009,41011,41015,41019,41029,41033,41039,41041,41043,41047,41051,41053,41057,41067,41071&tid=ACSDT1Y2019.B19013&hidePreview=true. Accessed: July 14, 2021.

University of Montana. 2021. Timber Harvest for Oregon. Dataset available: http://www.bber.umt.edu/fir/HarvestOR.aspx. Accessed: August 12, 2021.

Warziniack, T., C.H. Sham, R. Morgan, and Y. Feferholtz, Y. 2017. Effect of forest cover on water treatment costs. *Water Economics and Policy* 3(04):1750006. Available: https://www.worldscientific.com/doi/abs/10.1142/s2382624x17500060.

Yost, A. 2019. *Oregon Forest Carbon Policy.* November 21. Available: https://www.fs.usda.gov/pnw/documents-and-media/oregon-forest-carbon-policy-andrew-yost.

Section 3.13, Environmental Justice

Federal Interagency Working Group on Environmental Justice and NEPA Committee. 2016. *Promising Practices for Environmental Justice Methodologies in NEPA Reviews.* March 2016. Available: https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf.

Helvoigt, T.L., D.M. Adams, and A.L. Ayre. 2003. Employment Transitions in Oregon's Wood Products Sector During the 1990s. *Journal of Forestry*: 42–46.

Lamborn, C.C., J.W. Smith, and S.W. Burr. 2017. User fees displace low-income outdoor recreationists. *Landscape and Urban Planning* 167: 165–176.

ODF (Oregon Department of Forestry). 2002. Memorandum of Agreement between Oregon Department of Forestry and the Oregon State Historic Preservation Officer. On file with Oregon Department of Forestry, State Forests Division.

OFRI (Oregon Forest Resources Institute). 2021. Special Forest Products: Beyond Timber. Available: https://oregonforests.org/Special_Forest_Projects. Accessed: November 23, 2021.

OPRD (Oregon Parks and Recreation Department). 2019. 2019–2023 Oregon Statewide Comprehensive Outdoor Recreation Plan. Available: https://www.oregon.gov/oprd/PRP/Documents/SCORP-2019-2023-Final.pdf.

Oregon Employment Department. 2017. The Employment Landscape of Rural Oregon. Available: https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.2.

Rasker, R. 2021. The Transition from Western Timber Dependence: Lessons for Counties. Headwaters Economics. Available: https://headwaterseconomics.org/economic-development/trends-performance/timber-transition/.

U.S. Bureau of Labor Statistics. 2021a. Table 18: Employed persons by detailed industry, sex, race, and Hispanic or Latino ethnicity. Labor Force Statistics from the Current Population Survey. Available: https://www.bls.gov/cps/cpsaat18.htm. Accessed: October 21, 2021.

———. 2021b. *Occupational Outlook Handbook*, Logging Workers. U.S. Department of Labor. Available: https://www.bls.gov/ooh/farming-fishing-and-forestry/logging-workers.htm. Accessed: October 03, 2021.

———. 2021a. Table B03002: Hispanic or Latino Origin by Race. *2015-2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/table?q=b03002&text=b03002&g=0400000US41_0500000US41003,41005,41007,41009,41011,41015,41019,41029,41033,41039,41041,41043,41047,41051,41053,41057,41067,41071&tid=ACSDT5Y2019.B03002&hidePreview=true&tp=false. Accessed: July 14, 2021.

———. 2021b. Table C17002: Ratio of Income to Poverty Level. *2015-2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/table?q=table%20c17002&g=0500000US41003,41005,41007,41019,41029,41033,41039,41043,41047,41051,41053,41067,41071&tid=ACSDT1Y2019.C17002&hidePreview=true. Accessed: July 14, 2021.

———. 2021c. My Tribal Area. 2015-2019 American Community Survey 5-year estimates. Available: https://www.census.gov/tribal/. Accessed: October 15, 2021.

Section 3.14, Greenhouse Gas Emissions and Carbon Storage

CEQ (Council on Environmental Quality). 2016. *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews.* Available: https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf. Accessed: August 2021.

IPCC (Intergovernmental Panel on Climate Change). 2021. *Climate Change 2021: The Physical Science Basis. Summary for Policymakers.* Available: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf. Accessed: August 2021.

Chapter 4, Summary of Submitted Alternatives, Information, and Analyses

None.

Chapter 5, Additional Topics Required by NEPA

None.

Chapter 6, List of Preparers

None.

Appendix 1-C

Scoping Report

Scoping Report for the Western Oregon State Forests Habitat Conservation Plan Environmental Impact Statement

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ICF. 2021. *Scoping Report for the Western Oregon State Forests Habitat Conservation Plan Administrative Draft Environmental Impact Statement*. December. (ICF 250.19.) Seattle, WA. Prepared for National Marine Fisheries Service, Roseburg, OR.

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Acronyms and Abbreviations

CFR	Code of Federal Regulations
EIS	environmental impact statement
ESA	federal Endangered Species Act
FR	*Federal Register*
FWS	U.S. Fish and Wildlife Service
HCA	habitat conservation area
HCP	habitat conservation plan
ITP	incidental take permit
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
ODF	Oregon Department of Forestry
RCA	riparian conservation area
USC	United States Code

Chapter 1
Introduction

1.1 Proposed Action Overview

The National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (FWS) (collectively, the Services) are reviewing the applications from Oregon Department of Forestry (ODF; the applicant) for incidental take permits (ITPs) for the covered species and associated Western Oregon State Forests Habitat Conservation Plan (HCP), pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act of 1973, as amended (ESA) for ODF management of state forestlands. If the Services find that all requirements for issuance of the ITPs are met, the Services shall issue the requested permits, subject to the terms and conditions deemed necessary or appropriate to carry out the purposes of ESA Section 10.

ODF is preparing the HCP. NMFS is preparing an environmental impact statement (EIS) to evaluate the potential impacts associated with issuance of ITPs and implementation of the HCP. FWS is a cooperating agency in the NEPA process. The ITPs would authorize incidental take of the covered species that could result from activities covered by the HCP in the permit area over the permit term. The HCP is ODF's plan in support of its request for the ITPs; the stated intent of the HCP is to ensure that ODF avoids, minimizes, and, when necessary, mitigates take of listed species to the maximum extent practicable while conducting management of state forestlands. The permit area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 639,489 acres. Covered species under the proposed HCP include threatened and endangered species listed under the ESA, and currently unlisted species that have the potential to become listed during the HCP permit term. The covered activities under the HCP include ODF's land management activities in the permit area, as well as the activities needed to carry out the HCP's proposed conservation strategy.

1.2 Purpose of the Proposed Federal Action

The purpose of the federal action is to protect the covered species and their habitat while allowing the applicant to manage western Oregon state forestlands in compliance with the ESA. If granted, the ITPs would authorize the incidental take of covered species resulting from ODF's covered activities within the permit area.

Section 9 of the ESA (16 United States Code [USC] 1531 et seq.) and its implementing regulations prohibit the take of animal species listed as endangered or threatened. The term *take* is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct" (16 USC 1532(19)). Certain of these terms are further defined by federal regulations at 50 Code of Federal Regulations (CFR) 17.3.

Under Section 10(a) of the ESA, the Services may issue permits to authorize incidental take of listed animal species (16 USC 1539(a)(1)B). *Incidental take* is defined as take that is "…incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 CFR 17.3).
Section 10(a)(1)(B) of the ESA contains provisions for issuing ITPs to non-federal entities for take of endangered and threatened species, provided the applicant prepares a conservation plan (ESA

Section 10(a)(2)(A)) and satisfies the issuance criteria provided in ESA Section 10(a)(2)(B), which require that:

- The taking will be incidental.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
- The applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- The applicant will ensure that other measures that the Services may require as being necessary or appropriate will be provided.
- The Services have received such other assurances as may be required that the HCP will be implemented.

The ITPs would also require implementation of the HCP. In order to proceed with the issuance of the ITPs, the following permits, consultations, or other authorizations are anticipated to be required.

- ESA Section 7 biological opinion
- ESA Section 10 findings
- Magnuson-Stevens Fishery Conservation and Management Act
- Tribal consultation
- National Historic Preservation Act

Chapter 2
NEPA Compliance

The National Environmental Policy Act states that any federal agency undertaking a "major Federal action" likely to "significantly affect the quality of the human environment" must prepare an EIS (42 USC 4332(2)(C)). In considering whether the effects of a proposed action are significant, agencies shall analyze the potentially affected environment and degree of the effects of the action (40 CFR 1501.3(b)). NMFS has determined that issuance of an ITP for the proposed HCP may have a significant effect on the human environment and an EIS has been prepared.

2.1 Purpose of Scoping

The first formal step in the NEPA process is scoping, which is an early and open process for determining the scope of the issues for analysis in an EIS, including identifying the significant issues and eliminating from further study non-significant issues. Through this process, the public, organizations, and agencies assist in the development of the EIS by identifying important issues and alternatives to the proposed action that should be considered in the EIS.

This report describes the public noticing and engagement efforts undertaken by NMFS during the scoping period and summarizes comments received during the scoping period.

Chapter 3
Public Notices and Distribution of Notices

3.1 Notice of Intent

The Notice of Intent (NOI) was posted to the NMFS website and published in the *Federal Register* (FR) on March 8, 2021. The NOI provides background information on the proposed federal action, the HCP, and the ESA and NEPA processes, as well as information on how to participate in the EIS scoping process. The NOI is available on the NMFS website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

3.2 Email Notifications

Email notifications were distributed to interested parties on March 8, 2021, following the publication of the NOI in the FR. The email notice announced the opportunity to provide comments on the scope of the EIS and included a brief description of the proposed action, a link to the NMFS website providing webinar information, and instructions on how to submit comments through www.Regulations.gov.

The email notice was sent to approximately 800 individuals, including representatives of federal, state, and local governments, elected officials, tribes, nongovernmental organizations, businesses, and others who have expressed interest in the HCP and EIS processes.

3.3 Media Notifications

NMFS released a social media notice to announce the availability of the NOI and the opportunity to provide comments.

3.4 National Marine Fisheries Service Website

The NMFS website provided a summary of the proposed action, information about how to provide comments and a link to www.Regulations.gov, webinar information, the anticipated NEPA schedule, and a link to the FR notices: the NOI and the notice of the extension of the comment period.

3.5 Comment Period Extension

The March 8, 2021 NOI provided a 30-day comment period. In response to requests, NMFS extended the comment period by 14 days to April 21, 2021. A notice of the extension was published in the FR on April 8, 2021. On April 6, 2021, an email notification of the extension was also distributed to individuals who received the initial announcement regarding the NOI and scoping period on March

8, 2021. Additionally, NMFS updated their website to reflect the comment period extension and released a social media notice and press release through their media channels to announce the extension of the comment period.

Chapter 4
Tribal Outreach and Interaction

4.1 Tribal Notification and Information Session

NMFS and FWS provided advanced notification of the proposed action to tribes via a letter sent on January 29, 2021. The letter invited the tribes to participate in an information session regarding the upcoming scoping period. On February 24, 2021, NMFS and FWS held a video conference call with invited tribes to provide information on the HCP and EIS. As part of the information session, ODF presented an overview of the proposed HCP and NMFS provided information regarding the NEPA process, the upcoming scoping period, and the anticipated project schedule. On March 5, 2021, NMFS sent an email notification to tribes announcing the publication of the NOI in the FR and inviting tribes to participate in the scoping process. On April 6, 2021, NMFS sent an email notifying tribes of the comment period extension.

Chapter 5
Public Scoping Informational Webinar

NMFS held one virtual public informational scoping meeting on March 31, 2021. The webinar included a presentation by NMFS, a presentation by ODF, and a question-and-answer session. The purpose of the informational webinar was to provide information to the public about the proposed action, the NEPA process, how to submit comments, and ODF's proposed HCP, and to allow participants to ask NMFS questions about the NEPA process and the contents of the NOI. Representatives from FWS, including Rich Szlemp, biologist, and Kim Garner, Forest Resources Division Manager for the Oregon Fish and Wildlife Office, attended this meeting.

The webinar began with an overview of the agenda and basic functions of how to participate on the virtual meeting platform. The Oregon Coast Branch Chief of NMFS, Tere O'Rourke, went over the purpose of the meeting, explained the federal agency's proposed action, the NEPA process, and the purpose of scoping. Liz Dent, ODF State Forests Chief and other ODF staff provided a presentation on the proposed HCP, which included an overview of the components of the HCP and the HCP process and next steps. The NMFS EIS team provided additional information regarding the purpose of scoping, the types of scoping comments that are most effective, and the anticipated project schedule. The presentation concluded with a detailed explanation of how to submit comments using www.Regulations.gov. Following the presentation, NMFS provided an opportunity for webinar attendees to ask clarifying questions about the NEPA process and the NOI.

Chapter 6
Summary of Public Comments Received

During the scoping period a total of 44 written comments were received: 1 from a federal agency, 1 from a tribe, 1 from a state agency, 6 from local or regional agencies, 8 from nongovernmental organizations, 7 from businesses, and 20 from members of the public. All comments received during the scoping period are presented in Attachment A, *Public Scoping Comments*. The comments are summarized in this chapter by topic.

6.1 Comments on the NEPA Process

Commenters requested that the NEPA process continue to involve relevant stakeholders throughout EIS development.

6.2 Approach to Analysis

Commenters made the following suggestions regarding the approach to the EIS analysis.

- Consider cumulative effects of the HCP on all applicable resource areas.
- Include a discussion of monitoring and adaptive management strategies included in the action alternatives and an explanation of how additional monitoring requirements could be expected to be implemented during the permit term.
- Assess the feasibility of HCP implementation (e.g., funding certainty).

6.3 General Support or Opposition

Multiple commenters expressed support for the HCP, stating that they believe the HCP would represent an improvement from existing forest management practices and provide protections for species and habitat. Other commenters expressed opposition to the HCP, some stating that it is too restrictive of timber harvest and others stating that it does not provide enough protection for species.

6.4 Comments on the HCP

Multiple commenters provided feedback on the Administrative Draft HCP. Some comments referred to data, assumptions, and projected outcomes presented in the HCP. Other comments related to the HCP's covered species, terrestrial and aquatic conservation strategies, and monitoring and adaptive management. One comment suggested that public engagement during HCP development should have been more inclusive of certain stakeholders.

6.5 Alternatives

Commenters suggested that the following alternatives or elements of alternatives be analyzed in the EIS.

- Shorten the permit term to 30 or 50 years
- Modify covered species to remove non-listed species and/or species with limited data
- Modify the aquatic conservation strategy by:
  - Applying the Bureau of Land Management riparian strategy
  - Expanding the proposed HCP's process protection zone further upstream and/or widening the RCAs above this zone
  - Leaving trees on additional landslide initiation sites
  - Limiting hydrologically connected roads
  - Managing key watersheds with aquatic conservation as the primary objective
  - Allowing for more management within riparian conservation areas (RCAs)
  - Reducing the size of RCAs
- Modify the terrestrial conservation strategy by:
  - Increasing the acreage included in habitat conservation areas (HCAs).
  - Decreasing the acreage included in HCAs.
  - Removing younger stands from HCAs and replacing with older/more biologically diverse stands located outside of HCAs.
  - Removing lower habitat suitability areas in HCAs or removing areas that were not part of aquatic or terrestrial anchor habitats.
  - Decreasing the extent of HCAs using population modeling and increasing predator control throughout the plan area.
  - Excluding heavy or moderate thinning or clearcutting within the HCAs and prohibiting commercial benefit from management in HCAs.
  - Increasing harvest within HCAs.
  - Allowing stand management and harvest within HCAs.
  - Removing restrictions on herbicide spraying.
  - Strengthening restrictions or prohibiting chemical use.
- Modify management outside of HCAs and RCAs by:
  - Increasing management standards above the minimums allowed by the Oregon Forest Practices Act.
  - Reducing uniform, heavy logging and implementing a more ecologically oriented management practice such as variable-density thinning.
  - Including buffer stands around old-growth patches on non-HCP lands.

6.6 Water Resources

Commenters made the following suggestions on the analysis of water resources in the EIS.

- Include analysis of effects on multiple parameters, such as flow rates, water quality, stream sedimentation, temperature and turbidity, recruitment of woody debris, floodplain characteristics, and forest characteristics in stream corridors.
- Disclose and describe potential water pollutants from the HCP and potential effects on the status of waterways identified on the state of Oregon's U.S. Environmental Protection Agency–approved 303(d) list of waters that do not meet water quality standards.
- Disclose whether dredging or filling would occur under the HCP and address related effects.
- Include accurate, comprehensive baseline data on water resources in the plan area (e.g., acreages and channel lengths, habitat types and values, function of affected waters) to accurately assess effects on water resources.

Commenters also provided materials and references related to water resources for consideration in the EIS analysis.

6.7 Geology and Soils

Commenters made the following suggestions on the analysis of geology and soils in the EIS.

- Consider the interaction of anticipated effects of climate change (e.g., more frequent intense precipitation events) with road construction and timber harvest.
- Analyze effects of the HCP—specifically harvest, road construction, and buffering in riparian areas—on landslide initiation, debris flow, and changes in geomorphology as a result of erosion and sedimentation and describe how the alternatives would address these effects.
- Analyze changes in soil productivity as a result of the HCP.

6.8 Vegetation

Commenters made the following suggestions on the analysis of vegetation in the EIS.

- Account for losses of forestland to recent wildfires in the baseline analyzed in the EIS.
- Assess the impacts of proposed management on the condition of vegetation in the plan area, including thinning, canopy retention, forest structure, snag retention, downed wood, and forest habitat health.

Commenters also provided materials and references related to vegetation for consideration in the EIS analysis.

6.9 Wildlife

Commenters made the following suggestions on the analysis of wildlife in the EIS.

- Analyze effects on aquatic and terrestrial species, including endangered, threatened, and candidate species, not covered by the HCP.
- Assess effects of wildfire on terrestrial species and habitat.
- Provide an adequate baseline description of aquatic habitat and streams.
- Consider genetically distinct aquatic species populations and population sources and sinks.
- Consider direct and indirect cumulative effects on species, especially salmonids.
- Analyze the amount of take expected to occur under the proposed action.

Commenters also provided materials and references related to terrestrial and aquatic species for consideration in the EIS analysis.

6.10 Cultural Resources

Commenters suggested that the EIS discuss how adverse effects on cultural resources and/or archaeological sites would be minimized throughout the plan area and that EIS development include, as appropriate, a summary of consultation with state and federal agencies on potential effects on National Historic Preservation Act resources.

6.11 Tribal Resources

Commenters made the following suggestions regarding the EIS analysis of tribal resources:

- Incorporate input from tribal leaders on HCP development and summarize tribal consultation in the EIS.
- Conduct tribe-specific tribal consultation.
- Describe the process and outcomes of tribal engagement in the EIS.
- Identify whether any potentially affected sacred sites exist in the plan area and analyze related effects.

6.12 Air Quality

Commenters recommended that the EIS include a discussion of baseline conditions related to air quality in the plan area and analyze effects of the HCP on baseline conditions, identifying mitigation, if appropriate.

6.13 Socioeconomics

Multiple commenters suggested that the EIS should analyze the effects of the HCP on county tax revenues, community services (e.g., fire services, public safety services, health districts, rural law enforcement), and employment. One commenter recommended that the EIS include a discussion of the economic benefits of carbon sequestration in unlogged forests compared to the social costs of carbon-emitting activities.

6.14 Environmental Justice

A commenter suggested that the EIS identify potentially affected environmental justice communities using the U.S. Environmental Protection Agency's EJSCREEN tool and discuss whether the project would have disproportionate adverse effects on any such communities. This commenter also suggested that the NEPA process should include engagement with any potentially affected environmental justice communities.

6.15 Climate Change

Commenters recommended that the EIS consider the potential effects of climate change on the HCP and the potential effects of the HCP on climate change. Commenters also suggested that the EIS include discussion of potential effects on carbon sequestration and related social and environmental costs. Commenters also provided materials and references related to climate change for consideration in the EIS analysis.

6.16 Wildfire

Commenters expressed that the EIS should analyze the HCP in the context of intensifying wildfires and assess the effects of forest management practices on wildfire risk in the plan area. Commenters also suggested that the EIS discuss how natural disasters such as wildfire would be addressed in the permit area and how the HCP could affect fire response. Commenters also provided materials and references related to wildfire and salvage harvest for consideration in the EIS analysis.

Attachment A

Public Scoping Comments

Comments Entered Directly

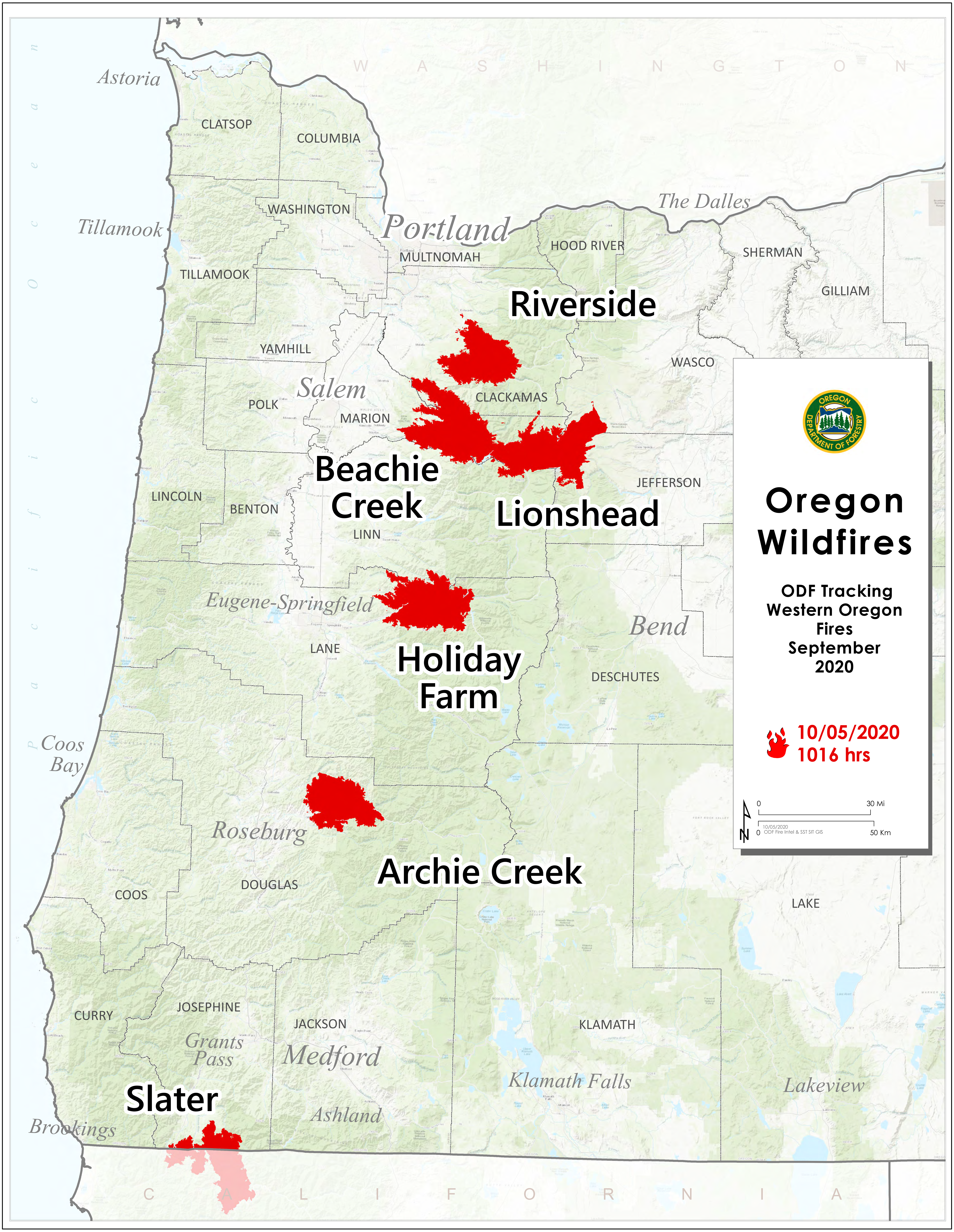
Commenter Name, Title, Affiliation	Comment Text
Rebecca White, Wildlands Director, Cascadia Wildlands	Please extend the scoping comment period by 30 days from today, March, 31, 2021. The Administrative Draft HCP was not made publicly available until this afternoon. It has significant new material and changes as compared to the earlier draft HCP, which was the only version available to the public up until today. As such, only 7 days remain to comment on a substantially revised and augmented document, which is an insufficient period of time for informed and meaningful public input into this process.
Owen Rodabaugh	I am writing in support of the Western Oregon State Forests Habitat Conservation Plan. As participant in the process representing a recreational trail user group I've been to a number of the meetings and have an understanding of the plan. I believe that the plan is a significant improvement from the current reactive method of managing habitat for these species. The plan to proactively identify, manage, and improve habitat to protect endangered species seems much more likely to result in better long term outcomes for those species while also providing better operational certainty for other stakeholders. I encourage NOAA to approve the HCP.
Arnold Bradley	Will there be enough time to create an alternative habitat and still maintain a viable population of each species? Probably not in our lifetime!
Thomas Hardesty	This getting out of hand, we need to protect our environment. The fire has done the most damage, burning thousand of acres of trees. This is our livelihood!
James Baker	As a small woodlot owner I feel that this Habitat conservation plan is desperately needed for both wild life and Rural communities
Hunter D. David	The whole aspect of government writing another EIS, is just more government plans to shut our forests down. The spotted owl hoax was part of this plan that devastated the western United States rural forestry communities. Conservation Plans usually leave out any real proper forest management such as thinning, logging and wildfire reductions. Trusting government in writing plans is a joke when knowing that the plans that you are tasked with, you must get the results the government masters want you to get! We need proper forest management and get rid of the inept BLM and USFS management of the western United States forests including what is in Oregon. I used to work for the Forest Service 1978-1992, it is lazy and political correctness that does no proper forest management. I have done wildland fire 25 seasons and again this is political correctness that destroys more forest lands. I hope that the EIS would actually take in the concerns of the working foresters and families that work the lands in western Oregon. I do not trust government reports for habitat conservation since the past spotted owl plan was a plagiarized document, that doubled the acreage needed for the owl and destroyed western communities that have never recovered with "tourism". Please keep political correctness and woke ness out of you plan.
Climate Change Truth, Inc.	One of the best ways we can continue to share key information to our leaders is by providing insights to our carbon emission issues and how to remedy without major effects to our economy and environment. A balanced approach as outlined below is a proven way to decrease atmospheric CO_2 levels. Please go to https://www.whitehouse.gov/contact/ Also your state Governor. Put in your information then copy and paste the below. Please do this multiple times a day.

	The Green New deal and Paris Climate accord are the wrong solution. The Intergovernmental Panel on Climate Change reports are inaccurate and are falsely skewing Data.Https://cctruth.org/ipcc.pdf Publishing garbage manuscripts in a journal whose chief editor that has a degree in Political Science. Is not science. 11th Climate Change Conference https://cctruth.org/GES_12-14-2020.pdf These are well documented facts about Climate Change -Atmospheric CO2 is not an emissions issue; it's a loss of photosynthesis issue due to deforestation. -IPCC GWP model is false Methane is less of a greenhouse gas than carbon dioxide. -Global sea rise is 1.1 mm/yr and linear not accelerating! -On Netflix please watch "kiss the ground" movie! These scientists show correctly if we stop breathing it wont lower atmospheric carbon dioxide.
Anonymous	Please stop using chemicals to manage our Public Forests. Allowing natural regrowth and a successional forest ecosystem is what a forest actually is. Spraying, replanting monocultures, and managing the diseases that a monoculture crop are vulnerable to, are not a natural forest. i.e. Swiss Needle Cast, bear damage, other pathogens and stressors affect a monoculture much more extensively than a diverse actual forest. The argument for optimizing commodity softwood production should not apply to either Public Forests or the funding mechanisms of the Oregon Department of Forestry. The highest and best use of Public Forests is the preservation of the Forest itself as it was before Oregon embarked on "active" management dependent on chemistry. By spraying hardwoods you eliminate the nitrogen fixing alders. You eliminate the very potentially high value added maple trees. You eliminate the natural selection of flora in microecosystems. Cedar trees and spruce trees filled productive niches in the balance of a forest ecosystem. Invasive species should be managed manually. The claim of ODF and the OFF people is that they are maximizing production to create jobs and economic opportunity. This has NOT proven to be the case. Replanting for a job market that exists in 40 years has been an incredible failure of planning. Now mechanization and Mill automation have eliminated 90% of Timber Jobs. There is NO reason to expect this trend to not continue into the next 4 decades. If Private Timber companies want to invest their resources to maximize commodity softwood, then that should be their prerogative. But, the Public Forests should be maximized to their highest potential to support all species of flora, fauna, recreation, watershed, and resilience to pathogens and pests- again without resorting to the use of chemicals. Managing Public forests for employment would create jobs related to security, access, fire control, pest control, invasive species control, and more economic development of the products of a diverse ecosystem. Maple can be locally processed for furniture, flooring, art, cabinetry, and music instruments. Finally there should be a fundamental restructuring of Public Forest Management's financial incentives. Funding ODF through commodity softwood stumpage is forever going to be a declining source of both revenue and Public Good. ODF should be funded through the General Fund and Public Forests should have a much expanded base of users and products. As in the Tech industry, you are incapable of predicting the value of markets in four decades. In order to maximize the potential of Public Forests, you need a diversity of opportunity in four decades. Carbon Storage and Recreation may very well be the leading uses of these Public Spaces. Additionally due to the import/export tax ban, Oregon should impose higher stumpage fees for all wood products and rebate these fees 100% to wood processed in Oregon. (Prorated to the level of consumer retail readiness). ODF has not increased employment in the Timber industry over the last 40 years. ODF has not increased the value to stakeholders in Oregon. ODF is conflicted by their funding mechanism. The economic development and the actual forest itself should be focused on Oregon Citizens' utility of these lands. Gating off the lands and

	spraying chemicals for monoculture crops is not in the greater Public interest of our State Citizens.
Anonymous	Oregon has failed to genetically distinguish watershed specific subspecies of CatostomustsiltcoosenesisTyee Sucker - aka Coastal Largescale Suckerfish. Individual watershed basins have not been genetically sequenced and the populations of these subspecies have not been adequately surveyed and monitored in relation to Forestry Management activities. These species are also contaminated with chemicals used in forestry management. The effect on the fish and consumers of these subspecies has not been documented.
Gary Strean	Please keep a balanced approach to Oregon forests. Environmentalism has destroyed our forests and contributed to wildfires that burned up our state last year. Lets start harvesting our forests and managing them instead of burning them. Sincerely, Gary Strean.
Erik Bufka	As someone born and raised in Oregon I have been able to watch the affects of the lack of forest management on your public lands. From road quality going down hill to roads no longer accessible due to no maintenance. Over crowded stands of timber with massive amounts of underbrush that led to the huge fires we have out west every summer. Oregon's clean air gets filled with nasty smoke of forest fires and the community's burned year after year. We can do so much better than this. Please bring back the logging and thinning, let the cattle graze and clean up our forests. Also bring the head office of BLM, USFS and USDA out West so they can see and live with the policy's that we have in place. It would help them to see the problems and the changes could be made to better serve our public land
Friends of Hug Point	The Habitat Conservation Program (HCP) currently being developed as part of the Oregon Department of Forestry's planning efforts has some important elements to preserve forested lands as habitat for many species in locations where they occur. However, current versions of the draft HCP being developed do not take into account the important role forest land plays in providing ecosystem services upstream and adjacent to important non fish-bearing streams, ephemeral streams, springs, seeps, and pools. The Friends of Hug Point represent 20 neighbors on the North Oregon coast that obtain their drinking water from springs, streams and wells that come from forested land east of US HWY 101. Because we are not members of an established water district, our water collection systems are relatively primitive and fragile. If the forests are indiscriminately harvested, severe and long term damage to our water quality and water collection systems results. The same pollutants that threaten fish also threaten our water systems: fine sediment, turbidity, and temperature. These often originate upstream and can quickly be transported from a "non-fish" stream segment to a "fish" stream just by passing 50 feet through a culvert or under a highway. Protections need to reach significantly further upstream than proposed and demonstrate a precautionary approach to preventing damages. Many Oregonians that live in unincorporated neighborhoods rely on similar water sources as their only supply of drinking water. Unless properly protected, an important aspect of daily life is threatened. We ask that the NOAA input to the ODF Western State Forests HCP process include protection for upstream water sources that are connected to HCP protected habitat.
Kellyann Lanspa	I support this Habitat Conservation Program- Protect environmentally sensitive species!
Hugh Scollan	I support this Habitat Conservation Program- Protect sensitive species

Scott Grey, Director of Western Resources, Stimson Lumber Company	The agencies and the permit applicant need to seriously consider an alternative to the current HCP that is much more aggressive towards predator control. It is my opinion that the current mitigations and habitat conservation areas established to protect the norther spotted owl (NSO) are inadequate. We have seen this type of plan where vast areas of lands are set aside for NSO protection but have not resulted in increased owl populations. The Northwest Forest Plan as implemented is a perfect example. The practice of simply setting aside large tracts of land has been an abysmal failure. NSO populations are lower than when listed while suitable habitat has increased during that time. Unfortunately, if you build it, they will come does not apply for NSOs. Barred owls are taking over instead. However, if there is aggressive action to control the barred owl population in the area, the spotted owl may have a chance to survive and grow in population. The draft HCP as written only addresses predator control in a sentence or two. It certainly is not a comprehensive plan to control barred owl populations. And if barred owl populations are controlled in such a manner as to allow spotted owl population to grow, less acres of habitat conservation areas could be required. Society desires wood products. It is a renewable resource and has a smaller carbon footprint than non-renewable alternatives. As a society, demand will only increase as more focus is placed on climate change and other environmental concerns. So, to meet demand for wood products, trees will be harvested. While some may not like that reality; the truth is a tree, which is a great example of solar energy at work, is the most environmentally sound solutions to meet societies demand for such products. But where that wood is harvested can have a great impact on the environment. It can be harvested in some of the most productive forests in the world, which include State Forests in Oregon, or it can be harvested elsewhere. As a Forester who has practiced in both California and Oregon, I can speak from experience that in Oregon, including the State Forests, the non-timber resources are given equal protection and the same consideration as timber management. Oregon rules and regulations along with foresters' professional ethic insists that these resources be protected. This has been confirmed in numerous studies such as the paired watershed studies. This proposed HCP puts about half the lands off-limits to forest management. Yet, demand for wood will not diminish and trees that could be harvested from this off-limits area will have to be harvested elsewhere. Since not many areas in the world have comprehensive laws like Oregon, it is likely that these trees will be harvested with less protection to the other forest resources. This is the unintended consequence of putting vast segments of land off limits to timber production. Further, this draft HCP has the most area set aside for conservation measures of any forestry HCP on the West Coast and thus compounds the negative consequences. For these reasons, I implore you to embrace an alternative that reduces the amount of land in habitat conservation areas while aggressively managing barred owl populations for the benefit of spotted owls. This win-win alternative allows for the management of the wood products society demands, while increasing the potential of NSO population increases. We have tried the other way and it hasn't worked.
Confederated Tribes of Grand Ronde	The Confederated Tribes of the Grand Ronde Community of Oregon (CTGR or Tribe) appreciates the opportunity to engage on the Western Oregon State Forests Habitat Conservation Plan (HCP). As a sovereign nation with treaty homelands, Tribal resources and land ownership in Western Oregon potentially impacted by the HCP, CTGR prefers government-to-government consultation as the primary mechanism of engagement. Just as there can be no replacement for the resources of

	the Tribe's home since time immemorial, there is no on-par substitute for direct government-to-government consultation. CTGR leaders and staff will be providing input as the HCP is developed, and look forward to consulting government-to-government with appropriate State and Federal leaders.
Andrea Mackey	No!!
Corey Fields	I stand for zero reduction in harvest. I would also tend we raise harvesting to stay ahead of managing forests. Oregon jobs need to stay in Oregon.
Pam Birmingham	While considering the preparation of the EIS for the proposed Western Oregon Habitat Conservation plan by the Oregon Department of Forestry (ODF) please consider the already decimated Northern Spotted Owl (NSO) population within the Coast Range. No incidental take permits and zero take should be allowed until this population shows signs of stability and recovery. There is so little NSO habitat across the landscape that any further depletion could push this species out of existence within its historic range. Please take a firm stand even though the timber lobby is strong. ODF will not protect this species on its own as demonstrated over the last 20 years or so. Thank you for your work in protecting our vanishing species, habitats and landscapes.
Denice Adams	This is 2021, not 1991. We know that sustainable timber harvest coupled with sound biology works. We can create habitat that enhances wildlife while ensuring that our rural communities also survive. The future depends on us.
Anonymous	Putting Oregon State managed lands into a HCP will place the State lands on a path to become a fire hazard like the Federal forest lands of Oregon already are. Habitat that is protected with HCP's burn and there is massive habitat loss. Anything that reduces the value of Oregon forestlands also reduces the care those lands receive. Habitats and species are protected by wealthy communities, poor communities exploit habitats and species out of desperation. Do not procede with a HCP for Oregon State Forests the resulting loss of habitat and communities is far too large, as evidenced by the history of Oregon's Federal forests. [See attachment labeled: Oregon Wildfires Map, submitted by anonymous commenter]
Tom Merritt	I support the alternative plan that has been attached. The Oregon Department of Forestry's plan is faulty, based on poor science that is outdated. [See attachment labeled: The Counties’ Twin Goals HCP Alternative]
Coast Range Association	Please accept the attached report assessing the science behind the Aquatic Conservation Strategy of the Northwest Forest Plan. Any Habitat Conservation Plan for state forests must account for the aquatic issues address in the science review. Of particular concern is the road density of state lands. Reading the above science review documents reveals that a particular problem for freshwater salmon habitat is the negative impacts of logging roads. As part of a 2012 ESA listing review of the Oregon Coastal Coho, we used Federal BLM road data and conducted a road density analysis for Western Oregon. The results were shocking. Road densities on Western Oregon's forest lands generally exceed acceptable densities for coastal coho recovery. [See attachment labeled: Conservation of Aquatic and Fishery Resources in the Pacific Northwest: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan]


Oregon
Wildfires
ODF Tracking
Western Oregon
Fires
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Beachie
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Lionshead
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Astoria
Tillamook
Portland
The Dalles
Salem
Eugene-Springfield
Bend
Coos
Bay
Roseburg
Grants
Pass
Medford
Ashland
Brookings
Klamath Falls
Lakeview
CLATSOP
COLUMBIA
WASHINGTON
MULTNOMAH
HOOD RIVER
SHERMAN
GILLIAM
TILLAMOOK
YAMHILL
WASCO
CLACKAMAS
POLK
MARION
JEFFERSON
LINCOLN
BENTON
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LANE
DESCHUTES
DOUGLAS
COOS
LAKE
CURRY
JOSEPHINE
JACKSON
KLAMATH

The Counties' Twin Goals HCP Alternative
Draft 4/5/21

Background

Under direction of the Board of Forestry (BOF), the Oregon Department of Forestry (ODF) has developed a draft Habitat Conservation Plan (HCP) for 638,000 acres of forest land managed by ODF. Most of these lands are State Forest Trust Lands that were transferred to the State by 14 Counties (the Counties).[1] Counties and Taxing Districts share 63.5% of the revenues from these lands, most of which come from commercial timber harvest.

The draft HCP proposes a set of "conservation strategies" designed to maintain and enhance habitat for a nine species of fish and seven terrestrial species, some of which are listed as threatened under the federal Endangered Species Act. As proposed, the HCP would result in a 70-year agreement with the US Fish and Wildlife Services and NOAA Fisheries (the Federal Agencies) under which ODF would not be prosecuted for incidental take of listed species.

Purpose and Need for A County Alternative

ODF's proposed HCP would establish 275,000 acres of Habitat Conservation Areas (HCA) and 77,000 acres of Riparian Conservation Areas (RCAs). Some incidental harvest will be permitted in the HCAs, but by and large the HCAs and RCAs would be unavailable for timber management. Only about 291,000 acres would be left for sustainable timber harvest. As proposed, ODF's draft HCP would result in unfavorable outcomes:

- Under ODF's draft HCP, timber harvest will drop over time from the current 260 MMbf to about 205 MMbf. The reduction in harvest means a reduction in timber revenues and jobs.

- ODF projects that its annual share of harvest revenues will fall short of its budget $12 million in the short run, and that the deficit will climb to $25 million per year in the long term.

- Annual revenues shared with Counties and Taxing Districts will fall from about $55 million to $42 million, putting additional financial pressure on current levels of service.

- The draft HCP did not estimate impacts on employment or wages in local communities. We expect that the harvest reductions would affect 500 jobs in the timber industry, at least 150 jobs in the Counties and Taxing Districts, as well an unknown number of jobs at ODF.

ODF's draft HCP measures conservation outcomes of the HCP in terms of the number of acres of suitable habitat, and suitable habitat will increase under the conservation strategies.

The HCP, however, <u>does not</u> estimate future populations of the subject species. For the Northern Spotted Owl (NSO) this is a serious shortcoming. Studies show that NSO populations have been steadily declining, in spite of the fact that large acreages of federal, state and private land have

[1] List of counties

been dedicated to improving habitat. It is now known that competition and predation from Barred Owls is the primary cause of the continued decline of the NSO.

Recent research shows that controlling the Barred Owl can stabilize and increase NSO populations. ODF's draft HCP recognizes that effect but does not make a hard commitment toward controlling Barred Owl populations (see Attachment A).

ODF's HCP also seeks to develop extensive acreage in the HCAs for Marbled Murrelet (MAMU) nesting habitat. MAMU populations in Oregon have stabilized and are increasing over the last few years. Even so, MAMU populations can be improved by controlling and limiting exposure to egg and fledgling predators.

The affected Counties offer an alternative HCP – the Twin Goals Alternative[2] – that will improve the financial, economic and conservation outcome by:

- Making a commitment to immediate and long-term control of Barred Owls in NSO core areas and Corvids in MAMU nesting habitat.
- Reducing the acreage in the Habitat Conservation Areas

In offering the Twin Goals HCP Alternative, the Counties do not waive any contractual or other legal rights to the State Forest Trust Lands established in State Courts. Nor do the Counties believe that an HCP is absolutely necessary for the ODF to manage the State Forest Trust Lands for the greatest permanent value as defined at the time these lands were established.

As the BOF and ODF appear resolved to enter into some kind of HCP agreement with the federal agencies, however, the Counties propose the Twin Goals Alternative as an HCP alternative that offers better economic, financial, social and conservation outcomes than ODF's draft HCP.

Design Principles for the Twin Goals HCP Alternative

The Counties' Twin Goals HCP Alternative is designed under the following principles:

1. The State Forest Trust Lands should provide dependable, predictable levels of timber harvest to County and Taxing District beneficiaries. Local economies will benefit from the family wage jobs provided by timber harvest and by revenue shared with the Counties and Taxing Districts.

2. Revenues derived from commercial timber harvest from the State forest Trust Lands should cover ODF's reasonable forest management costs.

3. Conservation strategies for listed species should represent the most cost-effective approach to meeting objectives.

4. Conservation objectives should include target populations as well as suitable habitat targets.

[2] Twin Goals --

5. Funding for conservation should come from ODF's budget.

6. Oregon's State Forest Trust Lands should not be required to make a greater contribution to listed species than other State agencies or private landowners.

7. An HCP for State Forest Lands should recognize the unique role that State Forests play in Oregon's forest sector.

8. An HCP for State Forest Trust Lands should recognize that under the federal Endangered Species Act, state and private land managers have a lessor responsibility toward species recovery than do federal agencies.

Goals and Objectives

ODF's draft HCP describes Goals focused on supporting the persistence of the covered fish and wildlife species. Measurable objectives are tied to each goal.

The Counties' Twin Goals HCP Alternative incorporates the same goals and most of the same species conservation objectives, as described in the conservation strategies below. In addition, the Counties' Twin Goals HCP Alternative is designed to achieve the following economic and social goals:

1. Coupled with increases in suitable habitat, immediate and long-lasting competitor/predator control will allow regional NSO population trend to stabilize by increasing the population rate of change from -6.1%[3] to something greater than 0%.

2. Coupled with increases in suitable habitat, immediate and long-lasting predator control will allow MAMU populations to increase, if ocean conditions permit.

3. Sustainable levels of timber harvest will be sufficient to maintain payments to Counties as projected in ODF's 2018 Business Case Analysis.

4. Sustainable levels of timber harvest will be sufficient to return revenue to Counties and Taxing Districts as projected in ODF's 2018 Business Case Analysis.

5. Sustainable levels of harvest will support current employment from forest management activities.

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[3] Across the Northwest Forest Plan area, the NSO population rate of decline was 3.8% from 1985 to 2013. Over the same time period, the rate of decline in the Oregon Coast Range was 5.1% (Dugger et al. 2016). Most recently (2002-2017), the rate of decline in The Oregon Coast Range has increased to 6.1% (Wiens 2020).

The Importance of Population Modeling for NSO and MAMU

ODF's draft HCP measures progress toward species recovery by projecting and measuring suitable habitat. The implicit assumption is that suitable habitat is the primary factor affecting populations, and that creating additional suitable habitat will automatically buoy populations.

The current consensus of biologists studying the NSO, however, is that competition and predation from the Barred Owl has a larger impact on NSO population trends than does habitat conditions, and that without a reduction in Barred Owl populations, the NSO population will continue to decline regardless of the amount of suitable habitat. Predation also plays a significant role in MAMU population trends.

The Counties' Twin Goals Alternative addresses this dynamic head on by making an immediate and long-lasting commitment to predator control. This will allow NSO and MAMU populations to stabilize and, coupled with some level of additional habitat, populations can be expected to increase. In contrast, without predator control much of any new suitable habitat will likely be unoccupied.

The importance of competitor/predator control in recovering NSO and MAMU populations points to the need to evaluate HCP alternatives with population modeling, along with projecting the number of acres of suitable habitat.

Population models for NSO and MAMU do exist and have been used to analyze long-term population trends under different forest management scenarios. While the initial NSO HCP developed by Washington State DNR in 1997 did not explicitly model population, the updated 2020 HCP reviewed NSO population dynamics modeling efforts and provided a novel matrix population stage model for MAMU[4]. In the final Environmental Impact Statement for its 2015 Resource Management Plan, The Bureau of Land Management adopted the USFWS parameterization of the HexSim model[5], a spatially explicit framework for NSO population projections. These models use information about the spatial distribution of habitat over time, the current distribution of the subject species, and assumptions about competitors/predators.

Employing the currently available population models along with findings from USFWS recent Barred Owl control research[6] will yield an appropriate comparison between alternatives that employ different amounts of competitor/predator control and habitat development.

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[4] https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan#FEIS

[5] Schumaker, N.H. *et al*. Mapping sources, sinks, and connectivity using a simulation model of northern spotted owls. Landscape Ecology. DOI: 10.1007/s10980-014-0004-4

[6] Wiens, J.D., Dugger, K.M., Lesmeister, D.B., Dilione, K.E., and Simon, D.C., 2020, Effects of barred owl (Strix varia) removal on population demography of northern spotted owls (Strix occidentalis caurina) in Washington and Oregon—2019 annual report: U.S. Geological Survey Open-File Report 2020–1089, 19 p., https://doi.org/10.3133/ofr20201089.

Design Elements of the Counties' Twin Goals Alternative

ODF's draft HCP identifies a set of conservation actions. The Counties' Twin Goals HCP Alternative leaves many of the conservation strategies unchanged from ODF's draft HCP. Here we outline the changes.

- Conservation Action 1: Establish Riparian Conservation Areas

  No changes

- Conservation Action 2: Riparian Equipment Restriction Zones

  No changes

- Conservation Action 3: Stream Enhancement

  No changes

- Conservation Action 4: Remove or Modify Artificial Fish-Passage Barriers

  No changes

- Conservation Action 5: Standards for Road Improvement and Vacating

  No changes

- Conservation Action 6: Establish Habitat Conservation Areas

  The Barred Owl control proposed in The Counties' Twin Goals Alternative will provide a larger effect on the recovery of NSO populations than would the extensive HCA's proposed in ODF's draft HCP. The proposed HCA acreage, therefore, can be substantially reduced while still providing a superior outcome for these listed species.

  Analysis with the population models will help establish the final HCA acreage for the Counties' Twin Goals Alternative. As a starting point, the Counties propose an HCA designation consistent with ODF's 2018 Business Case Analysis:

  > "Under an HCP, acres available for harvest are projected to increase [from] 51 percent to 63 percent of BOF forest lands."[7]

  Using that target would make about 402,000 acres available for sustainable timber harvest, leaving about 236,000 acres in RCAs, HCAs and any other ODF no-harvest land allocations.

  Our objective will be to ensure that the HCAs encompass most of the currently suitable habitat as well as lands most likely to become suitable habitat during the 70-year HCP term.

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[7] 2018, Oregon Department of Forestry, *Habitat Conservation Plan: A Business Case Analysis,* October 2018, page 40.

Specific HCA boundaries will be developed with assistance from ODF and the federal agencies.

- Conservation Action 7: Manage Habitat Conservation Areas

  No changes

- Conservation Action 8: Conservation Actions Outside HCAs and RCAs

  Outside the HCAs, ODF's draft HCP proposes rotations at culmination of mean annual increment (CMAI), claiming but not demonstrating social, environmental and economic benefits. The Counties will need more information before proposing or approving such a policy.[8]

  ODF's draft HCP also proposes a harvest schedule that departs from even flow. The draft HCP does not make clear the benefits of such a departure. The Counties need more information before proposing or approving such a policy.

  The dynamics between harvest flow and rotation ages can only be understood through use of ODF's timber harvest scheduling model. The Counties expect and look forward to working with ODF to do the analysis that will inform the design of the Counties' Twin Goals HCP Alternative on these points.

- Conservation Action 9: Strategic Terrestrial Species Conservation Actions

  ODF's draft HCP mentions but does not make concrete commitment to competitor/predator control. In contrast, the Counties' Twin Goals Alternative differs in that it commits to immediate and long-lasting competitor/predator control as a tool for increasing the populations of NSO and MAMU.

  Currently, NSO populations are declining at rates as high as 6.1% per year in the Coast Range, in spite of efforts to provide more suitable habitat on federal, state, and private lands in the region. Competition and predation by Barred Owls outweighs the benefits of increasing suitable habitat.

  Under the Counties' Twin Goals Alternative, initial Barred Owl control efforts will reduce the Barred Owl occupancy rate by 14%[9] (to 81% occupancy). According to recent research, that could improve the current NSO population rate of change from -6.1% per year to as much as 3.3% per year[10]. Reducing the Barred Owl population by 32% (to 65% occupancy)

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[8] Demonstrating in the field that a stand has reached CMAI is difficult and time consuming, if it is even possible at all. Given the 70-year term of the HCP, and given the propensity of those opposed to commercial timber harvest to use an agency's own standards against them (e.g. the USFS "survey and manage" language), we strongly recommend ODF to revisit the CMAI language in the draft HCP and come up with a rotation age standard that is demonstrable and incontrovertible.

[9] Per Wiens *et al*. 2020, assumes current occupancy of 93%.

[10] Dugger, K.M., et al. 2016. The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls. Ornithological Applications. 118, 57-116. http://dx.doi.org/10.1650/CONDOR-15-24.1

– the lower limit found from previous studies – could allow NSO populations to recover at rates up to 10% per year.

Population monitoring studies from 2000 to 2017 indicate MAMU populations in Oregon are increasing, demonstrating positive trends between 1.4% and 3.7% in the species recovery zones that overlap or partially overlap the state. Key threats to the long-term maintenance of the species that are actionable in the terrestrial habitat include nesting habitat loss and ongoing nest predation associated with habitat fragmentation. Protection of suitable nesting habitat is a commonly applied conservation tool for MAMU, but reducing nest predation can also significantly affect MAMU population resiliency.[11] One study demonstrated corvids were responsible for nearly 33% of nest predation events in a Washington population, and a subsequent modeling exercise for MAMU in California found that reducing corvid predation by 60% could stabilize a local population.[12]

The Counties' Twin Goals HCP Alternative will contribute to maintaining a positive or stable population trend for MAMU by protecting the existing occupied habitat in the HCAs, spatially arranging HCAs to provide larger blocks of habitat over time as younger forest matures to fill in gaps, and by implementation of targeted actions to address fragmented areas that are currently experiencing high levels of nest predation. These actions could include relocating campgrounds currently within occupied habitat and deploying corvid control or conditioned taste aversion techniques in specific areas where removal of recreational facilities is not feasible.

Predictions of the actual population depends in part on the spatial arrangement of suitable habitat over time. Population models have been developed and used in other large-scale planning processes and should be used here to compare the outcomes of HCP alternatives in terms of the population of the NSO and MAMU.

- Conservation Action 10: Seasonal Operations Restrictions

  No changes

- Conservation Action 11: Road Construction and Management Measures

  No changes

- Conservation Action 12: Establish and Maintain Conservation Fund

  Funding for predator control should come from ODF's share of harvest revenues. The additional harvest will be more than sufficient to cover the costs of predator control.

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[11] Marzluff, J. and E. Neatherlin. 2006. Corvid response to human settlements and campgrounds: Causes, consequences, and challenges for conservation. *Biological Conservation* 130: 301-314.

[12] Peery, M.Z., and R.W. Henry. 2010. Recovering marbled murrelets via corvid management: A population viability analysis approach. *Biological Conservation* 143(11): 2414-2424.

Next Steps

ODF's draft HCP is a comprehensive and complex plan that will guide management of the State Forest Trust Lands for a 70-year period. In this document, the Counties outline an alternative approach for managing these lands that should provide better conservation outcomes in terms of NSO and MAMU population recovery; more revenue to ODF, the State, the Counties and the Taxing Districts; and support more jobs and income than ODF's draft HCP.

A complete specification of the Counties' Twin Goals Alternative will require additional work, and the Counties hope and expect to work shoulder-to-shoulder with ODF and the federal agencies to turn the ideas here into a full-fledged alternative. The Counties, furthermore, stand ready to help ODF and the federal agencies develop and implement NSO and MAMU population models to fairly project the population impacts of the proposed HCP alternatives.

CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST:

Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan

Thank You!

We thank the generous members and supporters of the Coast Range Association for making the science review panel and this report possible. We also thank Doug Bevington at Environment Now for a grant of $5,000 in support of the science review panel.

CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST:
Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan.

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THE CRA SPONSORED AQUATIC CONSERVATION STRATEGY SCIENCE REVIEW PROCESS

Background

For the past ten years a series of agency and political proposals have been offered to change federal forest management under the Northwest Forest Plan (the Plan or NFP). The goal of all proposals is to achieve a substantial increase in timber production. All proposals to date have sought to weaken elements of the Plan's conservation provisions including the Aquatic Conservation Strategy (ACS). While attempts to change the NFP have occurred since 1994, recent initiatives are often associated with a claim that new science warrants change to the Plan's standards and guidelines or the allocation of land base for conservation and restoration purposes (late-successional and riparian reserves).

A number of federal laws guide the NFP's implementation and administration. These laws require agencies to follow the **best available science** when proposing actions. The BLM's 2008 WOPR initiative substantially departed from the NFP. At the time, the agency made representations that new science warranted the departure. Yet upon taking office, the Obama administration withdrew the WOPR knowing that it would not hold up in federal court. Its weakness was the adequacy of its science representations as required under federal law.

Preparing for a science review panel

The Northwest Forest Plan is twenty years old and its effects clearly show on the landscape in fewer timber cuts, larger areas of intact forest, and cleaner water flowing in streams and rivers. Achieving intact, complex, older forest structure was a key goal of the Plan. The other major goal of the Plan is to conserve and restore watershed functions through a Aquatic Conservation Strategy. Over the course of the Plan's twenty year history many new studies and scientific findings were published having relevance to the core assumptions of the Plan–including the ACS.

No less than five large, front-line Oregon-based conservation organizations prioritize the protection of federal forests. These groups work closely with scientists and have staff experts able to assess complex forest issues. In the summer of 2012, we sensed an expertise gap in the ability of the conservation community to adequately address proposed changes to the ACS. That's when the Coast Range Association began to explore how science-based expertise could be brought to bear on assessing political and agency proposals and clarify what the new science actually warrants. In January of 2013 we contracted Dr. Chris Frissell to advise the CRA on federal land management issues related to the ACS. In April of 2013, Dr. Frissell proposed convening an independent science review panel to assess the ACS in light of new science.

In May, 2013 Dr. Frissell produced a paper to help frame questions that might be addressed by a science review panel. The paper, *Evaluating Proposed Reductions of Riparian Reserve Protection in the Northwest Forest Plan: Potential Consequences for Clean Water, Streams and Fish*, offered that new science indeed had much to say. What the new science pointed to was that the federal ACS should not be weakened. At the same time it was becoming increasingly clear that a thorough review of the literature and writing a rigorous statement of science findings would be a sizable task.

The Independent Science Review Panel

Over the summer and fall of 2013, Dr. Frissell and Mary Scurlock of M. Scurlock & Associates prepared for and recruited the science review panel. For our part, the Coast Range Association sought guidance on the new science and a report to help us and the public assess proposals by political leaders and agency managers. On December 2nd and 3rd, 2013 the independent science review panel met in Portland. The panel was made up of nine scientists with Mary Scurlock providing policy expertise.

At the start of the panel's deliberations senior BLM staff briefed the panel on the guiding framework of their current Western Oregon Plans Revision process. In addition, a branch chief at the National Marine Fisheries Service briefed the panel on endangered salmon consultations occurring under the Northwest Forest Plan and the Endangered Species Act. Lastly, senior staff from the Environmental Protection Agency-Region 10 briefed the panel on relevant water quality issues in the area of the Northwest Forest Plan.

The Coast Range Association's role in the panel process was to cover the costs which included travel, food, lodging and meeting room expenses. Panel members understood they were volunteering their time and under no obligation to reach any outcome.

The panel finished its science review discussion on December 3rd. Extensive notes were taken. The panel agreed that Chris would author an initial draft report capturing the panel's consensus views on the implications of new science for the ACS.

Of the ten panel members, several individuals had direct experience developing the original Northwest Forest Plan. All panel member's professional careers had spanned the twenty years of the NFP's existence. Panel members knew the goals of the ACS and how it applied to federal forests under the NFP. In addition, panel members were thoroughly aware of land management practices on adjoining non-federal lands.

Members of the Independent Science Review Panel

Rowan. J. Baker Independent environmental consultant (Formerly US Fish and Wildlife Service)

Kelly Burnett Research Fish Biologist (Emeritus) Pacific Northwest Research Station-Corvallis Forestry Sciences Lab

Robert Beschta Professor Emeritus at the College of Forestry, Oregon State University.

Dominick A. DellaSella President and Chief Scientist of the Geos Institute and President of the Society for Conservation Biology, North America Section.

Christopher A. Frissell Consulting Research Ecologist and Freshwater Conservation Biologist, and Affiliate Research Professor, Flathead Lake Biological Station, The University of Montana.

Robert M. Hughes Courtesy Associate Professor in the Department of Fisheries and Wildlife at Oregon State University. Senior Scientist at Amis Opes Institute, and 2013-2014 President of the American Fisheries Society.

Dale A. McCullough Senior Fisheries Scientist at the Columbia River Inter-Tribal Fish Commission.

Jon Rhodes Senior Conservation Hydrologist with Planeto Azul Hydrologic Consultants.

Mary Scurlock Principal Policy Analyst, M. Scurlock & Associates freshwater policy consultants.

Robert C. Wissmar Professor, Aquatic & Fishery Sciences at University of Washington

The Final Report

Following the panel's Portland meeting members forwarded to Dr. Frissell a large number of published studies relevant to the many topics discussed. Over the next three months Chris worked to produce a draft report. During this period, additional review and input was received from two scientists unable to attend the Portland meeting: aquatic scientist James Karr of the University of Washington and Rich Nawa staff ecologist at the non-governmental organization KS Wild.

On March 2nd a draft report was sent to panel members. The draft triggered a large number of revisions and the consideration of still more scientific studies. Between March 2nd and March 30th an initial report was prepared for the CRA. The CRA submitted this version of the report to the BLM as public comment on March 31st. However, work continued for four additional months resulting in hundreds of corrections, changes and the addition of new studies.

On July 30th the CRA received the final report. The report is titled–***Conservation of Aquatic and Fishery resources in the Pacific Northwest: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan***. The document is authored by nine scientists and policy expert Scurlock. Collectively, the report's authors and science panel members not only represent the best available science but had developed much of the relevant science over the course of their professional careers.

The final report is the best synthesis of aquatic science related to the NFP since the development of the Plan in 1993. Federal land management agencies and Oregon's political leaders now have a document that clarifies many aquatic issues heretofore unaddressed in policy discussions. We consider the report to be a major achievement by the scientists involved and a highly significant contribution to public understanding of a vital federal land management issue.

Collectively, the report's authors and science panel members not only represent the best available science but had developed much of the relevant science over the course of their professional careers. The final report is the best synthesis of aquatic science related to the NFP since the development of the Plan in 1993.

KEY FINDINGS

Management after Wildfire, Disease, and Other Disturbances

For maintenance of forest ecosystem integrity, *post-disturbance logging should be prohibited in Riparian Reserves, Key Watersheds, Late Successional Reserves, and other areas where conservation is a dominant emphasis. Post-disturbance actions should prioritize road decommissioning or systemic road drainage improvements, and suspension of livestock grazing to reduce harm under the increased hydrological stresses expected in post-fire forests and their aquatic and riparian habitats and biota.*

Forest Thinning Intended to Reduce Tree Density or Wildfire Fuels

Thinning and fuels reduction by means of mechanized equipment or for commercial log removal purposes should be generally prohibited in Riparian Reserves and Key Watersheds. Any thinning or fuels treatment that does occur as a restorative treatment in Riparian Reserves (e.g., to remove non-native tree species from a site) should retain all downed wood debris on the ground. Thinning projects that involve road and landing (including those deemed "temporary") construction and/or reconstruction of road segments that have undergone significant recovery through non-use should also be prohibited, due to their long term impacts on critical watershed elements and processes.

Road Networks and Their Management

The authors suggest six policy changes to achieve needed road reductions: 1) *Prohibit the construction of new permanent and "temporary" roads*, except in limited instances were construction of a short segment of new road is coupled with and necessary for the decommissioning of longer and more damaging segments of existing road. 2) *Allow no net increase in road density in any watershed*. 3) *Strengthen road density restrictions for Key Watersheds and establish unambiguous standards and metrics for net road density reduction, which include adequate accounting for landings and the impacts of so-called "temporary" and decommissioned roads and landings*. 4) *Improve the system of classification (e.g., road type, use) and inventory (e.g., whether a road is active or decommissioned), and mapping (i.e., update maps to reflect current conditions)* to ensure that agency bookkeeping corresponds with actual field conditions. 5) *Require each proposed forestry and other development project to meet a target of incremental reduction of the road system* in all watersheds affected by the project. 6) *roads for which there are not adequate funds for maintenance and upkeep should be decommissioned*.

Riparian Reserves for Protecting Stream Temperature

We find no sufficient scientific support for reducing current ACS Riparian Reserve default widths for any stream type. In many watersheds and stream segments, larger areas of forest protection are warranted to prevent warming of shallow groundwater, particularly given likely trends future climate change, and the expectation of increased influence of wildfire and other "unmanaged" forest disturbances (Westerling et al. 2006).

Riparian Reserves and Nutrient Retention

Although more research is needed in the Pacific Northwest on nutrient retention, current scientific knowledge is sufficient to justify three recommendations. 1) *Continuous, no-cut Riparian Reserves exceeding 50 m (160 feet)* *along all streams and wetlands are generally needed to mitigate the effects of up-slope logging on nutrient loading to both freshwater ecosystems and downstream marine environments.* 2) *Cessation of livestock grazing in Riparian Reserves, road network reduction, and reconfiguration of remaining roads to reduce their hydrologic connectivity to surface waters are needed to reduce downstream nutrient loading*. 3) *Analysis of the effects of management actions on nutrient loading to immediate downstream receiving waters, including lakes, wetlands, reservoirs, mainstem rivers, estuaries, and the nearshore marine, are needed in environmental assessments, environmental impact statements, watershed analyses, and ESA consultations for aquatic species*.

Livestock Grazing

We conclude that *livestock grazing should be excluded from Riparian Reserves, Key Watersheds, and other lands where conservation is the primary management objective*.

Chemical Use in Forests

While the science on toxic chemicals is certainly advancing, we have five interim recommendations based on existing knowledge: 1) *Minimize application of chemicals for forest management purposes in time and space;* for example, hand-application should be favored over aerial application when there is no feasible alternative to pesticide use. 2) *Weigh the full range of environmental trade-offs between the perceived benefits of chemical use and its possible harms in each case before a decision is made to use chemicals in forest management*. 3) *Implement wide, un-thinned forested buffers in Riparian Reserves to help reduce exposure of fish and aquatic life to toxic chemicals*. Thinned or narrow buffers can allow greatly increased aerosol penetration (chemical) from slopes to streams, and narrower buffers may also allow more transport of toxins in runoff. 4) *Reduce road density and the hydrologic connectivity of roads to surface waters to help control toxins* that originate from road use and maintenance, as well as those that are applied up-slope but find their way to streams via surface runoff. 5) *Analyze the possible effects of management actions in affecting the delivery of toxic chemicals to streams in every NEPA document and ESA consultation*.

Climate Change: Consequences and Adaptation

Our overall recommendation is that 1) *ACS protections for Riparian Reserves should be sustained and strengthened to better protect and restore natural ecosystem processes that confer resilience to climate change*, as detailed in our other recommendations. In addition, 2) *an interagency scientific conservation design effort is needed to expand and reconfigure some present Key Watersheds to ensure they better encompass specific areas that are likely to be topographic and hydrologic buffers to future climate change impacts.* Finally, we recommend that 3) *the direct and indirect effects of management actions on the integrity and capacity of stream and watershed ecosystems for resilience to climate change be analyzed in every environmental assessment, environmental impact statement, watershed analysis, and ESA consultation.*

Monitoring and Adaptive Management

We recommend three policy shifts in how monitoring is employed under the ACS. First, as a standard management practice, require *some form of effectiveness monitoring and expert review of stream and watershed responses for every forestry, range, mining, recreation development, or active management project*. Secondly, *agencies should review existing programs of comprehensive regional and watershed-scale effectiveness monitoring programs, and develop comprehensive monitoring strategies to optimize return on the capital investment in monitoring*. We call for an *interagency scientific* *panel to review the status and effectiveness of trend monitoring efforts, and identify data sets that could be useful in drawing inferences for improved monitoring programs*. Third, agency-driven improvements in monitoring programs should include *increased emphasis on tracking ecological conditions, including explicit biological condition measures, and the ability to establish with some certainty that trends in Key Watersheds result from specific management actions or choices (which may include deferral of active management)*.

Conclusion

We conclude that attempts to reduce protections to watershed, riparian, and freshwater ecosystems by weakening major components of the ACS and other related conservation elements of the Northwest Forest Plan are not justified by new and emerging science. Improved ecosystem protections–and better monitoring of outcomes–are warranted across all land ownerships, including federal forest lands, if freshwater ecosystems and their biota, including salmon and other sensitive species are to be effectively conserved in an era of increased ecological stress and changing climate.

CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan

What follows on pages 10 through 45 is the final report as received by the Coast Range Association

CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST:

Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan

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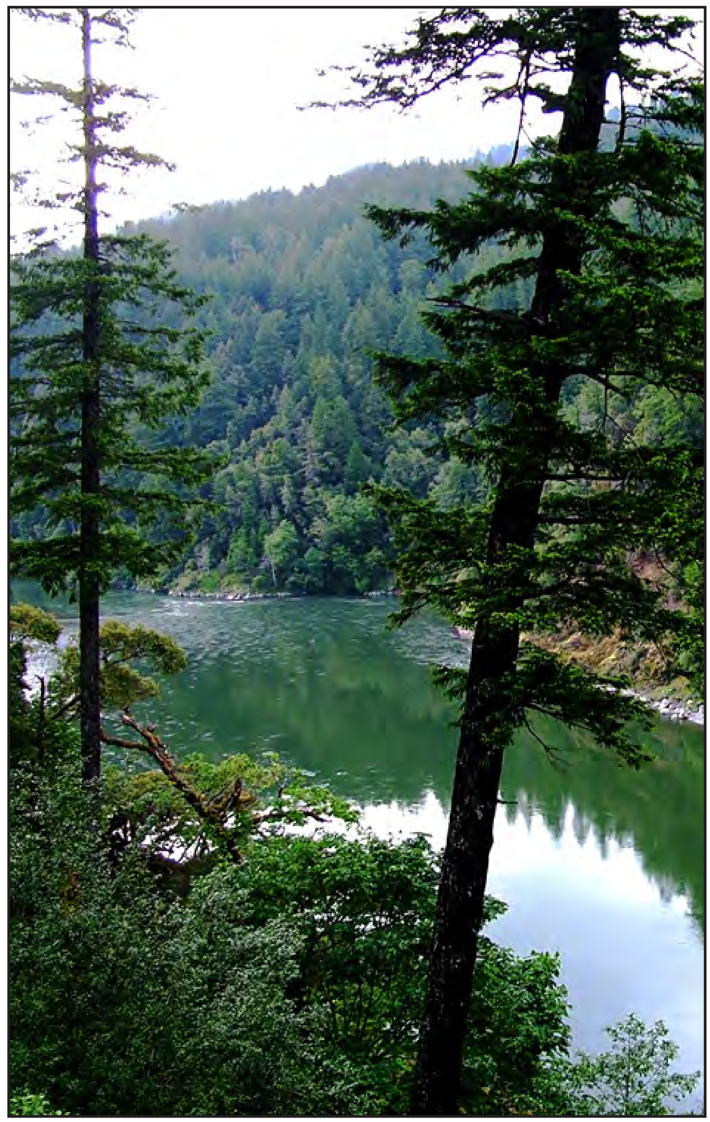

FINAL REPORT
July 30, 2014

CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST:

Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan

ABSTRACT

Twenty years have elapsed since a major science synthesis and planning effort led to adoption of the Aquatic Conservation Strategy (ACS) of the Northwest Forest Plan (NFP) in 1994. Their purpose was to protect and restore riparian and aquatic ecosystems on Pacific Northwest federal forest lands and to ensure that forest management plans achieved legally required and socially desired multiple use objectives, including water quality, aquatic and wildlife resources. In this paper, we review relevant science emerging since 1993 to assess whether proposed changes to the ACS, including reduced riparian reserve protections and a substantially lowered burden of proof for watershed-disturbing activities, are scientifically justified. Observed and anticipated effects of climate change, and of cumulative anthropogenic stressors operating in the nonfederal lands surrounding NFP lands strongly indicate the need to strengthen, not weaken key ACS protections. Roads and ground disturbance associated with mechanical thinning and fuels reduction activities, especially within Riparian Reserves, cause adverse environmental impacts that generally offset or exceed presumed restorative benefits. Headwater streams warrant wider riparian forest buffers than current ACS provisions to ensure effective retention of sediment and nutrients derived from upslope logging, fire, and landslides. Widespread and sustained ecological harm caused by roads is now widely recognized, and ACS measures should be strengthened to more effectively arrest and reduce road impacts in all catchments. Grazing, mining, post-disturbance logging (e.g., fire salvage), water withdrawal, and aerial application of toxic chemicals can cause both acute and chronic harm to aquatic ecosystems. Existing ACS standards and guidelines would need to be strengthened to more effectively control these impacts. A more thorough and current scientific review and synthesis by federal agencies to inform a future ACS is long overdue. Unfortunately, no such review has occurred, while recent agency and legislative proposals would substantially reduce protective provisions of the ACS and NFP by increasing the extent of logging and other mechanized forest management, such as fuels treatments.

Introduction: Origins of the Aquatic Conservation Strategy

In 1994, region-wide social protest over logging old-growth forests, court injunctions on federal forest timber sales, and a rare presidential "roundtable" summit, led to sweeping changes the management of federal forest lands in the U.S. Pacific Northwest. The federal agencies with primary land management responsibilities, the U.S. Department of Agriculture's Forest Service (USFS) and U.S. Department of Interior's Bureau of Land Management (BLM), jointly adopted a new, regional conservation and management framework now known as the Northwest Forest Plan (hereinafter referred to as the NFP, or the "Plan"). The NFP was designed to meet President Clinton's call for an approach that would (1) satisfy federal courts and lift the injunctions, (2) protect the environment, and (3) help stabilize the regional economy (GAO 1999). The Plan's Record of Decision (USDA and USDI 1994) offered a "scientifically sound, ecologically credible, and legally responsible" long-term management strategy for federal lands within the range of the northern spotted owl (*Strix occidentalis cauria*). The NWP region encompasses over 99,000 square km (24.5 million acres) within the highly productive forest zones of western Washington and Oregon and northern California. In addition to spotted owls and other wildlife species dependent on late seral forests, these federal lands also harbor sensitive, declining, and federally listed salmon species (FEMAT 1993; USDA and USDI 1994). Declines in once-abundant salmon and other fish assemblages, amphibians and invertebrates (e.g., river mussels) indicate substantial and persistent loss of aquatic ecosystem integrity (Hughes et al. 2004; Kaufmann and Hughes 2006).

To ensure that the new plan had the sound scientific basis necessary to withstand legal scrutiny, the federal agencies convened an interagency and interdisciplinary panel of scientists (Forest Ecosystem Management Assessment Team, FEMAT 1993) to develop the rationale and options for conservation provisions of the Plan. Recognizing that terrestrial and freshwater species fundamentally share the same landscape, FEMAT scientists developed a system of terrestrial reserves and conservation provisions and a separate but overlapping Aquatic Conservation Strategy ("ACS").

Since the NFP was adopted, social and political pressure have mounted to significantly recast or eliminate the Plan (e.g., Johnson and Franklin 2012), including key elements of its ACS. In late 2013, two bills were introduced in Congress (S.1784 and H.R.1526) that would substantially reshape management on approximately 8000 square km (roughly 2 million acres) managed by the BLM in western Oregon. Separately, the BLM has initiated an administrative planning process intended to result in a decision to replace the NFP policies. These efforts appear principally motivated by the goal of increasing commercial timber production (Blumm and Wigington 2013, DellaSala et al. 2014). Meanwhile, the Forest Service has adopted guidance that would permit substantial alteration of key elements of the ACS in future revisions of its National Forest Management Plans in the Pacific Northwest.

Both agency and congressional proponents of significant alterations of the NFP and its ACS have referred generally to "new science" as a basis for many proposed changes. However, we find that post-1993 scientific findings relevant to the ACS have not been synthesized and addressed in a systematic manner. In this paper we review the key ACS elements, briefly discuss several proposed modifications, and identify concerns about the likely consequences of proposed modifications. Finally we identify needed improvements in the protective measures in the ACS as indicated by new and emerging scientific knowledge, and suggest the form future revisions of ACS provisions might take if they are to be responsive and robust to recent scientific advances.

Core Design Elements of the Aquatic Conservation Strategy

FEMAT (1993) articulated the ACS with two spatial and two programmatic components for managing watersheds and riparian areas: (1) *Key Watersheds,* a land allocation comprising hydrologically discrete areas that putatively contain much of the remaining higher-quality aquatic habitat and offer the greatest potential protection for recovering at-risk fish species. These watersheds are priorities for active restoration, ARE subject to a “no net increase” mandate for road density and watershed analysis mandate for major land use activites.

TABLE 1.
The nine narrative ACS Objectives describing watershed functions and processes and which apply landscape-wide (USDA and USDI. 1994. Record of Decision, p.B-11).

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. *Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.*
2. *Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*
3. *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*
4. *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*
5. *Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*
6. *Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.*
7. *Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.*
8. *Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*
9. *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

(2) Riparian Reserves, a land allocation of varying widths along streams and lakes where aquatic and riparian objectives receive primary emphasis and where management is constrained according to activity-specific standards and guidelines. (3) *Watershed Analysis* is an assessment procedure designed to recommend how to tailor management priorities and actions to the biophysical limitations and perceived restoration needs of individual watersheds. (4) *Watershed Restoration*, a long-term program of somewhat unspecified scope and content, but which may include such wide-ranging provisions as road decommissioning, instream habitat alterations, and other measures (ROD 1994).

Late Successional [forest] Reserves, Congressionally designated reserves, and administratively withdrawn areas are land allocations outside of the specific components of the ACS, but they provide additional protection for portions of watersheds, riparian and aquatic ecosystems, particularly in terms of how they regulate landscape-wide management disturbances. In turn, aspects of the ACS also help provide habitat and connectivity for terrestrial wildlife species (ROD 1994, p.7). Many birds, mammals, amphibians, and invertebrates benefit from roadless areas (Trombulak and Frissell 2000); require large trees or wood debris for nesting or other uses; or rely on riparian forests for refuge, foraging, or dispersal (Pollock and Beechie 2014).

Beyond land allocations, the ACS imposes constraints on habitat-degrading management activities in two other ways: 1) It provides binding *standards and guidelines* that explicitly constrain numerous potential management activities within riparian reserves and key watersheds. 2) It requires all management activities on surrounding federal forestlands to be consistent with maintaining and restoring watershed functions and processes that are described in nine narrative ACS objectives (Table 1). The activity-specific standards and guidelines were intended to "prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the [ACS] objectives" (USDA and USDI 1994). The precaution that management activities may not retard recovery is a potent requirement. In order to ensure an action does not retard or prevent attainment of recovery, managers must ascertain the net effects of any proposed action on natural recovery processes at site-specific areas and larger spatial scales. This requirement addresses the observation (FEMAT, 1993) that past ecological degradation caused by numerous incremental harms often is not recognized. Cumulative effects across the landscape commonly offset gains from those passive or active management measures claimed to benefit ecological conditions and aquatic resource values.

Although it is beyond the scope of this paper to enumerate the many activity-specific standards and guidelines that comprise the ACS, some specific examples will be discussed because they are conspicuously affected by new or emerging scientific knowledge. The nine over arching ACS objectives also have binding force and constitute forest-wide standards and guidelines themselves (ROD 1994). This approach was explicitly intended to constrain activities in geomorphically, hydrologically, and ecologically sensitive areas and to limit the cumulative impacts of activities throughout a watershed (FEMAT 1993, V-29). The identified goal was to maintain conditions within a broadly conceived "range of variability" across multiple spatial and temporal scales, by evaluating, avoiding, or reversing ecologically harmful management at watershed and site-specific scales. The science of ecological restoration broadly recognizes that avoidance of adverse impacts is far more effective than post-hoc remediation of impacts (Kauffman et al. 1997, Karr et al. 2004, Roni et al. 2008), and this principle is codified in the Plan's Standards and Guidelines for watershed restoration (guideline WR-3 clearly states: "*Do* *not use mitigation or planned restoration as a substitute for preventing habitat degradation.")* During the mid-1990s, some federal agencies argued that site-specific failure to meet ACS objectives was broadly acceptable if unacceptable outcomes were not expected to be observed at larger scales. However, courts have validated that the conservation burdens delineated in the ACS apply to both site- or project-specific as well as larger scales, such as a watershed, planning area, or national forest.[1] The guiding language in the nine narrative objectives directs managers to "maintain and restore" specifically identified ecological conditions and functions. Hence management activities that will affect aquatic ecosystems may be pursued only under a reasonable assurance that they are restorative or protective in nature. It is not sufficient that management activities produce acceptably small adverse impacts, or cause harms that might potentially be mitigated by other measures.

Courts have ruled that FEMAT (1994) embodies the best available scientific information pertaining to the impacts of forestry activities on salmon and their habitat in the Pacific Northwest federal forests and that the Plan adequately integrates FEMAT's scientific representations[2]. Several scientific reviews (e.g., Spence et al. 1996, DellaSala and Williams 2006, Reeves et al. 2006a, Everest and Reeves 2006) have broadly concluded that while a great deal of new information has been published, the fundamentals and rationale of FEMAT and the ACS remain consistent with available scientific information. However, no interagency scientific panel comparable to the scope of FEMAT has been reconvened to formally address the broad question of how new scientific information may affect the validity of the ACS and how that might in turn affect Endangered Species Act (ESA) consultations, Clean Water Act (CWA) compliance, or NEPA, NFMA, and other relevant project level planning processes.

Because the ACS is incorporated into agency land use management plans, it is directly enforceable by third parties pursuant to the over arching resource planning statutes of the USFS and BLM. While the majority of distribution of salmon species in the Pacific Northwest lies downstream of federal forest watersheds, the federal lands provide important high-quality refugia for many populations (Burnett et al. 2006), and federal forests confer regional hydrologic benefit to water quality and ecosystem integrity downstream. Implementation of the ACS on federal forests has become a foundational baseline component for attainment of salmonid recovery under the Endangered Species Act and of water quality standards under the Clean Water Act. For example, federal ESA salmon recovery plans in Oregon and California rely heavily on Plan implementation (e.g., NMFS 2007, pp. 402-403, NMFS 2012, pp. 3-48, 49). Furthermore, because of the extent to which ACS implementation is widely assumed to represent the federal contribution to aquatic ecosystem conservation, changes have regulatory implications for nonfederal lands. For example, the underlying analyses of Habitat Conservation Plans granted to nonfederal landowners in the Pacific Northwest under the ESA, with assurances extending 40-50 years, explicitly rest on full ACS implementation on surrounding federal lands. (See e.g. WA DNR 2005). Similar expectations

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1 See e.g. Pac. Fed'n of Fishermen's Ass'ns et. al. v. Nat'l Marine Fisheries Serv., 71 F. Supp. 2d 1063 (W.D. Wash. 1999) ("PCFFA II")(finding that the Plan requires a determination of consistency with the ACS objectives at the project scale); Pac. Fed'n of Fishermen's Ass'ns et. al. v. Nat'l Marine Fisheries Serv. 265 F.3d 1028 (9th Cir. 2001) ("PCFFA III") (finding NMFS' biological opinions on 23 timber sales affecting then-listed Umpqua cutthroat trout and Oregon Coast coho salmon failed to assess site-level impacts).

2 See e.g. Seattle Audubon Soc'y v. Lyons, 871 F. Supp 1291, 1303 (W.D. Wash. 1994), aff'd sub nom., Seattle Audubon Soc'y v. Moseley, 80 F.3d 1401 9th Cir. 1996) (finding adequate scientific support in the plan's decision record and "unprecedented thoroughness" of the agencies' effort to meet "the legal and scientific needs of forest management").

undergird the state of Oregon's restoration plan for salmon and water quality.[3] In basins where water quality standards are not being met, state and federal regulators routinely consider the ACS to be an adequate implementation plan for BLM and Forest Service managers. Substantive alteration and weakening of the ACS threatens to upset a complicated web of region-wide conservation planning that is explicitly and implicitly dependent on the future habitat quality and recovery rate that the ACS is designed to achieve.

3 http://www.oregon.gov/OPSW/archives/ocsri_mar1997/ocsri_mar1997ex.pdf (identifying NFP implementation as a critical element of Oregon's salmon recovery plan)

Changes to the ACS Proposed by Administrative and Legislative Efforts

ACS Riparian Reserves. Based on the nested set of ecological rationales considered in FEMAT (1993), the ACS specified a set of "default" widths of the Riparian Reserve land allocation to be a) at least two site-potential tree heights (*ca*. 100 m or 330ft) on either side of fish-bearing streams, and b) at least one tree height (*ca*. 50 m or 160 feet) on non-fish bearing streams. Within these reserves, the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Beyond these default delineations, Riparian Reserves must be drawn to protect areas susceptible to channel erosion and mass wasting. The Riparian Reserve widths were based on ecosystem process considerations (FEMAT 1993, Olson et al. 2007) and broadly specified population viability and habitat considerations for seven groups of salmonids and many terrestrial and avian species. Various sources (e.g., Johnson et al. 2012) have estimated that based on the high stream densities prevailing over much of the region, roughly 40% of total acres within the Plan area are located within the "default" Riparian Reserve system. However, only about 11% of the Plan area lies in Riparian Reserves associated with those areas (often referred to as "Matrix lands") where commercial logging is expected to be concentrated, and where the Riparian Reserve allocation most directly restricts potential logging activity and other management-related disturbances. Very few of the many completed watershed analyses offered a scientific rationale for reducing default Riparian Reserve areas in any location; a larger number identified site-specific reasons to expand Riparian Reserves beyond the specified default widths (Pacific Rivers Council 2008).

Proposed Changes to the ACS and Riparian Reserves. The BLM's 2008 Western Oregon Plan Revisions (WOPR) proposed a new regime of management for the "Oregon and California (O&C) Lands, distributed widely across western Oregon (Blumm and Wigington 2013). The WOPR proposed greatly reducing default Riparian Reserve widths, primarily arguing that ACS default delineations include some upland or "non-riparian" vegetation and that summer stream shade and large wood recruitment to fish-bearing streams could be maintained with narrower reserve widths. Narrative objectives and standards and guidelines were also reduced or eliminated, allowing commercial timber harvest in Riparian Reserves for pervasive "safety and operational" reasons. The analyses and rationale underlying the WOPR were withdrawn by BLM in 2009 in significant part because they were deemed unlikely to survive consultations with ESA enforcement agencies (the National Marine Fisheries Service and US Fish and Wildlife Service). In a recent regional planning document, BLM (2013) argued again that "Riparian Reserve boundaries extend out beyond the water influence zone and are wider than necessary for water quality protection" but provided few or no specific scientific citations to support these claims. BLM has provided little scientific rationale or empirical validation for their decision to selectively focus on hydrophilic vegetation, proximate stream shade, and large wood recruitment as the only ecological considerations dictating riparian reserve delineation—in contrast to the much more comprehensive set of biophysical functions considered in FEMAT and the NFP ACS. (Note, as detailed later in this text, we also disagree with BLM's specific simplifying assumptions about effect of Riparian Reserve width on maintenance of shade and wood recruitment, and further conclude that other functions, such as nutrient retention, implicate much wider and less-disturbed reserves.)

A similar extremely constricted perspective on riparian ecological functions appears to underlie two Congressional bills for BLM lands in western Oregon (the "O&C" Lands), one of which (H.R. 1526, http://defazio.house.gov/issues/bipartisan-oc-forests-plan) would reallocate some 675,000 ha (1,667,000 acres) to an "O&C Trust"," the primary purpose of which is timber management (Blumm and Wigington 2013). Areas equivalent to Riparian reserves in the Trust would be designated at about half the width of the current ACS default requirement for steams (with extremely limited buffers for springs, seeps, wetlands, and unstable landscapes). A U.S. Senate bill introduced in 2013 (S.1786) would allocate about 50% of O&C lands to so-called "forestry emphasis areas," cut default Riparian Reserve areas by half across all stream types, with further narrowing if watershed analysis deems them "not ecologically important." The bill would provide for potentially extensive commercial logging in the rubric of thinning riparian areas where stands are younger than 80 years of age; only stands older than 120 years would be protected from logging. These older stands remain in scattered small patches across O&C lands but are important ecologically given high levels of timber cutting on surrounding nonfederal lands (DellaSala et al. 2013). Environmental review at the project level would also be curtailed from current requirements, including but not limited to eliminating the requirement for project-level determinations of consistency with ACS objectives.

Meanwhile the USFS—which manages the majority of federal forestlands in the three state NWP area, has focused on incrementally replacing the ACS with new provisions in upcoming revisions of individual National Forest Plans. In 2008 the Forest Service adopted new regional planning guidance (USDA 2008) that generally mirrors the NFP default riparian area widths and key watersheds allocations, but altered the narrative ACS Objectives, Watershed Analysis, and other NFP direction for management within reserve areas. This guidance stakes a claim for expanded agency discretion to undertake a broader range of vegetation and ground-disturbing management activities within riparian reserves, including but not limited to thinning and other commercial logging and livestock grazing. The 2008 Forest Service regional guidance, if implemented in future revised Forest Plans, would allow actions that alter riparian reserve resources and goals, as long as managers can present a general argument that impacts would be offset by other, beneficial actions or naturally-occurring improvements dispersed or averaged across time or space. The apparent intent of these changes is to reduce the burden for analysis of environmental impacts associated with such projects, which would, for example, streamline approval of more aggressive implementation of mechanized and commercial thinning and other vegetation- and ground-disturbing actions within Riparian Reserves. We are concerned that the 2008 USFS planning guidance has not been subject to rigorous external or scientific review, and if implemented could have harmful consequences for riparian and aquatic resources that have not been adequately evaluated or disclosed.

Weakening of the Northwest Forest Plan ACS will impact numerous listed fish, wildlife and plant species by changing the range of acceptable on-the-ground outcomes from management actions. Across the Pacific Northwest, reduced protections for listed species and water quality via changes in the ACS would likely necessitate reconsideration of many existing agency programs and initiatives that have been premised on implementation of the 1994 ACS measures.

***ACS Watershed Restoration*.** The ACS intended watershed restoration to be strategically identified and prioritized through *Watershed Analysis*, with particular emphasis on improving ecological conditions in *Key Watersheds*. Protection through passive restoration (Kauffman et al. 1997) of existing high-quality habitat is explicitly prioritized over active instream rehabilitation. To be effective, instream habitat-improvement projects rely on concurrent long-term riparian and catchment-scale protection and rehabilitation measures, and these must be programmatically tiered to management plans affecting each watershed. Hence site-specific active measure, such as instream habitat structures or riparian tree planting, should not be claimed to mitigate for ongoing or future harmful and degrading management actions (Frissell and Nawa 1992, Frissell and Bayles 1996, Roni et al. 2008).

Proposed Changes in Watershed Restoration Policy. In contrast, the current Senate Bill would simply allocate $1 million annually for instream wood placement and $5 million for road removal or "improvement" across the BLM's O&C land area, and apparently exclude such activities from environmental analysis under NEPA. In doing so this bill would decouple active restoration measures from land management decisions. The bill would also alter the programmatic approach to watershed restoration, as discussed in the next section.

Proposed changes to ACS Key Watershed allocations. The Senate and the House bills and the BLM (2013) call for revising Key Watershed allocations in place for the past 20 years under the NFP and ACS. Many current Key Watersheds would apparently be dropped from the allocation under the House bill, with the consequences for conservation planning and species at risk unevaluated; the Senate Bill calls for a revised watershed classification to accommodate new land allocations.

Certain revised Key Watershed delineations might in theory benefit particular populations of species such as ESA-listed coho salmon. However, the concept of prioritizing conservation efforts in Key Watersheds is undermined when watershed-scale priorities are upended and reshuffled on a time frame that is decades shorter than the amount of time expected for significant watershed restoration to occur. Effective watershed restoration requires a sustained commitment to aquatic resource protection and restoration, coupled with appropriately conditioned and scaled land management and effectiveness monitoring extending for decades to centuries (FEMAT 1993). Critical components of the ROD for the ACS include requirements for no road construction within inventoried roadless areas within Key Watersheds, and no net increase in road density within each Key Watershed. These protections for Key Watersheds would apparently be lost under the Congressional proposals, at least for those Key Watersheds that would be de-designated. Although the 2013 Senate bill would retain a process it refers to as "Watershed Analysis" its purpose appears to be inverted: it would not focus on watershed restoration, but on identifying ecological changes due to increase commercial logging over that which might occur under the default prescriptions specified in the bill.

CHANGES IN TERRESTRIAL LAND ALLOCATIONS ALSO AFFECT WATERSHED INTEGRITY

Land allocations within the NFP and other authorities, but outside of the ACS, including Late Successional Reserves, Wilderness, other congressionally designated or "administratively withdrawn" lands, and inventoried roadless areas, can confer additional protection to watersheds. These land allocations can prevent or retard road network expansion, and other disturbances, allowing natural ecosystem maintenance and natural recovery processes to proceed. They limit the spatial extent of disturbances across watershed and stream networks, and reduce the incidence or likelihood of adverse cumulative impacts. Many Key Watersheds are closely associated with such specially designated lands, though unfortunately few are largely or entirely nested such within such conservation delineations (Frissell and Bayles 1996). As a consequence, when new proposals strip away the protection conferred by Late Successional Reserves, roadless areas, or other administrative designations, watersheds are placed at greater risk of impact from forestry activities. Land disturbance from roads, logging, grazing, or other actions can undermine the benefits of restoration and land protection elsewhere in the same watershed (Espinosa et al. 1997), depending on the geography of the watershed in question. The trade-offs of cumulative risk and potential harm to watersheds and sensitive or listed aquatic species from changes in land allocation have not been rigorously assessed in the Congressional and administrative proposals. Such trade-offs amount to a wholesale re-casting of NFP land allocations for the region that includes and surrounds the O&C lands. Each of the 2013 Congressional bills proposes to substantially re-allocate protection of older forests, generally by focusing protection on older stands rather than the more expansive Late Successional Reserves of the present NFP. Moreover the Congressional bills make special provision for thinning under nearly all land allocations, with guidelines allowing for agency-determined findings of need and some minimal requirements for tree retention. Although the NFP did not prohibit thinning or salvage logging in these areas, the legislative bills favor more extensive and intense logging and increasing fragmentation by logging roads than have previously occurred in areas now classified as Late Successional Reserves.

NEW SCIENCE THAT INFORMS AQUATIC CONSERVATION STRATEGY AND PRACTICES

In the following section we discuss some relevant new science published since the convening of FEMAT (1993). We provide selected citations and briefly summarize our view of major implications for the purpose of developing and improving an effective aquatic conservation framework. While our interpretations and recommendations focus on the ACS, many of the citation sources and their implications are derived from studies of other regions and ecosystem types out of necessity because of limited research done in the Pacific Northwest. Just as in FEMAT (1993), relevant scientific information that is critical to define and frame topics of crucial conservation concern sometimes originates from other similar regions, and often spans a variety of disciplines.

In this paper we were not able to comprehensively address all areas of scientific advancement concerning forest management, water quality and aquatic conservation. Some topics await further elaboration. For example, we do not comprehensively discuss the literature on impacts of logging and roads on streamflow patterns (e.g., Moore and Wondzell 2005), and subsequent effects on stream geomorphology, habitat, and biota. However, we do consider known effects of forest management and climate change on streamflows as a contributing concern under several topic headings. Most importantly, we also do not assess new science pertinent to non-aquatic and amphibian wildlife species in this report. This important work remains to be done.

Management after Wildfire, Disease, and Other Disturbances. Salvage logging of dead or dying trees after fires, insect outbreaks, and other disturbances in Pacific Northwest forests continues to be undertaken in the region, and its effects are a recurring ecological concern (see review by Lindenmayer and Noss 2006). Soon after the NFP was adopted in 1994, the scientific community began to weigh in on the inadvisability of post-disturbance logging. Scientists have catalogued the critical importance of large standing live trees, snags, and downed wood from fallen trees in the post-disturbance recovery of natural forests, including stand successional pathways, watershed processes, and wildlife and fish habitat (e.g., Gresswell 1999, Minshall 2003). Numerous scientific syntheses provided precautionary advice against post-fire logging on a wide range of causal grounds (e.g., Beschta et al. 2004, Karr et al. 2004, Lindenmayer et al. 2004, Lindenmayer and Noss 2006, Donato et al. 2006, Noss et al. 2006). More recent work has identified the potential importance of pulses in trophic energy following high-severity wildfire (Malison and Baxter 2010) for persistence and recovery of aquatic and riparian species. This new information builds on a more longstanding recognition that wildfire, that among its many other effects, plays an important long-term role in the generation of complex wood debris structures in streams (Minshall 2003). Other reviews focused on plant and landscape ecology broadly call into question the effectiveness of salvage logging insect-infested trees to control insect outbreaks (e.g., Black et al. 2013, Six et al. 2014). Similar concerns about the consequences of salvage logging curtailing natural ecosystem recovery processes pertain to salvaging of stands affected by any natural mortality agent, such as windthrow or volcanism.

However, post-disturbance logging was not expressly ruled out in the NFP and ACS, and the political demand for salvage logging remains high, so large post-fire salvage logging projects have been pursued by the USFS and BLM in many areas, including on occasion within Key Watersheds, Riparian Reserves, Late Successional Forest Reserves, and designated critical habitat of listed species (see DellaSala et al. 2014). Scientific consensus on the inadvisability of post-disturbance logging largely emerged in the years just after FEMAT, hence the ACS should be strengthened to reflect such sources as the recommendations in Beschta et al. (2004), Karr et al. (2004), and Black et al. (2013).

We conclude that for maintenance of forest ecosystem integrity*, post-disturbance logging should be prohibited in Riparian Reserves, Key Watersheds, Late Successional Reserves, and other areas where conservation is a dominant emphasis. Post-disturbance actions should prioritize road decommissioning or systemic road drainage improvements, and suspension of livestock grazing to reduce harm under the increased hydrological stresses expected in post-fire forests and their aquatic and riparian habitats and biota.*

Forest Thinning Intended to Reduce Tree Density or Wildfire Fuels. Current ACS language allows the agencies to "apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain…objectives." The agencies carry a project-specific burden to establish the need for thinning and that outcomes are ecologically restorative. Recently the USFS and BLM have pressed to increase in the average size of thinning projects apparently to reduce the number and cost of site-specific environmental analyses by broadening their scope. Agency initiatives presume extensive use of mechanical harvesting methods in conjunction with commercial timber sales to thin trees in Riparian Reserves and other areas where conservation values are given highest priority. In wetter forest types, the primary claim that thinning is restorative rests on the assumption that the growth rate and vigor of those trees left alive after thinning will likely improve, thereby hastening the future development of larger-sized trees in the stand. In drier forests, the primary rationale is that thinning is needed to promote a generalized reduction in fuel loads, thereby presumably reducing the risk, or severity, or rate of spread, of wildfire and that thinning can increase fire resistance of selected individual trees.

Regardless of silvicultural intent, mechanized treatments in Riparian Reserves can disturb vegetation and soils in close proximity to surface waters, where the risk of sediment delivery and other impacts is demonstrably high (Rashin et al. 2006, Dwire et al. 2010). Logging activity that disturbs soils within riparian buffers can also reduce the buffer's effectiveness to retain sediment and nutrients delivered from upslope sources. Thinning or other disturbance of coniferous or deciduous trees and shrubs within riparian and wetland areas can cause decades of diminished summer low flows (after an initial few years during which low flows may increase), as a consequence of increased water demand by rapidly re-growing vegetation (Hicks et al. 1991, Moore and Wondzell 2005). In addition, thinning and yarding of logs from near-stream areas requires or encourages the construction of roads in close vicinity to streams, where the likelihood of sediment delivery and other impact from roads is increased (Luce et al. 2001). Bryce et al. (2010) found that for sediment-sensitive aquatic vertebrates and macroinvertebrates, minimum-effect levels for percentage fines were 5% and 3%, respectively, meaning that even small increases in fines can adversely affect salmonids and their prey.

Mechanized thinning and fuels operations usually require higher-density road access to be feasibly implemented. Mechanical treatments for fuels reduction are particularly problematic because recurring entries at roughly 10-year intervals are necessary to sustain the desired conditions (Martinson and Omi 2013); such a forest management regime strongly favors, if not requires, a permanent, high-density road network. Many thinning projects involve road and landing construction and reconstruction, as well as elevated haul and other use of existing roads, all of which significantly contribute to watershed and aquatic degradation. Even if constructed roads and landings are deemed "temporary," their consequent impacts to watersheds and water bodies are long lasting or permanent. The hydrological and ecological disruptions of road systems and their use (Jones et al. 2000, Trombulak and Frissell 2000, Gucinski et al. 2001, Black et al. 2013), exacerbated by other effects of vehicle traffic, will likely outweigh any presumed restorative benefit to streams and wetlands accruing from thinning and fuels reduction. In recent years, the prospect of future thinning or fuels reduction projects often has become the basis for the USFS or BLM to avoid or delay decommissioning environmentally harmful roads, even when fiscal resources were available for the work. Prescribed fire without extensive mechanical treatment is of much less concern, as it is more feasible to apply in sparsely-roaded wildlands, entails far less soil disturbance, and if conducted in proper times and places it can more adequately mimic the ecological effects of natural wildfire.

Substantial questions remain about the putative ecological benefits of thinning and fuels reduction. This is critical because agency proponents commonly argue that the desired ecological benefits outweigh the adverse environmental effects of logging and fuels treatments. Dispute among federal agencies about claimed ecological benefits of thinning in moister, Douglas-fir-dominated forest types (widespread in the Pacific Northwest) led to an interagency scientific review in 2012-2013 (Spies et al. 2013). That panel concluded that increased tree growth might be better obtained from thinning very young, high-density stands--which very seldom produces commercially saleable logs. They further concluded that thinning produces unusually low-stem-density forests and causes long–term depletion of snag and wood recruitment that is likely detrimental in most Riparian Reserves (Spies et al. 2013, and see Pollock et al. 2012, Pollock and Beechie 2013). Further depletion of wood recruitment in headwater streams can adversely affect the behavior of debris flows in Pacific Northwest watersheds in ways that further reduce residual wood debris and its important functions over extensive portions of streams and rivers (May and Gresswell 2002), where present-day wood abundance is decimated compared to historical conditions (Sedell et al. 1988, Pollock and Beechie 2014). Finally, recent reviews also raise compelling, unanswered questions about the effectiveness of thinning forests for attempted control of insect outbreaks (Black et al. 2013, Six et al. 2014).

The effect of thinning on fire behavior and effects within riparian areas has been little studied. For western North American forests in uplands the literature is replete with ambiguous and conflicting results regarding the effects of thinning and other mechanical fuels treatments on fire severity, rate of spread, and recurrence. Moreover, the probability of a fire burning through a treated stand within the limited time window of potential effectiveness of a fuels treatment has been shown to be very small (Lydersen et al. 2014, Rhodes and Baker 2008). Any presumed benefit is even less persistent in Riparian Reserve areas where woody vegetation regrows rapidly after treatment, and where in moister forest types fire tends to recur with lower frequency. Equally important, we question whether managers should be striving to reduce fire severity in riparian areas as a rule, considering that high-severity fire plays a natural and historical role in shaping riparian and stream ecosystems (Gresswell 1999, Minshall 2003, Benda et al. 2003, Malison and Baxter 2010). Other natural forest disturbances, including windthrow, insect outbreaks, and landslides on forested slopes, appear to play a similarly important role in generating pulses of wood debris recruitment to streams, establishing a long-lasting source of ecological and habitat complexity.

Considering the difficult-to-justify costs and recognized inherent risks of adverse impact associated with such operations in sensitive areas, balanced against the uncertainty in intended benefits, we conclude the following: *Thinning and fuels reduction by means of mechanized equipment or for commercial log removal purposes should be generally prohibited in Riparian Reserves and Key Watersheds. Any thinning or fuels treatment that does occur as a restorative treatment in Riparian Reserves (e.g., to remove non-native tree species from a site) should retain all downed wood debris on the ground. Thinning projects that involve road and landing (including those deemed "temporary") construction and/or reconstruction of road segments that have undergone significant recovery through non-use should also be prohibited, due to their long term impacts on critical watershed elements and processes.*

Road Networks and Their Management. Roads are ecologically problematic in any environment because they affect biota, water quality, and a suite of biophysical processes through many physical, chemical, and biological pathways (Trombulak and Frissell 2000, Jones et al. 2000, Al-Chokhachy et al. 2010).

The magnitude of existing road impacts on watersheds and streams in the Plan may equal or exceed the effect of all other activities combined. Firman et al. (2012) reported that density of spawning coho salmon across coastal Oregon streams was negatively associated with road density. Kaufmann and Hughes (2006) found that road density in Coast Range streams was associated negatively with 25-50% of the variability in condition of aquatic vertebrate assemblages. More recently, Meredith et al. (2014) showed that the abundance of habitat-forming wood in Columbia Basin streams declined with proximity to roads, and the effect was roughly the same magnitude as that of natural climate and vegetation differences or long-term livestock grazing.

Roads are necessary to support logging, mining, grazing, and motorized recreation, but the existing federal forest road system far outstrips the extent of those demands. The number and poor condition of USFS and BLM roads, the agencies' inability to prevent current roads from deteriorating and harming streams, and the pervasive effects of roads on the physical and biological environments were recognized in FEMAT (1993). In addition, forest roads have been the subject of high-profile national dialogue and policy reviews since the development of the Plan (Gucinski et al. 2001, Pacific Rivers Council 2008). The ACS's primary means of protecting streams from roads and encouraging effective restoration are twofold: First, ASC objectives discouraged locating roads within Riparian Reserves, and second, roadless areas were to be maintained and overall road density reduced in Key Watersheds. For a small number of Key Watersheds where road network reduction has been pursued, agency monitoring efforts have reported improvements of certain instream habitat conditions, a response not detected elsewhere (Gallo et al. 2005, Reeves et al. 2006a). Often overlooked is that proposals to reduce the size of Riparian Reserves could provide more free rein for the construction of roads and landings in closer proximity to streams, markedly increasing the likelihood of sediment delivery and alteration of near-stream hydrology.

How to substantially reduce road density in critical watersheds and improve road drainage, stream crossings, and other factors that affect streams and aquatic biota, while maintaining sufficient roads for other forest uses, remain central challenges to forest planning and management. The ACS and other operative policies have lacked sufficient means and impetus to accomplish this in the past 20 years. We therefore suggest five policy changes to achieve needed road reductions: 1) *Prohibit the construction of new permanent and "temporary" roads*, except in limited instances were construction of a short segment of new road is coupled with and necessary for the decommissioning of longer and more damaging segments of existing road. 2) *Allow no net increase in road density in any watershed*. New "temporary" roads and landings should be considered to be roads and counted towards road density levels for at least several decades after decommissioning. 3) *Strengthen road density restrictions for Key Watersheds and establish unambiguous standards and metrics for net road density reduction, which include adequate accounting for landings and the impacts of so-called "temporary" and decommissioned roads and landings*. 4) *Improve the system of classification (e.g., road type, use) and inventory (e.g., whether a road is active or decommissioned), and mapping (i.e., update maps to reflect current conditions)* to ensure that agency bookkeeping of road miles corresponds with actual field conditions. This provision is necessary because at present many roads "disappear" when dropped from the inventory, but they in fact remain on the landscape causing watershed impacts. Also, lax road mapping programs and narrow definitions of what constitutes a road can significantly under represent the actual road densities. 5) *Require each proposed forestry and other development project to meet a target of incremental reduction of the road system* in all watersheds affected by the project. Road density redution should be required until road density in the affected watershed is lower than the target established on the basis of biological response.[4] Finally, 6) *roads for which there are not adequate funds for maintenance and upkeep should be decommissioned*.

Riparian Reserves for Protecting Stream Temperature. Conservation (including restoration) of natural thermal regimes of streams and rivers was but one of many factors considered when ACS default riparian reserve widths were determined in the initial design of the ACS. In recent years the land management agencies and others have commonly assumed shade from riparian vegetation is the predominant proximate control on stream temperature, and some research has suggested that trees within 30 m or so of the stream margin contribute over 90 percent of the effective shade (e.g., Reeves et al. 2013). Furthermore, it has been suggested that headwater streams that do not carry water in summer should presumably not need shade to conserve summer thermal maxima in downstream waters. These two premises have become a primary rationale for proposals by BLM and in congressional bills to reduce default Riparian Reserve widths for some stream types, with the intent of increasing the area of Matrix land or equivalent that is subject to commercial logging. From the perspective of temperature protection, we have four concerns with this rationale for shrinking Riparian Reserves.

4 E.g., 1 mile per square mile (0.62 km per square km) for watersheds with Pacific salmon, steelhead and cutthroat trout (Lee et al. 1997, Thompson and Lee 2000, Carnefix and Frissell 2009), and 0.5 miles per square mile for watersheds supporting bull trout (USFWS 1999; Baxter et al. 2000, see Fig 5 and Appendix, showing that population growth remained negligible in streams with higher road densities; and Ripley et al. 2005, Fig. 5 showing that probability of bull trout occurrence in Alberta tributary streams dropped by half where road densities exceeded about 0.6 miles per square mile).

First, *redundancy*: most current analyses rest on a static view of riparian stand structure and function—that is, shade is modeled as a nearest single layer function of the existing standing trees only. The tree nearest to the stream margin is attributed as the contributor to shade, even though one or more trees standing behind it, slightly farther from the stream, may contribute shade as well. But when trees fall or die in the so-called "inner zone," then the "outer zone" trees become a replacement source of shade. Obviously, if the outer zone trees have been logged, that functional redundancy is lost and any riparian disturbance, man-made or natural, may lead to incrementally reduced stream surface shade—and an increase in stream temperatures.

Second, *density*: whereas we measure canopy shade with fixed-resolution instruments, little is known about how measurements of shade translate to actual solar penetration. In the coarsest sense, a canopy densiometer is used to visually estimate canopy cover with only 17 sample points that are irrespective of solar path. Even more quantitative instruments, such as the Solar Pathfinder or SunEye have the tendency to overlook the value of small canopy gaps or multiple canopy thickness in reducing light intensity reaching the stream, as does the densiometer. "Redundant" tree canopies create a shade structure that is dense compared to that of a single tree, and this may substantially affect the actual solar energy reaching the water surface in ways that we that we seldom adequately measure.

Third, *groundwater*: thermal response is affected in numerous ways by near-surface groundwater, which affects both surface streamflow rate and the temperature of water at the point of delivery. After initial increases in base flow following logging, summer base flow can decline for many years as a consequence of rapidly re-growing second-growth vegetation and its evapotranspiration demand (Hicks et al. 1991, Moore and Wondzell 2005). Logging in the outer areas of Riparian Reserves or forested wetlands can contribute to or conceivably magnify this effect. Accordingly, in some Pacific Northwest watersheds, stream temperature is more strongly associated with catchment-wide logging than with streamside vegetation cover (Pollock et al. 2009). Stream warming in such watersheds (often containing gently sloping or hilly terrain and numerous forested wetlands) could be influenced by reduced canopy shade over large areas of near-surface groundwater. Warming also could be influenced by changes in shallow groundwater flux rates and the level of the water table (Poole et al 2008). Hence, stream temperatures in some circumstances can become warmer at their point of origin (in spring, summer and fall) following watershed logging. Other research has established the importance of the hyporheic flow exchange in determining surface water thermal regime (Poole and Berman 2001, Baxter and Hauer 2001, Poole et al. 2008). The hyporheic zone may include extensive areas of shallow subsurface flow within montane alluvial valleys. In summer this subsurface pool may be dominated by spring snowmelt or cool rain runoff that cools surface streams when it discharges in midsummer (Poole and Berman 2001, Wondzell 2011). The extent of hyporheic storage and exchange bears a somewhat uncertain relationship to surface landforms, and until the decades after FEMAT, land management agencies lacked both the methods and incentive to accurately map these critically important areas (Torgersen et al. 1999, Baxter and Hauer 2001, Ebersole et al. 2003, Poole et al. 2004, Poole et al. 2008, Torgersen et al. 2012). Sediment accumulation in streambeds, or loss of step pools and other structures contributing to channel complexity—often formed by stable large wood—is thought to reduce entrainment of surface flows into, hence flow exchange with, the hyporheic zone (Moore and Wondzell 2005, Poole et al. 2008).

Given these uncertainties, and the increased importance of such groundwater source areas under future climate changes, any management change that increases the areal extent of logging in watersheds poses a risk of contributing to undesired stream warming. Notably, winter and spring stream temperatures can be of comparable importance to summer temperatures in meeting the habitat needs of species. In particular, temperatures of seasonably intermittent streams (even though they may be non-fish-bearing in summer or support salmonids only in early summer) can be important for salmon and other species in winter and spring (Wigington et al. 2006), and are directly and indirectly influenced by riparian canopy shade, thermal insulation, and other forest conditions that mediate water temperature fluctuations.

Fourth, *channel migration*: over time, stream channels migrate and even small streams have secondary channels that may flow only during the rainy season. However, existing side channels and backwaters provide important rearing and refuge habitat for salmonids, and they are commonly unmapped or mapped poorly. In addition, if riparian buffers are narrowed, some of these channels may migrate outside the narrowed buffer and be exposed to direct sunlight and substantially warmed. For instance, the sources of LWD are impaired during channel migration where outer zones have been harvested. Washington state and private forest practices rules have included criteria designed to identify and protect channel migration zones for many years (Brummer et al. 2006); in the ACS, explicit rules for their delineation are left to watershed analysis.

Considering the multiple ecological factors and processes that affect stream temperature and considering that temperature conservation is but one of many significant functional factors influenced by streamside forests, we *find no sufficient scientific support for reducing current ACS Riparian Reserve default widths for any stream type. In many watersheds and stream segments, larger areas of forest protection are warranted to prevent warming of* *shallow groundwater, particularly given likely trends future climate change, and the expectation of increased influence of wildfire and other "unmanaged" forest disturbances* (Westerling et al. 2006).

Riparian Reserves and Nutrient Retention. The role of forested riparian buffers in retaining nutrients mobilized by upslope disturbance, or delivered to watersheds in precipitation and fertilization, is globally recognized. Forested buffer zones are commonly prescribed to reduce nutrient delivery to streams in agricultural landscapes (Sweeney and Newbold 2014). Logging and fuels management treatments that disturb green vegetation generate increased nitrogen leaching from forest soils that enters streams and wetlands by both surface and subsurface flow paths (Wenger 1999, Gomi et al. 2002, Kubin et al. 2006). Any ground-disturbing activity or condition (such as a road network) tends to mobilize phosphorus in association with soil erosion. Logging disturbs vegetation and soils over large areas, and scaled over large landscapes or river basins, initial disturbance of forested lands tends to generate larger net increases in nutrient loading than repeat disturbances of already-altered agricultural or urban lands (Wickham et al. 2008; note this observation is from a large population of monitoring sites and remains true even though agricultural lands are commonly more heavily fertilized than forest lands). Over time, nutrient loading to headwater streams transfers downstream, where nutrients accumulate in rivers, lakes, estuaries, and nearshore marine ecosystems (Freeman et al. 2007). For all of these reasons, forestry operations have been identified as a major contributor to nutrient loading, eutrophication, and associated impairment of water quality in Pacific Northwest lakes (Blair 1994, Dagget et al. 1996, Oregon DEQ 2007), rivers and estuaries (Oregon DEQ 2007).

Cumulative nutrient impairment of downstream receiving waters can occur without violation of nutrient standards in headwater streams, simply as a consequence of sustained increases in loading from storm water runoff from forest roads and periodic logging. In effect, logging alters the entire regime of nutrient and sediment export, and nutrient losses to surface waters are endemic and widespread consequences of logging and other disturbance of forested watersheds.

The question of what role Riparian Reserves play in nutrient retention has received insufficient consideration in the Pacific Northwest. Research on the nutrient retention efficiency of various forested buffer widths from the Upper Midwest and other regions (Nieber et al. 2011, Sweeney and Newbold 2014) suggests that average phosphorus and nitrogen retention is around 80% for undisturbed buffer zones of 30 m (100 feet) wide. Extrapolation suggests that buffers of 45 m (150 feet) or greater might be necessary to attain 90-99 percent retention of nutrients mobilized by upslope disturbance. These distances are likely too small for Pacific Northwest forests, where slopes are steeper, soils tend to be more porous, and macropores or channeled flow from uplands are more common than in the Midwest (all factors identified in Nieber et al. [2011] as reducing retention efficiency).

By virtue of their high density of surface channels across most mountainous landscapes, headwater streams with seasonal flow receive a large portion of the nutrients mobilized by up-slope disturbance (Gomi et al. 2002, Freeman et al. 2007). Therefore, full protection of wide Riparian Reserves along even the smallest stream channels (and surface-connected wetlands) is likely necessary for effective nutrient retention when surrounding uplands are disturbed. Channel network expansion from gully erosion (Reid et al. 2010) or roads (Wemple and Jones 2002) and channel simplification through loss of woody debris or sediment increases also reduces retention efficiency of nutrients, sediment, and organic matter in headwater systems. Moreover, thinning or other disturbance of vegetation or soils within the Riparian Reserve could short-circuit the benefit of riparian forest buffers, by creating a near-stream source of nutrients that is not fully mediated by the retention capacity of the default-width riparian zone.

Although more research is needed in the Pacific Northwest on nutrient retention, current scientific knowledge is sufficient to justify three recommendations. 1) *Continuous, no-cut Riparian Reserves exceeding 50 m (160 feet) along all streams and wetlands are generally needed to mitigate the effects of up-slope logging on nutrient loading to both freshwater ecosystems and downstream marine environments.* 2) *Cessation of livestock grazing in Riparian Reserves, road network reduction, and reconfiguration of remaining roads to reduce their hydrologic connectivity to surface waters are needed to reduce downstream nutrient loading.* 3) *Analysis of the effects of management actions on nutrient loading to immediate downstream receiving waters, including lakes, wetlands, reservoirs, mainstem rivers, estuaries, and the nearshore marine, are needed in environmental assessments, environmental impact statements, watershed analyses, and ESA consultations for aquatic species.*

Livestock Grazing. Whereas forestry predominates in the Northwest Forest Plan area, grazing affects a significant portion of the area as well; for example, 22 percent of BLM lands were subject to livestock grazing in the early 2000s (BLM 2008). A larger area was affected by historic grazing, where soil impacts may persist. Livestock grazing has large impacts on streams (Al-Chokhachy et al. 2010) because livestock tend to concentrate in streams, floodplains and alluvial valleys (see Beschta et al. 2013 for a recent synthesis). Besides direct disruption of wetlands and streambeds, and the suppression of woody vegetation, soil compaction by grazing in both riparian and upland areas degrades runoff quality and adversely alters flow regimes and watershed functions such as soil water storage and nutrient retention.

In addition to these direct impacts, new research shows that managing for livestock can indirectly alter ecosystem trophic cascades. For example, livestock depredation on open range led to programs to extirpate large native carnivores. Reduced numbers of carnivores release native ungulates and other herbivores from predation, leading to declines of riparian vegetation and stream conditions even outside of livestock-grazed areas (Beschta and Ripple 2012). Removing livestock grazing from federal lands has high potential to increase the resilience of watersheds and streams to environmental stresses, including climate change (Beschta et al. 2013, 2014). Measures to reduce the ecological impacts of livestock grazing, primarily by fencing streamside areas and moving cattle frequently from site to site, have met with variable success (Rhodes et al. 1994). Implementation of these methods is limited by the high capital cost of building and maintaining extensive fencing, the wages of field personnel to manage herds, and the cost of necessary environmental review and monitoring. Livestock grazing in forests is a commercial use that is not restorative, and often is marginal economically. We conclude that *livestock grazing should be excluded from Riparian Reserves, Key Watersheds, and other lands where conservation is the primary management objective.*

Chemical Use in Forests. Only very recently has science begun to directly tackle the difficult questions of fate, effects, and toxicity of pesticides and other chemicals associated with forestland uses on stream biota. Toxic contaminants come from various sources, including storm water runoff from roads (particularly those that discharge directly to surface waters pipes and ditches) (McCarthy et al. 2008, Feist et al. 2011). Herbicides are applied to tree plantations and roadsides to control unwanted vegetation. Until recently these activities were limited by court order on BLM and USFS lands, but now they are increasing in extent and frequency, as well as continuing on adjacent private forest lands. The NMFS is reviewing the science concerning potential harm to listed species of Pacific salmon from application of commonly used pesticides. For example, use following label restrictions of the herbicide 2,4-D was determined to jeopardize Pacific salmon (NMFS 2011). Forest fire retardants that are aerially dropped in large quantities during wildfire suppression operations often reach surface waters, where they may be toxic to salmonids (Buhl and Hamilton 1998, Gaikowski et al. 1996).

While the science on toxic chemicals is certainly advancing, we have five interim recommendations based on existing knowledge: 1) *Minimize application of chemicals for forest management purposes in time and space;* for example, hand-application should be favored over aerial application when there is no feasible alternative to pesticide use. 2) *Weigh the full range of environmental trade-offs between the perceived benefits of chemical use and its possible harms in each case before a decision is made to use chemicals in forest management.* 3) *Implement wide, un-thinned forested buffers in Riparian Reserves to help reduce exposure of fish and aquatic life to toxic chemicals.* Thinned or narrow buffers can allow greatly increased aerosol penetration (chemical) from slopes to streams, and narrower buffers may also allow more transport of toxins in runoff. 4) *Reduce road density and the hydrologic connectivity of roads to surface waters to help control toxins* that originate from road use and maintenance, as well as those that are applied up-slope but find their way to streams via surface runoff. 5) *Analyze the possible effects of management actions in affecting the delivery of toxic chemicals to streams in every NEPA document and ESA consultation.*

Climate Change: Consequences and Adaptation. Anticipated climate change will alter the way we expect ecosystems to respond to forest management actions (Dale et al. 2001, Mote et al. 2003). In general for this region, hydrologic model predictions stepped-down from regional and global circulation models project increased stream and lake warming (varying magnitude across the seasons); more intense winter precipitation events, including flood and wind disturbance of riparian forests; earlier snow pack melting except for the highest elevation watersheds; and likely increased intensity and duration of droughts (Battin et al. 2007, Dalton et al. 2013). In very general terms, most climate change scenarios suggest larger and higher severity wildfires than seen in recent decades, and generally elevated evapotranspiration that could further reduce low summer streamflows. Luce and Holden (2009) documented a widespread pattern of declining summer streamflow over recent decades at gauging stations across the Pacific Northwest.

Climate changes will likely exacerbate existing (ongoing) trends in watershed degradation by affecting key processes or factors (stream thermal regimes, surface flows, groundwater and floodplain connectivity, landslide rates, fuels, fire, invasive species, and post disturbance human responses, to name but a few). Most climate change adaptation strategies call for strategic removal of non-climate stressors, because these will likely be more tractable or remediable than climate stressors (ISAB 2007, Furniss et al. 2010). No formal review of the ACS has apparently been conducted by the USFS or BLM to determine what, if any, science-based changes to the ACS best address future climate scenarios. It seems unlikely, however, that even a cursory review of the climate literature would lend support to proposals to remove or diminish currently protective provisions of the ACS.

The current ACS requirements are integral to assuring streams, wetlands, and other water bodies have the best possible resilience in the face of increasing climate stress. Extensive forested north-facing slopes can moderate some climate influence on watersheds, and localized springs, and extensive shallow alluvial aquifers that store water seasonally can moderate summer streamflows and both summer and winter temperatures (Poole and Berman, 2001, Isaak et al. 2010, Wondzell 2011). Complex natural riparian vegetation communities and natural accumulations of large wood (resulting in concentrations of stored sediment) in and near floodplains are instrumental in creating and maintaining conditions that support hyporheic flow exchange. Wide Riparian Reserves provide not only shade, but essential protection and support for the natural processes that maintain and regenerate the suite of hydrologic and geomorphic elements that help buffer streams against climate forcing.

Intact watersheds are often seen to be less vulnerable to storms, floods, droughts, wildfire, and other extreme events, and are expected to be more resilient to future climate change than highly altered watersheds. Streams and rivers affected by reduced alluvial groundwater storage and diminished hyporheic buffering, fragmentation and loss of biological habitat connectivity, and a less intact native biota, are likely to respond more quickly and with greater volatility to climate change, as are engineered systems such as roads and dams. Watershed resilience in the face of climate change can best be maintained by protecting and restoring the suite of natural processes and conditions that characterize natural forested riparian areas and floodplains (Seavy et al. 2009, Furniss et al., 2010). This is exactly what the ACS was originally designed to accomplish. Whittling away riparian protections on the basis of narrowed, single-factor considerations such as proximate stream shade undermines the comprehensive protection of stream and riparian processes that the ACS was designed to maintain and restore. Finally, under changing climate, some management practices that seemed to produce desirable outcomes in the past may not do so in the future. For example, the putative effectiveness of forest thinning at altering fire behavior could become even more uncertain if weather extremes become more of a top-down driver of fire behavior (see Martinson and Omi 2013) in future climates (Dale et al. 2001, Westerling et al. 2006).

Our overall recommendation is that 1) *ACS protections for Riparian Reserves should be sustained and strengthened to better protect and restore natural ecosystem processes that confer resilience to climate change,* as detailed in our other recommendations. In addition, 2) *an interagency scientific conservation design effort is needed to expand and reconfigure some present Key Watersheds to ensure they better encompass specific areas that are likely to be topographic and hydrologic buffers to future climate change impacts.* Finally, we recommend that 3) *the direct and indirect effects of management actions on the integrity and capacity of stream and watershed ecosystems for resilience to climate change be analyzed in every environmental assessment, environmental impact statement, watershed analysis, and ESA consultation.*

Monitoring and Adaptive Management.

Environmental monitoring data often prove to be useful, but we cannot always anticipate how those data will be useful. Monitoring can be especially valuable when coupled with available data from historical records and time series sampling (such as streamflow gauging and temperature recorder data strings) (Wissmar 1993, Wissmar and Beschta 1988). Substantial progress has been made in the past 20 years on sampling design and methods of data collection for monitoring streams, watersheds and regions of watersheds (Steel et al. 2010). Twenty years after FEMAT, there are greatly expanded technological capabilities for spatially explicit data reporting and analysis, and numerous and increasingly robust methods to integrally evaluate considerations of ecological scale, geographical context, spatial and temporal continuity, and biological connectivity in data design and analysis.

The Northwest Forest Plan designated large

Adaptive Management Areas where alternative means of management and conservation might be implemented and closely monitored. For many reasons this option failed. Public involvement was required, but in most cases the public could not agree on the need for trial and testing of specific management hypotheses (Gray 2000). Managers and scientists also sometimes disagreed on hypotheses to test or what practices should be implemented. Lacking coherent large-scale experimental proposals drawing broad social support, funding never materialized. These failures are by no means endemic to the NFP—they characterize many, if not most aspirational attempts at formalized, large-scale adaptive management (Walters 1997).

We note, however, that ongoing management across multiple ownerships and with a multitude of natural background conditions creates a broad array of natural experiments that already exist on the landscape. Scientists can probably continue to learn much of what we need to know by creative monitoring of extant natural experiments. However imperfect they may be, natural experiments are more beneficial than waiting for planned, large-scale experiments that have proven exceedingly difficult to execute (and are almost always far from ideal themselves in terms of design and resources).

The existing monitoring program for aquatic resources in the Northwest Forest Plan area (Aquatic and Riparian Effectiveness Monitoring Program, AREMP, http://www.reo.gov/monitoring/reports/watershed/aremp/aremp.htm) in our view is constrained by certain design and sampling protocols that limit AREMP's capacity for drawing inferences about changes in habitat condition, living system condition, and biophysical processes over time. Whereas AREMP is intended by design to detect trends in some riparian or stream conditions over large areas, interpreting causal relations for responses requires information about changes in physical conditions and biota at specific locations over time. Further, AREMP design is based on delineated hydrologic units some of which do not represent hydrographically complete watersheds; this confounds identifying linkages between watershed condition and stream biotic and physical responses (Omernik 2003). Considering the scope of natural and man-caused variability in the field, Anlauf et al. (2011) suggested that AREMP incorporates a statistically insufficient number of sites to yield useful confidence intervals needed for reliable assessments of many measures of stream condition.

Effectiveness monitoring generally fails when the design or data preclude process or cause-effect inferences, or when assumed fundamental relationships between habitat indices and biological populations and assemblages remain untested. Outside of the specific confines of AREMP, some useful new understanding has emerged from regionally extensive monitoring programs on federal lands in the Pacific Northwest (e.g., Hough-Snee et al. 2014, Meredith et al. 2014). In our view, these studies, far more specifically than AREMP, focus on iterative explicit hypotheses about cause-and-effect relations to inform the query and analysis of field survey data

We recommend three policy shifts in how monitoring is employed under the ACS. First, as a standard management practice, require *some form of effectiveness monitoring and expert review of stream and watershed responses for every forestry, range, mining, recreation development, or active management project.* Every project that could potentially affect watershed and stream conditions should integrally include collection of a field data set that sheds some light on key post-project biophysical conditions influenced by the project. Agency actions should help to increase the certainty of outcomes at particular sites. Agencies should first engage experts that could check collective awareness of the reliability of conventional assumptions about the effects of management actions. Expert's perspectives would and increase the likelihood of the agencies identifying unanticipated outcomes that warrant broader study and management consideration. Expert review of project outcomes is needed to discourage the institutional habitat of assuming *a priori* that project outcomes are more certain and unequivocally beneficial than they often are.

Secondly, agencies should review existing programs of comprehensive regional and watershed-scale effectiveness monitoring programs, and develop comprehensive monitoring strategies to optimize return on the capital investment in monitoring. *We call for an interagency scientific panel to review the status and effectiveness of trend monitoring efforts, and identify data sets that could be useful in drawing inferences for improved monitoring programs.* New monitoring programs should be capable of assessing the effects of management actions and climate change on aquatic ecosystems and biological resources associated with BLM and USFS lands. They should be robust to both anticipated and unanticipated environmental changes.

Third, agency-driven improvements in monitoring programs should include *increased emphasis on tracking ecological conditions, including explicit biological condition measures, and the ability to establish with some certainty that trends in Key Watersheds result from specific management actions or choices (which may include deferral of active management).* Key Watersheds are especially critical for the medium- and long-term conservation success of the ACS, and may be disproportionately important to the survival and recovery of ESA-listed and other sensitive species. The special need to focus sustained time-trend effectiveness monitoring in Key Watersheds again raises the concern that re-delineation of Key Watersheds with each new piece of legislation or management planning cycle could disrupt long-term monitoring efforts. Pursuant to our third recommendation, we also recommend that agencies retain some degree of flexibility in allocation of monitoring resources to allow for occasional more directed and intensive investigation where assessments indicate that surprising and ecologically important outcomes have occurred.

CONCLUSIONS

In this report we examine selected new and emerging science that is relevant to the future of the ACS, and touch on concepts that should be integral to whatever might replace the ACS in the future. We believe more exhaustive consideration of the topics we raised--and a broadened consideration of others, including the functions of riparian and watershed reserves for conservation of terrestrial wildlife species--will only strengthen our conclusion that the founding rationale, basic architecture, and core conservation elements of the ACS remain sound. We also maintain that some specific improvements in ACS protection and conservation provisions are warranted.

New science raises many concerns about the adequacy of implementation of the ACS by the federal agencies. These issues include including post-fire and other logging after disturbances, logging and fuels treatments in riparian areas, the degree of riparian protection for headwater streams, the adequacy of past efforts for road system downsizing and remediation, the adequacy of conservation priorities for and delineations of Key Watersheds, the effectiveness of grazing management, and whether current monitoring is as useful as it should be.

This report raises concerns about anticipated climate change. While climate change does not fundamentally alter the basic facts of good conservation and responsible management, it both theoretically and materially raises the level of concern about many specific management issues, including the potential effectiveness of restoration actions, the effectiveness of riparian areas as stream buffers, and implications for the burden of proof for management actions that balance known environmental problems against presumed restorative benefits. Most watersheds in the region are of mixed federal and other ownership. Because progress in protection and restoration on private lands has been limited (Stout et al. 2012), federal lands will likely continue to be the focus of watershed protection and aquatic habitat conservation, and related climate change initiatives for the foreseeable future.

Finally, an improved monitoring program will be necessary to ascertain that conservation of aquatic ecosystems and resources is in fact occurring, especially in the face of increasing physical and biotic stresses imposed by changing climate and human population growth. It will be of continued or increasing importance to evaluate the degree to which Riparian Reserves can serve as effective buffers against the cumulative effects of logging, roads, and other disturbances on forest lands catchment-wide. This question has assumed greater importance as research in disturbed ecosystems worldwide has demonstrated that watershed condition can sometimes affect fish assemblages more strongly than does riparian condition (Roth et al. 1996; Wang et al. 2003; 2006; Sály et al. 2011; Marzin et al. 2012).

We conclude that attempts to reduce protections to watershed, riparian, and freshwater ecosystems by weakening major components of the ACS and other related conservation elements of the Northwest Forest Plan are not justified by new and emerging science. Improved ecosystem protections--and better monitoring of outcomes--are warranted across all land ownerships, including federal forest lands, if freshwater ecosystems and their biota, including salmon and other sensitive species are to be effectively conserved in an era of increased ecological stress and changing climate.

LITERATURE CITED

Al-Chokhachy, R., B.B. Roper, and E.K. Archer. 2010. Evaluating the status and trends of physical stream habitat in headwater streams within the interior Columbia River and upper Missouri River Basins using an index approach. *Transactions of the American Fisheries Society* 139:1041-1059.

Anlauf, K.J., W. Gaeuman, and K.K. Jones. 2011. Detection of regional trends in salmonid habitat in coastal streams, Oregon. *Transactions of the American Fisheries Society* 140:52-66.

Battin, J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. *Proceedings of the National Academy of Sciences of the United States of America* 104:6720–6725.

Baxter, C.V. and F.R. Hauer. 2000. Geomorphology, hyporheic exchange, and selection of spawning habitat by bull trout (Salvelinus confluentus). *Canadian Journal of Fisheries and Aquatic Sciences* 57: 1470-1481.

Benda, L., D. Miller,., P. Bigelow, , and K. Andras, 2003. Effects of post-wildfire erosion on channel environments, Boise River, Idaho. *Forest Ecology and Management*, 178(1):105-119.

Beschta, R.L., J.J. Rhodes, J.B. Kauffman, R.E. Gresswell, G.W. Minshall, J.R. Karr, D.A. Perry, F.R. Hauer, and C.A. Frissell. 2004. Postfire management on forested public lands of the Western United States. *Conservation Biology* 18: 957–967.

Beschta, R.L., D.L. Donahue, D.A. DellaSala, J.J. Rhodes, J.R. Karr, M.H. O'Brien, T.L. Fleischer, and C. Deacon-Williams. 2013. Adapting to climate change on western public lands: Addressing the ecological effects of domestic, wild, and feral ungulates. *Environmental Management* 51:474–491.

Beschta, R.L., D.L. Donahue, D.A. DellaSala, J.J. Rhodes, J.R. Karr, M.H. O'Brien, T.L. Fleischer, and C. Deacon-Williams. 2014. Reducing livestock effects on public lands in the western United States as climate changes: A reply to Svejcar et al. *Environmental Management*, in press.

Beschta, R.L. and W.J. Ripple. 2012 The role of large predators in maintaining riparian plant communities and river morphology. *Geomorphology* 157-158: 88-98.

Black, S.H., D. Kulakowski, B.R. Noon, and D. DellaSala. 2013. Do bark beetle outbreaks increase wildfire risks in the Central U.S. Rocky Mountains: Implications from recent research? *Natural Areas Journal* 33:59-65.

Blair, M.S. 1994. Oregon coastal lake study: Phosphorus loading and water quality implications. M.S. Thesis, Oregon State University, Corvallis, OR. 114 pp.

BLM (Bureau of Land Management). 2008. Final Environmental Impact Statement for the Revision of the Resource Management Plans of the Western Oregon Bureau of Land Management Districts. Portland, OR. Available online at http://www.blm.gov/or/plans/wopr/final_eis/

Blumm, M.C., and T. Wigington. 2013. The Oregon and California Railroad Grant Lands' sordid past, contentious present, and uncertain future: a century of conflict. *40 Boston College Envvironmental Affairs Law Review* 40:1 (2013). http://lawdigitalcommons.bc.edu/ealr/vol40/iss1/2/

Brummer, C.J., T.B. Abbe, , J.R. Sampson, , and D.R. Montgomery, 2006. Influence of vertical channel change associated with wood accumulations on delineating channel migration zones, Washington, USA. *Geomorphology* 803:295-309.

Bryce, S.A., G.A. Lomnicky, and P.R. Kaufmann. 2010. Protecting sediment-sensitive aquatic species in mountain streams through the application of biologically based streambed sediment criteria. *Journal of the North American Benthological Society* 29:657-672.

Buhl, K.J. and S.J. Hamilton. 1998. Acute toxicity of fire-retardant and foam-suppressant chemicals to early life stages of Chinook salmon (*Oncorhynchus tshawytscha*). Environmental Toxicology and Chemistry 17(8):1589-1599.

Burnett, K. M., G.H. Reeves, D.J. Miller, S. Clarke, K. Vance-Borland, and K. Christiansen. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. *Ecological Applications* 17(1), 66-80.

Carnefix, G. and C. A. Frissell. 2009. Aquatic and other environmental impacts of roads: The case for road density as indicator of human disturbance and road-density reduction as restoration target, a concise review. Pacific Rivers Council Science Publication 09-001. Pacific Rivers Council, Portland, OR and Polson, MT. http://pacificrivers.org/science-research/resources-publications/road-density-as-indicator/download

Carpenter, S.R., N.F. Caraco, D.L. Correll, R.W. Howarth, A.N. Sharpley, and V.H. Smith. 1998. Nonpoint pollution of surface waters with phosphorus and nitrogen. *Ecological Applications* 8:559–568. http://dx.doi.org/10.1890/1051-0761(1998)008[0559:NPOSWW]2.0.CO;2

Cover, M.R., C.L. May, W.E. Dietrich, and V.H. Resh. 2008. Quantitative linkages among sediment supply, streambed fine sediment, and benthic macroinvertebrates in northern California streams. *Journal of the North American Benthological Society* 27(1):35-149. http://csmres.jmu.edu/geollab/May/Web/Research/Reprints/cover%20et%20al%202008%20jnabs.pdf

Daggett, S.G., A.H. Vogel, and R.R. Petersen. 1996. Eutrophication of Mercer, Munsel, and Woahink Lakes, Oregon. *Northwest Science* 70 (Special Issue 2):28-38.

Dale, V.H., L.A. Joyce, , S. McNulty, , R.P. Neilson, , M.P. Ayres, , M.D. Flannigan, , ... and M.B. . Wotton. 2001. Climate Change and Forest Disturbances: Climate change can affect forests by altering the frequency, intensity, duration, and timing of fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, or landslides. *BioScience* 51(9):723-734.

Dalton, M.M., P.W. Mote, and A.K. Snover. 2013. *Climate Change in the Northwest Implications for Our Landscapes, Waters, and Communities*. Island Press, Washington DC. 271 pp.

DellaSala, D.A. 2013. Ecological Importance of Bureau of Land Management O&C and Coos Bay Wagon Road Holdings in Western Oregon with Special Attention to Surface Water Source Areas. Geos Institute, Ashland, OR, 19 pp.

DellaSala, D. A., R.G. Anthony, M.L. Bond, Monica, E.S. Fernandez, C.A. Frissell, Chris, C.T. Hanson, and R. Spivak. 2014. Alternative Views of a Restoration Framework for Federal Forests in the Pacific Northwest. *Journal of Forestry* 111(6):420-429.

DellaSala, D.A. and J. Williams. 2006. Northwest Forest Plan ten years later – how far have we come and where are we going. *Conservation Biology* 20:274-276.

DellaSala, D.A., J.R. Karr, and D.M. Olson. 2011. Roadless areas and clean water. *Journal of Soil and Water Conservation* 66:78A-84A.

Donato, D.C., J.B. Fontaine, J.L. Campbell, W.D. Robinson, J.B. Kauffman, and B.E. Law. 2006. Post-wildfire logging hinders regeneration and increases fire risk. Science 311: 352.

Dwire, K.A, C.C. Rhoades, and M.K. Young. 2010. Potential effects of fuel management activities on riparian areas. pp. 175–205 In W.J. Elliot et al., (eds.), Cumulative watershed effects of fuel management in the western United States. USDA Forest Service General Technical Report RMRS-GTR-231, Rocky Mountain Research Station, Ft. Collins, CO. ftp://frap.fire.ca.gov/pub/incoming/TAC/Contractor%20final%20lit%20review%20docs/lit%20review_water/Dwire%202006.pdf

Ebersole, J.L., W.J. Liss, and C.A. Frissell. 2003. Cold water patches in warm streams: Physicochemical characteristics and the influence of shading. *Journal of the American Water Resources Association* 39:355-368. (Published online 8 June 2007).

Espinosa, Jr., F.A., J.J. Rhodes, and D.A. McCullough. 1997. The failure of existing plans to protect salmon habitat in the Clearwater National Forest in Idaho. *Journal of Environmental Management* 49(2): 205-230.

Estes, J.A. 2011. Trophic downgrading of planet Earth. *Science* 333. 15 July 2011

Everest, F.H. and G.H. Reeves. 2006. Riparian and aquatic habitats of the Pacific Northwest and southeast Alaska: ecology, management history, and potential management strategies. Gen. Tech. Rep. PNW-GTR-692. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 130 p.

Fausch, K.D., C.E. Torgersen, C.V. Baxter, and H.W. Li. 2000. Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. *BioScience* 52(6):1-16.

Feist, B.E., E.R. Buhle, P. Arnold, J.W. Davis, and N.L. Scholz. 2011. Landscape ecotoxicology of coho salmon spawner mortality in urban streams. *PLoS ONE* 6(8): e23424. doi:10.1371/journal.pone.0023424. http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0023424

FEMAT (Forest Ecosystem Management and Assessment Team). 1993. Forest Ecosystem Management: An ecological, economic and social assessment. USDA Forest Service, BLM, USFWS, NOAA, EPA and National Park Service, Portland, Oregon. 1039 p.

Firman, J.C., E.A. Steel, D.W. Jensen, K.M. Burnett, K. Christiansen, B.E. Feist, Blake E., D.P. Larsen, and K. Anlauf. 2011. Landscape models of adult coho salmon density examined at four spatial extents. *Transactions of the American Fisheries Society* 140:440-455.

Freeman, M.C., C.M. Pringle, and C.R. Jackson. 2007. Hydrologic connectivity and the contribution of stream headwaters to ecological integrity and regional scales. *Journal of the American Water Resources Association* 43(1):5-14. DOI: 10.1111/j.1752-1688.2007.00002.x. http://www.energy.vt.edu/ncepstudy/pub/nature/regionalscaleinfluence.pdf

Frissell, C.A. and D. Bayles. 1996. Ecosystem management and the conservation of aquatic biodiversity and ecological integrity. *Water Resources Bulletin* 32:229-240.

Furniss, M.J., B.P. Stabb, S. Hazelhurst, C.F. Clifton, K.B. Roby, B.L. Ilhadrt, E.B. Larry, A.H. Todd, L.M. Reid, S.J. Hines, K.A. Bennett, C.H. Luce, and P.J. Edwards. 2010. Water, climate change, and forests: watershed stewardship for a changing climate. USDA Forest Service General Technical Report PNW-GTR-812, Portland, Oregon, 75pp. http://www.fs.fed.us/pnw/pubs/pnw_gtr812.pdf

Franklin, J.F. and K.N. Johnson. 2012. A restoration framework for federal forests in the Pacific Northwest. *Journal of Forestry* 110: 429-439.

Frissell, C.A. and R.K. Nawa. 1992. Incidence and causes of failure of artificial habitat structures in streams of western Oregon and Washington. *North American Journal of Fisheries Management* 12:182-197.

Gaikowski, M.P., S.J. Hamilton, K.J. Buhl, S.F. McDonald, and C.H Summers. 1996. Acute toxicity of three fire-retardant and two fire-suppressant foam formulations to the early life stages of rainbow trout (*Oncorhynchus mykiss*). *Environmental Toxicology and Chemistry* 15(8):1365-1374.

Gallo, K., S.H. Lanigan, P. Eldred, S.N. Gordon, and C. Moyer. 2005. Northwest Forest Plan—the first 10 years (1994–2003): Preliminary assessment of the condition of watersheds. Gen. Tech. Rep. PNW-GTR-647. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 133 p.

GAO (Government Accountability Office). 1999. Ecosystem Planning: Northwest Forest and Interior Columbia River Basin Plans Demonstrate Improvements in Land-Use Planning (Letter Report, 05/26/99, GAO/RCED-99-64). http://www.gpo.gov/fdsys/pkg/GAOREPORTS-RCED-99-64/html/GAOREPORTS-RCED-99-64.htm

Gomi, T., R.C. Sidel, and J.S. Richardson. 2002. Understanding processes and downstream linkages of headwater streams. *BioScience*52:905-916.

Gray, A.N. 2000. Adaptive ecosystem management in the Pacific Northwest: a case study from coastal Oregon. *Conservation Ecology* 4(2):6. [online] http://www.consecol.org/vol4/iss2/art6/

Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. *Transactions of the American Fisheries Association* 128:193–221.

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes. 2001. Forest roads: a synthesis of scientific information. Gen. Tech. Rep. PNWGTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. http://www.fs.fed.us/pnw/pubs/gtr509.pdf

Hicks B.J., R.L. Beschta, and R.D. Harr. 1991. Long-term changes in streamflow following logging in western Oregon and associated fisheries implications. *Water Resources Bulletin* 27(2): 217- 226.

Hough-Snee, N., A. Kasprak, B.B. Roper, and C.S. Meredith. 2014. Direct and indirect drivers of instream wood in the interior Pacific Northwest, USA: decoupling climate, vegetation, disturbance, and geomorphic setting. *Riparian Ecology and Conservation* 2(1): 2299-1042. DOI: 10.2478/remc-2014-0002

Houlahan, J.E. and C.S. Findlay. 2003. The effects of adjacent land use on wetland amphibian species richness and community composition. *Canadian Journal of Fisheries and Aquatic Sciences* 60: 1078–1094

Hughes, R.M, S. Howlin, and P.R. Kaufmann. 2004. A biointegrity index for coldwater streams of western Oregon and Washington. *Transactions of the American Fisheries Society* 133:1497-1515.

ISAB. (Independent Scientific Advisory Board). 2007. Climate change impacts on Columbia River basin fish and wildlife. Northwest Power and Conservation council, Portland, OR. 136 pp. http://www.nwcouncil.org/media/31247/isab2007_2.pdf

Issak, D.J., C.H. Luce, B.E. Rieman, D.E. Nagel, E.E. Peterson, D.L. Horan, S. Parkes, and G.L. Chandler. 2010. Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network. *Ecological Applications* 20:1350–1371.

Johnson, K.N. 2010. Water, climate change, and forests: watershed stewardship for a changing climate. USDA Forest Service General Technical Report PNW-GTR-812. Portland, Oregon, 75pp. http://www.fs.fed.us/pnw/pubs/pnw_gtr812.pdf

Johnson, K.N. and J.F. Franklin. 2012. Increasing Timber Harvest Levels on the BLM O&C Lands While Maintaining Environmental Values (Revised). Testimony before the Senate Committee on Energy and Natural Resources , June 25, 2013. Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR. Online at http://fes.forestry.oregonstate.edu/sites/fes.forestry.oregonstate.edu/files/PDFs/Johnson_June%202013.pdf

Jones, J.A., F. J. Swanson, B.C. Wemple, and K.U. Snyder. 2000. Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks. *Conservation Biology* 14:76-85.

Karr, J.R., J.J. Rhodes, G.W. Minshall, F.R. Hauer, R.L. Beschta, C.A. Frissell, and D.A. Perry. 2004. The effects of postfire salvage logging on aquatic ecosystems in the American West. *BioScience*54:1029-1033.

Kauffman, J.B., R.L. Beschta, N. Otting, and D. Lytje. 1997. An ecological perspective of riparian and stream restoration in the western United States. *Fisheries* 22(5):12-24.

Kaufmann, P.R. and R.M. Hughes. 2006. Geomorphic and anthropogenic influences on fish and amphibians in Pacific Northwest coastal streams. pp. 429-455. In R.M. Hughes, L. Wang, and P.W. Seelbach (eds.). *Landscape influences on stream habitat and biological assemblages*. American Fisheries Society, Symposium 48.

Klein, R.D., J. Lewis, and M.S. Bufflben. 2012. Logging and turbidity in the coastal watersheds of northern California. *Geomorphology* 139-140:136-144. http://www.sciencedirect.com/science/article/pii/S0169555X11005277

Kubin, E. 2006. Leaching of nitrogen from upland forest-regeneration sites into wetland areas. Pp. 87-94 In Krecek, J. and M. Haigh (eds.) *Environmental Role of Wetlands in Headwaters*. Springer, The Netherlands.

Labbe T.R. and K.D. Fausch. 2000. Dynamics of intermittent stream habitat regulate persistence of a threatened fish at multiple scales. *Ecological Applications* 10: 1774–1791.

Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams, and others. 1997. Broadscale assessment of aquatic species and habitats. Pp. 1057-1496 in S.J. Arbelbide (editor). An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins: Vol. III. USDA Forest Service General Technical Report PNW-GTR-405.

Lindenmayer, D.B., D.R. Foster, , J.F. Franklin, , M.L Hunter,., R.F. Noss,., F.A. Schmiegelow, , and D. Perry, 2004. Salvage harvesting policies after natural disturbance. *Science (Washington)* 303(5662):303.

Lindenmayer, D.B. and R.F. Noss. 2006. Salvage logging, ecosystem processes, and biodiversity conservation. *Conservation Biology* 20(4): 949–958.

Lowe, W.H. and G.E. Likens. 2005. Moving headwater streams to the head of the class. *BioScience* 55:196-197.

Luce, C.H., B.E. Rieman, J.L. Dunham, J.G. King, & T.A. Black, 2001. Incorporating aquatic ecology into decisions on prioritization of road decommissioning. Water Resources Impact 3(3):8-14.

Luce, C.H. and Z.A. Holden. 2009. Declining annual streamflow distributions in the Pacific Northwest United States, 1948–2006. *Geophysical Research Letters* 36, L16401, doi:10.1029/2009GL039407, 2009.

Lydersen, J.M., M.P. North, and B.M. Collins. 2014. Severity of an uncharacteristically large wildfire, the Rim Fire, in forests with relatively restored frequent fire regimes. Forest Ecology and Management 328:326-334. DOI:10.1016/j. Foreco.2014.06.005.

Malison, R.L. and C.V. Baxter. 2010. The “fire pulse:” wildfire stimulates flux of aquatic prey to terrestrial habitats driving increases in riparian consumers. *Canadian Journal of Fisheries and Aquatic Sciences* 67(3):570-579.

Martinson, E.J. and P.N. Omi. 2013. Fuels treatments and fire severity: A meta-analysis. Research Paper RMRS-RP-103WWW. USDA Forest Service, Fort Collins, CO. 38 pp. http://www.fs.fed.us/rm/pubs/rmrs_rp103.pdf

Marzin, A.P., P. Verdonschot, and D. Pont. 2012. The relative influence of catchment, riparian corridor and local anthropogenic pressures on fish and macroinvertebrate assemblages in French rivers. *Hydrobiologia* 704: 375–388.

McCarthy S.G., J.P. Incardona, and N.L. Scholz. 2008. Coastal storms, toxic runoff, and the sustainable conservation of fish and fisheries. American Fisheries Society Symposium 64:1-21.

McCullough, D.A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to Chinook salmon. EPA 910-R-99-010. Prepared for the United States Environmental Protection Agency, Region 10, Seattle, Washington. 279 p.

Meredith, C., B. Roper, and E. Archer. 2014. Reductions in instream wood in streams near roads in the interior Columbia River Basin. *North American Journal of Fisheries Management* 34(3):493-506.

Minshall, W. 2003. Responses of stream benthic macroinvertebrates to fire. *Forest Ecology and Management* 178:155-161.

Minshall, G.W., C.T. Robinson, and D.E. Lawrence. 1997. Postfire response of lotic ecosystems in Yellowstone National Park U.S.A. *Canadian Journal of Fisheries and Aquatic Sciences* 54:2509-2525.

Montgomery, D.R. 1995. Input- and output-oriented approaches to implementing ecosystem management. *Environmental Management* 19(2): 183-188.

Montgomery, D.R., G.E. Grant, and K. Sullivan. 1995. Watershed analysis as a framework for implementing ecosystem management. *Water Resources Bulletin* 31(9):369-386.

Moore, R.D. and S.M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: A review. *Journal of the American Water Resources Association* 41(4):763-784. DOI: 10.1111/j.1752-1688.2005.tb03770.x

Mote, P.W., E.A. Parson, A.F. Hamlet, W.S. Keeton, D. Lettenmaier, N. Mantua, E.L. Miles, D.W. Peterson, D.L. Peterson, R. Slaughter, and A.K. Snover. 2003. Preparing for climatic change: the water, salmon, and forests of the Pacific Northwest. *Climatic Change* 61: 45–88.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management* 16(4):693-719

NMFS (National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Pacific Northwest Region, Seattle, WA. 472 pp. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/puget_sound/chinook/pugetsoundchinookrecoveryplan.pdf

NMFS (National Marine Fisheries Service). 2011. Biological Opinion: Environmental Protection Agency Registration of Pesticides 2,4-D, Triclopyr BEE, Diuron, Linuron, Captan, and Chlorothalonil. June 30, 2011. 970 pp. + appendices. http://www.nmfs.noaa.gov/pr/pdfs/consultations/pesticide_opinion4.pdf

NMFS (National Marine Fisheries Service). 2012. Recovery Plan Volume 1 for the Southern Oregon Northern California Coast Evolutionarily Significant Unit of coho salmon (*Oncorhynchus kisutch*). Southwest Regional Office, Arcata, CA. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/southern_oregon_northern_california/soncc_plan_draft_2012_entire.pdf

NOAA-NMFS and USFWS (National Marine Fisheries Service and US Fish and Widllife Service). 2006a. Final Environmental Impact Statement for the Proposed Issuance of Multiple Species Incidental Take Permits or 4(d) Rules for the Washington State Forests Habitat Conservation Plan (January 2006).

NOAA-NMFS and USFWS (National Marine Fisheries Service and US Fish and Widllife Service). 2006b. Endangered Species Act Section 7 Consultation Biological Opinion and Section 10 Statement of Findings And Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation (June 5, 2006). 337 pp.

Noss, R.F., J.F. Franklin, W.L. Baker, T. Schoennagel, and P.B. Moyle. 2006. Managing fire-prone forests in the western United States. Frontiers in Ecology and the Environment 4:481-487.

Olson, D.H., P.D. Anderson, C.A. Frissell, H.H. Welsh, Jr., and D.F. Bradford. 2007. Biodiversity management approaches for stream-riparian areas: perspectives for Pacific Northwest headwater forests, microclimates, and amphibians. *Forest Ecology and Management* 246(1):81-107.

Omernik, J.M. 2003. The misuse of hydrologic unit maps for extrapolation, reporting and ecosystem management. *Journal of the American Water Resources Association* 39:563–573.

Oregon DEQ. 1994. Coquille River and estuary water quality report, Total Maximum Daily Load program. Oregon Department of Environmental Quality. Portland, OR. 48pp. http://www.deq.state.or.us/wq/tmdls/docs/southcoastbasin/coquille/CoquilleRiverTMDL.pdf

Oregon DEQ. 2007. Tenmile Lakes Watershed Total Maximum Daily Load (TMDL). Oregon Department of Environmental Quality. Portland, OR. 167 pp. http://www.deq.state.or.us/wq/tmdls/docs/southcoastbasin/tenmile/tmdl.pdf

Pacific Rivers Council. 2008. Comments on BLM WOPR DEIS. Portland, Oregon. [Jan. 11, 2008]. http://pacificrivers.org/conservation-priorities/land-management/federal-forest-planning/western-oregon-plan-revisions/prcs-comprehensive-comments-on-the-draft-eis

Pacific Rivers Council (Wright, B. and C. Frissell). 2010. Roads and rivers II: An assessment of national forest roads analyses. Report for the Pacific Rivers Council, Portland, OR. [online] http://pacificrivers.org/science-research/resources-publications/roads-and-rivers-ii/download

Pollock, M.M. and T.J. Beechie. 2014. Does riparian forest thinning enhance biodiversity? The ecological importance of large wood. *Journal of the American Water Resources Association* 50(3):543-559. DOI: 10.1111/jawr.12206

Pollock, M.M., T.J. Beechie, M. Liermann, and R.E. Bigley. 2009. Stream temperature relationships to forest harvest in western Washington. *Journal of the American Water Resources Association* 45(1):141-156.

Pollock, M.M., T.J. Beechie, and H. Imaki. 2012. Using reference conditions in ecosystem restoration: an example for riparian conifer forests in the Pacific Northwest. *Ecosphere* 3(11) Article 98: 1-23. http://dx.doi.org/10.1890/ES12-00175.1

Poole, G.C. and C.H. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. *Environmental Management* 27(6):787–802.

Poole, G.C., S.J. O'Daniel, K.L. Jones, W.W. Woessner, E.S. Bernhardt, A.M. Helton, J.A. Stanford, B.R. Boer, and T.J. Beechie. 2008. Hydrologic spiralling: the role of multiple interactive flow paths in stream ecosystems. *River Research and Applications* 24(7):1018-1031.

Rashin, E.B., C.J. Clishe, A.T. Loch, and J.M. Bell. 2006. Effectiveness of timber harvest practices for controlling sediment. *Journal of the American Water Resources Association* 42:1307-1347.

Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionarily significant units of anadromous salmonids in the Pacific Northwest. *In* J. Nielsen (editor), Proceedings of the American Fisheries Society Symposium on Evolution and the Aquatic Ecosystem, Bethesda, Maryland. Pp. 334–349.

Reeves, G.H., J.E. Williams, K. Gallo, and K.M. Burnett. 2006a. The aquatic conservation strategy of the Northwest Forest Plan. *Conservation Biology* 20: 319-329.

Reeves, G.H, P.A. Bisson, B.E. Reiman, and L.E. Benda. 2006b. Postfire logging in riparian areas. *Conservation Biology* 20:994-1004.

Reeves, G.H., B.R. Pickard, and K.N. Johnson. 2013. Alternative Riparian Buffer Strategies for Matrix Lands of BLM Western Oregon Forests that Maintain Aquatic Ecosystem Values. REVIEW DRAFT. January 23, 2013.

Reid, L.M., N.J. Dewey, T.E. Lisle, and S. Hilton. 2010. The incidence and role of gullies after logging in a coastal redwood forest. *Geomorphology* 117: 155-169. [online] http://naldc.nal.usda.gov/download/40745/PDF

Reid, L.M. and S. Hilton. 1998. Buffering the buffer. In: Proceedings of the Conference on Coastal Watersheds: The Caspar Creek Story. U.S.D.A. Forest Service, Pacific Southwest Forest and Range Experiment Station, Redwood Sciences Lab, Arcata, CA. http://www.fs.fed.us/psw/publications/documents/gtr-168/08reid.pdf

Rhodes, J.J. and W.L. Baker. 2008. Fire probability, fuel treatment effectiveness and ecological trade-offs in western U.S. public forests. *The Open Forest Science Journal* 1:1-7.

Rhodes, J.J., D.A. McCullough, and F.A. Espinosa. 1994. A coarse screening process for evaluation of the effects of land management activities on salmon spawning and rearing habitat in ESA consultations. Columbia River Inter-Tribal Fish Commission, Technical Report 94-4. Portland, OR. 245pp.

Roni, P., K. Hanson, and T. Beechie, 2008. Global review of the physical and biological effectiveness of stream habitat rehabilitation techniques. *North American Journal of Fisheries Management*, 28(3):856-890.

Roth, N.E., J.D. Allan, and D.L. Erickson. 1996. Landscape influences on stream biotic integrity assessed at multiple spatial scales. *Landscape Ecology* 11:141–156.

Sály, P., P. Takács, I. Kiss, P. Bíró and T. Erós. 2011. The relative influence of spatial context and catchment- and site-scale environmental factors on stream fish assemblages in a human-modified landscape. *Ecology of Freshwater Fish* 20: 251–262.

Seavy, N.E., T. Gardali, G.H. Golet, F.T. Griggs, C.A. Howell, R. Kelsey, S.L. Small, J.H. Viers, J. F. Weigand. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. *Ecological Restoration* 27(3): 330-338. http://er.uwpress.org/content/27/3/330.full.pdf+html

Sedell, J.R., P.A. Bisson, , F.J. Swanson, , and S.V. Gregory, (1988).What we know about large trees that fall into streams and rivers. Pp. 83-112 In *From the forest to the sea, a story of fallen trees*, Maser, C., Tarrant, R.F., Trappe, J.M., and Franklin, J.F., tech eds. USDA Forest Service General Technical Report GTR-PNW-229, Pacific Northwest Res. Sta., Portland, OR. http://andrewsforest.oregonstate.edu/pubs/pdf/pub871.pdf

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Funded jointly by the U.S. EPA, U.S. Fish and Wildlife Service and National Marine Fisheries Service. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR.

Spies, T., M. Pollock, G. Reeves, and T. Beechie. 2013. Effects of riparian thinning on wood recruitment: A scientific synthesis. Science Review Team, Wood Recruitment Subgroup, Forestry Sciences Laboratory, Corvallis, OR, and Northwest Fisheries Science Center, Seattle, WA. 28 January 2013. 46pp. http://www.mediate.com/DSConsulting/docs/FINAL%20wood%20recruitment%20document.pdf

Steel, E.A., R.M. Hughes, A.H. Fullerton, S. Schmutz, J.A. Young, M. Fukushima, S. Muhar, M. Poppe, B.E. Feist, and C. Trautwein. 2010. Are we meeting the challenges of landscape-scale riverine research? A review. *Living Reviews in Landscape Research* 4(2010):1. http://www.livingreviews.org/lrlr-2010-1.

Stout, H.A., P.W. Lawson, D.L. Bottom, T.D. Cooney, M.J. Ford, C.E. Jordan, R.G. Kope, L.M. Kruzic, G.R. Pess, G.H. Reeves, M.D. Scheuerell, T.C. Wainwright, R.S. Waples, E. Ward, L.A. Weitkamp, J.G. Williams, and T.H. Williams. 2012. Scientific conclusions of the status review for Oregon coast coho salmon (*Oncorhynchus kisutch*). U.S. Dept. Commerce, NOAA Tech. Memo.NMFS-NWFSC-118, 242 p.

Sweeney, B.W. and J.D. Newbold, 2014. Streamside Forest Buffer Width Needed to Protect Stream Water Quality, Habitat, and Organisms: A Literature Review. *Journal of the American Water Resources Association* (JAWRA):560-584.

Thompson, W.L. and D.C. Lee. 2000. Modeling relationships between landscape-level attributes and snorkel counts of chinook salmon and steelhead parr in Idaho. *Canadian Journal of Fisheries and Aquatic Sciences* 57:1834–1842. doi:10.1139/cjfas-57-9-1834

Torgersen, C.E., Price, D.M., Li, H.W., and McIntosh, B.A. 1999. Multiscale thermal refugia and stream habitat associations of chinook salmon in northeastern Oregon. *Ecological Applications*, 9(1):301-319.

Torgersen, C.E., J.L. Ebersole, and D.M. Keenan. 2012. Primer for Identifying Cold-Water Refuges to Protect and Restore Thermal Diversity in Riverine Landscapes. EPA 910-C-12-001, U.S. Environmental Protection Agency, Seattle, Washington. p. 91.

Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14:18-30.

USDA/USDI 1994. ROD (Northwest Forest Plan Record of Decision). FSEIS and ROD for the Amendment of Planning Documents and Management of Habitat for Late-Successional Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR. http://www.blm.gov/or/plans/NFPnepa/FSEIS-1994/NFPTitl.htm

USDA Forest Service Pacific Northwest Region. 2008. Aquatic and Riparian Conservation Strategy (ARCS), August 13, 2008. 31 pp.

USFWS (USDI Fish and Wildlife Service). 1999. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Bull Trout in the Conterminous United States. Final Rule. Federal Register 64:58909-58933.

Walters, C. 1997. Challenges in adaptive management of riparian and coastal ecosystems. *Conservation Ecology* 1(2):1. [online] http://www.consecol.org/vol1/iss2/art1/

Wang, L.Z., J. Lyons, P. Rasmussen, P. Seelbach, T. Simon, M. Wiley, P. Kanehl, E. Baker, S. Niemela, and P.M. Stewart. 2003. Watershed, reach, and riparian influences on stream fish assemblages in the Northern Lakes and Forest Ecoregion, USA. Canadian Journal of Fisheries and Aquatic Sciences 60: 491–505.

Wang, L., P.W. Seelbach, and J. Lyons. 2006. Effects of levels of human disturbance on the influence of catchment, riparian, and reach-scale factors on fish assemblages. Pages 199–219 In R.M. Hughes, L. Wang, and P.W. Seelbach, editors. Landscape influences on stream habitats and biological assemblages. American Fisheries Society Symposium 48, Bethesda, Maryland.

WDNR (Washington Department of Natural Resources). 2005. Forest Practices Habitat Conservation Plan. Olympia, WA. http://www.dnr.wa.gov/businesspermits/topics/forestpracticeshcp/pages/fp_hcp.aspx

Wemple, B.C. and J.A. Jones. 2003. Runoff production on forest roads in a steep, mountain catchment. *Water Resources Research* 39(8):1220, doi:10.1029/2002WR001744.

Wenger, S. 1999. A review of the scientific literature on riparian buffer width, extent, and vegetation. Office of Public Service and Outreach, Institute of Ecology, University of Georgia, Athens, Georgia, USA. http://www.cc.utexas.edu/law/centers/cppdr/services/Improving%20Streams%20web/Work%20Groups/Public%20Lands/Wegner_1999_Review_of_buffer_width.pdf

Westerling, A.L., H.G. Hidalgo, , D.R. Cayan, , and T.W. Swetnam, 2006. Warming and earlier spring increase western US forest wildfire activity. *Science*, 313(5789):940-943.

Wickham, J.D., T.G. Wade, and K.H. Ritters. 2008. Detecting temporal change in watershed nutrient yields. *Environmental Management* 42:3223-231.

Wigington, P.J., J.L. Ebersole, M.E. Colvin, S.G. Leibowitz, B. Miller, B. Hansen, H. Lavigne, D. White, J.P. Baker, M.R. Church, J.R. Brooks, M.A. Cairns, and J.E. Compton. 2006. Coho salmon dependence on intermittent streams. *Frontiers in Ecology and the Environment* 4(10):514-519.

Wissmar, R.C. 1993. Long-term monitoring in stream ecosystems. *Environmental Monitoring and Assessment* 26: 219-234.

Wissmar, R.C. and R. Beschta. 1998. Restoration and the management of riparian ecosystems. *Freshwater Biology* 40(3): 571-585.

Wondzell, S.M. 2011. The role of the hyporheic zone across stream networks. *Hydrologic Processes* 25(22):3525-2532. DOI: 10.1002/hyp.8119

INDEPENDENT SCIENCE REVIEW PANEL: NORTHWEST FOREST PLAN, AQUATIC CONSERVATION STRATEGY

On December 2nd and 3rd, 2013 an independent science review panel met to assess new science relevant to the Northwest Forest Plan's (NFP) **Aquatic Conservation Strategy** (ACS). The panel was organized by consulting ecologist Dr. Chris Frissell and policy analyst Mary Scurlock, JD on behalf of the Coast Range Association (CRA).

Draft recommendations had been circulating in policy arenas and land management agencies suggesting that new scientific research warrants reductions in stream protection. In turn, political leaders and agency managers further interpreted various science studies and have offered proposals for significant departures from the NFP and its ACS.

The CRA asked Dr. Frissell and Ms. Scurlock to convene a panel of independent scientists qualified to assess the original basis of the ACS and new proposals in light of a broad review of the relevant science. Specifically, we sought: 1) guidance on whether the best available science warrants changes to the twenty-year old NFP-ACS, and; 2) a framework for evaluating the merits of emerging land management proposals by political leaders and agency managers.

For two days the panel met in Portland, Oregon. The panel considered science and policy issues outlined in background briefing documents prepared by Chris and Mary, with a particular emphasis on new scientific information since the adoption of the NFP in 1994.

At the start of the panel's deliberations, BLM staff briefed the panel on the guiding framework for their Western Oregon Plans Revision process. In addition, a branch chief at the National Marine Fisheries Service briefed the panel on endangered salmon consultations occurring under the Northwest Forest Plan and the Endangered Species Act. Lastly, senior staff from the Environmental Protection Agency Region 10 briefed the panel on relevant water quality issues in the area of the Northwest Forest Plan.

The Coast Range Association's role in the panel process was to cover the panel's costs which included travel, food, lodging and meeting room expenses. Panel members understood they were volunteering their time and under no obligation to reach any outcome.

The panel finished its science review discussion on December 3rd, 2013. Extensive notes were taken. The panel agreed that Chris would author the initial draft report capturing the panel's review of scientific literature and consensus views on the implications of new science for the NFP's Aquatic Conservation Strategy.

Following the panel's meeting, panel members forwarded to Dr. Frissell a large number of published studies relevant to the topics discussed. Over the next three months Chris worked to produce a draft report. On March 2nd a draft report was sent to panel members. Since March 2nd further input was received and numerous report revisions were offered. During this period, additional review and input was received from participating scientists who were unable to attend the Portland workshop: aquatic scientist James Karr of the University of Washington and Rich Nawa staff ecologist at the non-governmental organization KS Wild. The report's authorship represents those scientists and policy experts that were able to fully review and participate during the eight months of the report's development.

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REGIONAL ADMINISTRATOR'S DIVISION

April 5, 2021

Michelle McMullin
NOAA Fisheries Oregon Coast Branch
2900 Stewart Parkway NW
Roseburg, Oregon 97471

Dear Michelle McMullin:

The U.S. Environmental Protection Agency has reviewed the National Marine Fisheries Service's Notice of Intent to prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan and in support of Oregon Department of Forestry's request for Endangered Species Act Incidental Take Permit issuance (EPA Region 10 Project Number 21-0011-NMFS). EPA's comments are provided pursuant to our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act.

According to the NOI, the NMFS proposes to evaluate the potential environmental impacts associated with an authorization for incidental take of federally protected species during the HCP activities. The HCP activities include stand management, road system management, recreation infrastructure construction and maintenance, and conservation actions. The proposed HCP will support the anticipated ITP issuance. After analysis of potential impacts from the proposed action, the NMFS will process ODF's request for an ITP, then decide whether to grant, grant with conditions, or deny the ITP.

EPA appreciates the information provided in the NOI. EPA offers the NMFS the enclosed scoping comments on specific topics we believe are important to consider in the NEPA analysis for this project.

Thank you for the opportunity to comment of this project proposal early in the NEPA process. If you would like to discuss these comments, please contact Caitlin Roesler of my staff at 206-553-6518 or roesler.caitlin@epa.gov, or me at 206-553-1774 or chu.rebecca@epa.gov.

Sincerely,

Rebecca Chu, Chief
Policy and Environmental Review Branch

Enclosure

U.S. EPA Detailed Comments on the Notice of Intent for the Western Oregon State Forests Habitat Conservation Plan April 2021

Water Quality and Aquatic Resource Impacts

Section 303(d) of the Clean Water Act requires the State of Oregon and Tribes with EPA-approved Water Quality Standards identify water bodies that do not meet WQS. This section of the Clean Water Act also requires the development of water quality restoration plans to meet established water quality criteria and associated beneficial uses. Activities authorized under the proposed HCP may impact aquatic resources in the planning area. EPA recommends that the EIS include the following information:

- Acreages and channel lengths, habitat types, values, and function of waters likely to be impacted. The nature of the impacts and specific pollutants likely to affect those waters should be described.
- Water bodies potentially affected by the project that are listed on the State of Oregon most current EPA-approved 303(d) list and a description of how the project would meet the antidegradation provisions of the CWA. The antidegradation provision of the CWA prohibits degrading water quality within water bodies that are currently meeting WQS.
- Existing restoration and enhancement efforts for potentially impacted waters, how the proposed project would coordinate with on-going protection efforts, and any mitigation measures, including compensatory mitigation required under the CWA, to reduce impacts to surface waters of the U.S.
- Whether the project would result in discharge of dredged or fill materials into surface waters of the United States. If so, a CWA §404 permit from the U.S. Army Corps of Engineers would be required for the project. The EIS would need to describe this permit application process and recommended measures to protect aquatic resources from impacts resulting from the proposed project.
- Floodplain impacts and actions to be taken to minimize related impacts. See CWA §404 and Executive Order 11988, *Floodplain Management.*[1]

Riparian Buffers

The HCP set a 35-foot buffer on Type N streams to limit temperature increases to 1°C, an increase which is proposed to be mitigated in the 500-foot Temperature Protection Zone (TPZ) between Type N and Type F waters. Recovery of stream temperature in the TPZ is dependent on the amount of expected heat dissipation and groundwater recharge within the TPZ. Attenuation of added heat energy from upstream harvest reaches on similar headwater streams was reported in the publication "Effectiveness of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington."[2] This data supports the HCP finding that recovery of a 1°C stream temperature is likely to occur in the TPZ. However, results from the 2018 "Ripstream" study[3] conducted by the Oregon Department of Forestry suggest a 35-foot buffer width would result in an average temperature increase of 1.65°C, which may not be fully attenuated in the TPZ. EPA recommends that the NMFS consider wider Type N riparian buffers to account for greater than expected stream temperature increases.

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[1] https://www.epa.gov/cwa-404/floodplain-management-executive-order-11988

[2] https://www.dnr.wa.gov/publications/fp_cmer_hard_rock_phase1_2018.pdf

[3] Groom, J. D., Madsen, L. J., Jones, J. E., & Giovanini, J. N. (2018). Informing changes to riparian forestry rules with a Bayesian hierarchical model. Forest Ecology and Management, 419, 17-30.

Sedimentation
Roads can contribute more sediment to streams than any other management activity and interrupt the subsurface flow of water, particularly where roads cut into steep slopes. In addition, roads have been shown to produce elevated volumes of chronic surface sediment runoff from the road surface. Roads and their use contribute to habitat fragmentation, wildlife disturbance, and the introduction or exacerbation of noxious weeds. The EIS should include a description of how roads in the project area impact aquatic resources, provide the current number of road miles and density, and discuss the change in road miles, density, and usage levels that will occur as a result of the project. To the maximum extent practicable, EPA recommends focusing on the use of existing system roads to minimize road construction impacts on previously unimpacted areas.

Debris flows can also be a source of significant sediment. The HCP proposes 35-foot buffers on potential debris flow tracks and high-energy reaches. These buffers extend from the aquatic zone to the potential initiation site. However, it is not clear how the landslide initiation sites are identified. EPA recommends that the EIS include an evaluation of whether steep landslide prone areas of the state forests are appropriately identified as initiation sites. Ensuring adequate buffering to avoid landslide initiation and debris flows is necessary to limit sedimentation and water quality degradation.

Air Quality Impacts
Because projects allowed under the HCP may result in impacts on air quality, EPA recommends that the EIS for the project include:

- A detailed discussion of ambient air conditions (baseline or existing conditions), National Ambient Air Quality Standards (NAAQS), and criteria pollutant non-attainment areas in the analysis area and vicinity, if applicable.
- Estimation of criteria pollutant emissions for the analysis area and a discussion of the timeframe for release of these emissions from construction through the lifespan of the proposed project. The EIS should specify all emission sources and quantify related emissions.
- Mitigation measures to minimize impacts to air quality from the HCP projects.

Stand Management
EPA recommends that the EIS state how the NMFS will avoid and minimize potential timber harvest impacts such as accelerated erosion, impacts to sensitive resources, and introduction of invasive species. In terms of silvicultural management, EPA recommends the NMFS ensures that proposed activities are consistent with an understanding of natural disturbance and stand development processes and disclose the level of consistency likely to be achieved.

Threatened and Endangered species
In addition to the ITP covered species, EPA recommends that the EIS identify impacts to other endangered, threatened, or candidate species listed under the Endangered Species Act, state sensitive species, and their habitats (including critical habitat) occuring in the analysis area.

Alternatives
Identify a range of alternatives that avoid, minimize, and compensate for impacts to water, air, wildlife, and other resources.

Cumulative Effects

Cumulative effects are those that are reasonably foreseeable, related to the proposed action under consideration, and subject to the agency's jurisdiction and control. EPA recommends that the EIS analysis consider evaluation of impacts over the entire area of impact and consider the effects of projects under the HCP when added to other past, present, and reasonably foreseeable future projects in the analysis area. Considering all the actions in this area together would help decision makers to understand more clearly what the cumulative impacts on environmental resources are likely to be. EPA has issued guidance on how to provide comments on the assessment of cumulative impacts, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents.*[4] The guidance states that to assess the adequacy of the cumulative impact assessment, there are five key areas to consider:

- Resources, if any, that are being cumulatively impacted.
- Appropriate geographic area and the time over which the effects have occurred and will occur.
- All past, present, and reasonably foreseeable future actions that have affected, are affecting, or would affect resources of concern.
- A benchmark or baseline.
- Scientifically defensible threshold levels.

Climate Change Adaptation

EPA recommends that the EIS include a discussion of reasonably foreseeable effects that changes in the climate may have on the proposed project, and what impacts the proposed project will have on climate change consequences. These considerations could help inform the development of measures to improve the resilience of the project.

Monitoring and Adaptive Management

EPA recognizes that the HCP has included information on proposed monitoring and adaptive management. EPA recommends that the EIS describe the monitoring program designed to assess implementation of the HCP over time and measure the effectiveness of the HCP in achieving conservation goals. We also recommend that the EIS describe a mechanism to consider and implement additional mitigation measures. In addition, the adaptive management and monitoring plan in the EIS may include the following elements:

- Establish how current analysis in the project area has been or will be done, and how this analysis will inform monitoring priorities.
- Lay out monitoring questions that will be used to inform the adaptive management process.
- Define how success will be measured.
- Provide information to determine whether management direction is being followed, whether desired results are being achieved, and whether underlying assumptions are valid.
- Be as specific as possible about who is the responsible decisionmaker at critical steps of the monitoring plan.

[4] https://www.epa.gov/sites/production/files/2014-08/documents/cumulative.pdf

- Evaluate monitoring strategies periodically to determine if questions and protocols are still relevant and if changes are needed.

Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.[5] Executive Order 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*" (February 16, 1994), directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. It further directs agencies to develop a strategy for implementing environmental justice and providing minority and low-income communities access to public information and meaningfully participate in the process. As such, EPA recommends that the NMFS address adverse environmental effects of the proposed project on communities with these concerns and outline measures to mitigate for impacts.

EPA encourages the NMFS to use EPA's EJSCREEN[6] for the EIS to determine the presence of communities with EJ characteristics (e.g. minority and low-income populations). After the NMFS has determined if communities with EJ characteristics exist in the project area, we recommend that the EIS discuss whether these communities would be potentially affected by individual or cumulative actions of the proposed action. EPA also recommends addressing whether any of the alternatives would cause any disproportionate adverse impacts, such as higher exposure to toxins; changes in existing ecological, cultural, economic, or social resources or access; cumulative or multiple adverse exposures from environmental hazards; or community disruption.

If it is determined that communities with EJ characteristics may be disproportionately impacted, describe in the EIS the measures taken by the NMFS to fully analyze the environmental effects of the action on the affected communities and identify potential mitigation measures. Clearly identify a monitoring and adaptive management plan to ensure that mitigation is effective and successful.

Present opportunities for affected communities to provide input into the NEPA process. In the EIS, include information describing what was done to inform these communities about the project and the potential impacts it will have on their communities (notices, mailings, fact sheets, briefings, presentations, translations, newsletters, reports, community interviews, surveys, canvassing, telephone hotlines, question and answer sessions, stakeholder meetings, and on-scene information), what input was received from the communities, and how that input was utilized in the decisions that were made regarding the project.

Coordination with Tribal Governments

EPA recommends the EIS describe the process and outcome of government-to-government consultation between the NMFS and each of the tribal governments that would be affected by the project, issues that were raised, if any, and how those issues were addressed. See Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments.*[7]

In the EIS, summarize the results of tribal consultation and identify the main concerns expressed by tribes (if any), and how those concerns were addressed. As a resource, we recommend the document

[5] https://www.epa.gov/environmentaljustice/learn-about-environmental-justice
[6] https://ejscreen.epa.gov/mapper/
[7] https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/Req-EO13175tribgovt.pdf

Tribal Consultation: Best Practices in Historic Preservation[8], published by the National Association of Tribal Historic Preservation Officers.

National Historic Preservation Act

Consultation for tribal cultural resources is required under Section 106 of the National Historic Preservation Act. Historic properties under the NHPA are properties that are included in the National Register of Historic Places or that meet the criteria for the NRHP. Section 106 of the NHPA requires a federal agency, upon determining that activities under its control could affect historic properties, to consult with the appropriate State Historic Preservation Office/Tribal Historic Preservation Office. Under NEPA, any impacts to tribal, cultural, or other treaty resources must be disclosed in the EIS. Section 106 of the NHPA requires that federal agencies consider the effects of their actions on cultural resources, following the regulation at 36 CFR 800.

In the EIS, discuss how the NMFS would avoid or minimize adverse effects on the physical integrity, accessibility, or use of cultural resources or archaeological sites, including traditional cultural properties (TCPs), throughout the project area. Discuss mitigation measures for archaeological sites and TCPs. EPA encourages the NMFS to append any Memoranda of Agreements to the EIS, after redacting specific information about these sites that is sensitive and protected under Section 304 of the NHPA. EPA also recommends providing a summary of all coordination with Tribes and with the State and Tribal Historic Preservation Offices, including identification of NRHP eligible sites and development of a Cultural Resource Management Plan.

Executive Order 13007, Indian Sacred Sites

Executive Order 13007, "Indian Sacred Sites" (May 24, 1996), requires federal land managing agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners, and to avoid adversely affecting the physical integrity, accessibility, or use of sacred sites. It is important to note that a sacred site may not meet the NRHP criteria for a historic property and that a historic property may not meet the criteria for a sacred site. It is also important to note that sacred sites may not be identified solely in consulting with tribes located within geographic proximity of the project. Tribes located outside the direct impact area the plan area may also have religiously significant ties to lands within the plan area and should be included in the consultation process.

In the EIS, address the existence of Indian sacred sites in the project areas, including seeps and springs, that may be considered spiritual sites by regional tribal nations. Discuss how the NMFS would ensure that the proposed action would avoid or mitigate for the impacts to the physical integrity, accessibility, or use of sacred sites.

[8] National Association of Tribal Historic Preservation Officers. May 2005. Tribal Consultation: Best Practices in Historic Preservation. http://www.nathpo.org/PDF/Tribal_Consultation.pdf.

COMMENT TO NOAA ON THE ENVIRONMENTAL IMPACT STUDY FOR OREGON'S HABITAT CONSERVATION PROGRAM

I live on the Trask River outside Tillamook on acreage surrounded by the Tillamook State Forest. I'm writing in support of the need for a meaningful and effective Habitat Conservation Program (HCP) for western Oregon state forests. I feel I have standing because of where I live, and all I've seen in our forests.

It's more than doing the fiscally responsible thing for people who benefit from timber harvesting on our state forestlands. It's more than reducing clear-cuts and pesticides, and addressing endangered species. It's about protecting our ability to live in good health near our forests and watersheds. It's come to that.

Our drinking water quality is under attack as treatment centers add more chemicals to offset siltation and chemicals from the relentless industrial logging of our watersheds. People are asking if we can afford or even get a safe glass of water to drink any more. What are our kids being exposed to? Trihalomethanes!

It's becoming clear that our forests are more valuable for carbon storage than clear-cutting our old growth stands for money. I can only imagine what future generations will say about all the logging on public lands while our planet is consumed by wild fires, violent storms, coastal erosion, and poor air. What were they thinking comes to mind? Why didn't they set aside large tracts of public forest sooner to safeguard our planet's ability to provide for people, plants and animals? Was it all about maximizing profits?

The Oregon HCP under review is our best chance to achieve a compromise and balance on the issues raised above. Its strongest points come from independent consultants and scientists with HCP experience from other states.

Despite comments to the contrary, this HCP has long been in the works, and is the culmination of years of discussion.   I urge you to continue and complete your review as expeditiously as possible.

Ron Byers

Joint Water Commission

General Manager
Niki Iverson
150 E. Main Street
Hillsboro, OR 97123
503-615-6585

April 7, 2021

Michelle McMullin
NOAA Fisheries Oregon Coast Branch
2900 Stewart Parkway NW
Roseburg, Oregon 97471

Subject: Public Comment on the notice of intent to prepare an environmental impact statement (document NOAA-NMFS-2021-0019)

Dear Michelle McMullin:

The Joint Water Commission (JWC) is the primary drinking water supplier for over 400,000 people in Washington County, Oregon. The JWC is made up of four member agencies: the Cities of Hillsboro, Forest Grove, Beaverton, and the Tualatin Valley Water District (TVWD). The JWC water supply comes from surface water sources: the Tualatin River including its tributaries Sain Creek and Scoggins Creek, and the Middle Fork of the North Fork of the Trask River. In addition to diverting water directly from these sources, in the summer months the JWC uses water from storage supplies in Barney Reservoir, on the Middle Fork of the North Fork of the Trask River, and Scoggins Reservoir (Hagg Lake) on Scoggins Creek, a tributary of the Tualatin River.

Nearly twenty percent of the JWC's drinking water source area is included in the Western Oregon State Forests Habitat Conservation Plan (WOSF HCP). Drinking water supply is threatened by many of the same environmental changes of which endangered species are subjected. In much the same way as the Columbia Torrent Salamander and Upper Willamette River Chinook suffer when turbidity, water temperature, or water quantity deteriorate, so too does the ability to provide safe and affordable drinking water.

Management activities that have the potential to contribute to these environmental changes are therefore intrinsically tied to water supply and human consumption. Plans for protecting these species should include an in-depth assessment of the impacts that proposed management activities have to drinking water source areas. The JWC believes that ODF goals of minimizing take of endangered species and providing financial security can be aligned with the preservation of water resources.

JWC's primary areas of concern with the proposed permit area are in the upper Trask River watershed, specifically around Barney Reservoir, and the upper Tualatin River watershed, especially the Scoggins Creek drainage. These are sensitive and vital resources, and the water quality in these areas impacts the JWC's ability to provide drinking water to our customers.

Please consider including the following suggestions in the scope of the Environmental Impact Statement.

- Include drinking water supplies as an economic and social benefit in the review of the Greatest Permanent Value.
- Establish sufficient time delays between harvests to avoid abrupt landscape-scale changes in short periods of time.

- Identify locations where the permitted area overlaps with drinking water source areas, and consider adding Habitat Conservation Areas in these overlapping locations, where possible.
- Consider organizing the Environmental Impact Statement by watershed within each ecoregion.
- Include a drinking water stakeholder in the development of the EIS and companion forest management plans to ensure protection of the region's drinking water supplies.
- Identify and notify downstream water resource stakeholders of planned activity.
- Evaluate and develop water quality thresholds based on impacts to downstream stakeholders as well as species in the permit area. Develop guidelines using these thresholds that trigger disturbance activities to cease until water quality improves.
- Evaluate how proposed management activities impact wildfire resiliency and drought management as wildfire and drought directly impact the survival of endangered species as well as water supply systems.

Thank you for the opportunity to comment on the notice of intent to prepare an environmental impact statement for the WOSF HCP. The JWC values our strong working relationship with the Forest Grove District that has supported high-quality and reliable drinking water supplies for decades. We would like to continue that strong partnership in order to protect drinking water supplies for future generations by working together to address water quality impacts associated with land management activities. Thank you for your consideration.

Sincerely,

Jessica Dorsey
Senior Program Manager, Water Resources
Joint Water Commission
150 E. Main Street
Hillsboro, OR 97123

Darlene Chirman
Great Old Broads for Wilderness,
Cascade Volcanoes Chapter
7017 SE Martins Street
Portland OR 97206
805-455-3541

Great Old Broads For Wilderness
Get Into The Wild

April 16, 2021

Naonal Marine Fisheries Service
submitted via website

RE: Comments on Scoping for NEPA
Habitat Conservaon Plan for Western OR State Forests

Naonal Marine Fisheries Service:
The Great Old Broads for Wilderness is a non-profit organizaon dedicated to the protecon of our public forests. This le. er is submi ed on behalf of the Cascade-Volcano chapter, based in NW Oregon (Portland) and Southern Washington, commenng on the scope of an Environmental Impact Statement (EIS) to be prepared under NEPA, for the Habitat Conservaon Plan for the Western Oregon State Forests. The goal of the HCP is to provide long-term protecon for the covered species that are listed or candidates for lisng under the federal Endangered Species Act.

Our chapter commented on the dra HCP in October 2020, in support of the Oregon Board of Forestry moving forward with the Habitat Conservaon Plan effort. We reviewed the dra HCP at that me. Given the very short me period between attendance at the virtual Scoping hearing on April 1 and deadline for submng scoping comments due April 7, we have not had me to review the changes in the HCP in the interim.

At the Scoping hearing, I asked if the EIS will cover the companion Forest Management Plan to be developed by the OR Department of Forestry (ODF) and was told it does not. That informs some of our recommendaons for issues to be subject to environmental review in the EIS.

In regards to the Riparian Conservaon areas, the EIS should evaluate stream buffers to ensure adequate protecon for aquac listsed species. Buffers of 120 feet are proposed for all fish-bearing streams within the permit area; please evaluate adequate buffers for headwaters where the 2 covered species of torrent salamanders inhabit.

Please evaluate the adequacy of plans to address the remaining barriers to fish passage. Data in the early dra of the HCP provided data from 23 years (1995-2018) of 284 fish passage improvements, but there remained 169 impassable and 93 paral barriers in the permit area. Determine a feasible compleon date to address remaining barriers to fish passage to enhance salmonid recovery.

The Plan will also evaluate the road system, and repair, relocate or abandon road segments that cause sedimentaon of the streams, priorizing fish-bearing streams. We request evaluaon of the proposed meline for these acons, and ensure serious consideraon of road abandonment to reduce sedimentaon risks and fragmentaon of habitat with HCAs and RCAs.

We strongly urge the EIS to address how natural disasters such as wildfire are addressed in the permit area. We wish to see guidance for development of the Forest Management Plan, parcularly in regards to post-fire logging. With major wildfires in Oregon in 2020,we are seeing extensive post-fire logging in the Sanam State Forest, which is included in the HCP. Within the 16,600 acres of the Sanam SF that burned, about 3000 acres is proposed for post-fire logging. ODF was asked to exclude proposed HCP areas with HCA and RCA designaon from logging, but were told ODF is guided by the current Forest Management Plan. Proposed for logging includes areas designated as complex forest stands, or designated to become complex forests over me, and excluded from harvest. Over 240 acres of complex forests are slated for post-fire logging, some 120 years of age. Given the habitat preference for old growth, listed species such as Northern spo ed owl (NSO) and Marbled murrelet habitat are likely to be affected. In one planned harvest unit, 5 of 12 units of Northern spo ed owls are proposed for logging. A Biological Assessment will be prepared for review by the USFWS. However, NSO circles are also noted on roadsides where hazard trees are planned for removal. Research indicates that natural regeneraon of burned forests recovers complex forest aribut es sooner than if they are logged post-fire and planted. Spo ed owls are known to remain in burned forests, but abandon logged forests. This is an issue of significant concern, and should be evaluated for management recommendaons in the EIS.

Increasing frequency and intensity of wildfires is associated with climate change. We request that the EIS evaluate wildfire, changes in snowmelt and stream flows, and other climate change impacts to forests may affect the recovery of listed species in the western Oregon state forests, and acons that might be taken to mig ate some of these impacts.

In summary, our Great Old Broads for Wilderness chapter requests that the EIS evaluate adequacy for riparian buffers, sufficient plans to remediate fish passage barriers, road relocaon or abandonment especially from RCAs. In addion, we ask for evaluaon of impacts to the permit area of wildfire and appropriate recovery acons that will not negav ely impact covered species. We also ask for climate impacts and possible mig aons to be included in the analysis.

Thank you for your consideraon of our comments on the scope of the Environmental Impact Statement for the Habitat Conservaon Plan for the Western Oregon State Forests.

Sincerely,

Darlene Chirman, Leadership Team
Great Old Broads for Wilderness, Cascade-Volcano Chapter

COMMENT FROM NORTH COAST COMMUNITIES FOR WATERSHED PROTECTION TO NOAA ON CONSIDERATION OF THE ENVIRONMENTAL IMPACT STUDY OF THE HABITAT CONSERVATION PROGRAM (HCP) FOR WESTERN OREGON FORESTS

North Coast Communities for Watershed Protection (NCCWP) is a grassroots group working, through education and advocacy, for better protections of the water we drink, the air we breathe, and the forests that sustain us. We have over 700 members that live in coastal towns and communities. The Tillamook and Clatsop State Forests are integral parts of our lives, especially for drinking water.

We are commenting because we have a critical stake in creating meaningful set asides in our neighboring state forests. We see the HCP under consideration as our best chance to achieve sanctuaries for important activities beyond logging. We know that the focus of the HCP is endangered species; put coastal citizens and visitors in that category because our drinking water is endangered.

Our watersheds are being logged so extensively that public water treatment facilities are having to use more chemicals to offset siltation and pesticides used in logging practices. The costs and health hazards are passed on to ratepayers and consumers. Studies have shown that pesticides and other chemicals used in logging and timber processing are showing up in our local seafood. Certainly not good for the animals, and what about people?

We support the HCP because it leaves more mature trees standing to provide valuable ecosystem services, including natural water filtration, and more opportunities to store carbon. We believe that these natural ecosystem services are already more valuable than the old growth timber being cut. We want fewer and much smaller clear-cuts, more restrictions on pesticide spray, protections for endangered species, and we want to emphasize, we must make safe drinking water a priority. Our state forests play a critical role in this.

If anything, the HCP under review, does not go far enough. Additional source water protections need to be added to the plan. We are also concerned about areas outside the HCP, and how logging activities such as clear-cutting on steep slopes, roads and pesticides will impact HCP areas.

Please use your review to stress protection of safe drinking water sources, and improve the plan. Thank you.

Nancy Webster　　Betsy McMahon　　Ron Byers

Clatsop County
Board of Commissioners

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Subject – Public Comments – NEPA – HCP

The Clatsop County Board of Commissioners strives to create public policy through a transparent and deliberative consideration of competing goals and objectives. At the end of the day, good public policy balances multiple and overlapping interests into a unified and cohesive strategy that moves the entire community forward. While a Habitat Conservation Plan (HCP) is supported by this Board, the plan must consider and weigh the direct and indirect impacts over a wide range of factors, including the environment, economy, education, public safety, social services, equity, and sustainability. The HCP is not just a guide to the management of state forests; but more aptly a guide to management of state forests within the larger context of a safe, healthy, stable and sustainable community. It is through this lens that our comments are offered.

Timber revenues from state forests directly fund many essential services in this rural county, including schools, fire departments, traditional county services and special districts (including law enforcement and health districts). For its part, the County also distributes timber dollars to non-profit agencies serving our most vulnerable populations. Based on the experience of other rural counties who have lost major resource-based employers and/or the related tax revenue, the path towards revenue replacement is long, steep and uncertain. This type of resource depletion directly impacts the quantity and quality of a broad range of public services and impacts community livability.

Clatsop County and other taxing jurisdictions are fiscally constrained and work diligently to ensure each public dollar is spent effectively and efficiently. The aggregated 20-25% reduction in harvestable land will significantly impact subject taxing jurisdictions. Certain rural taxing entities will bear the brunt of the harvest reductions; many of which serve very low-income communities. In addition, Clatsop County has a number of long-standing challenges that make the loss of revenue exponentially problematic, including a 9.2% unemployment rate; 46% of households living below the poverty level; and a median household income 13% below the statewide average.

Each acre set aside for habitat conservation is an acre unavailable to support the stability of our economy and public institutions. While set asides are part and parcel of the HCP, any number of decisions/approaches are available to responsibly and justifiably maximize harvestable land while complying with HCP requirements.

Clatsop County is also concerned about the ongoing vulnerability to fire and the availability of adequate response capabilities. Timber revenues maintain many resource roads within the Clatsop State Forest and provides much of the firefighting infrastructure. As harvest levels decrease, so will the funding available to mitigate and respond to the inevitable fire. The Oregon Department of Forestry provides staff to state, private, and federal lands to fight wildfires. If reduced revenues lead to a reduction in staff these resources will not be available to help keep these blazes contained.

The Board of Commissioners respectfully requests that NEPA consider the full economic and social impacts of this large reduction in harvestable land. The immediate impact of lost revenue to the taxing jurisdictions and the potential corresponding loss of public sector employment will be compounded by a loss in jobs in the local logging and milling industries. At least one of the local mills relies on the larger logs produced on ODF lands and may not remain open based on the projected volumes. The loss of family-wage jobs will inevitably cascade through the economy and impact ancillary businesses.

Despite the assurances in the HCP on the robust stakeholder engagement, the counties were excluded from participation on the Steering Committee and Scoping Team despite the administrative statute requiring them to advise the Oregon Board of Forestry and the state forester on management of State Lands. Stakeholder engagement meetings were primarily informative in nature and not structured for coproduction and/or active collaboration and problem-solving.

The Board of Commissioners respectfully requests the set asides (acres and stands) be reviewed and justified with particular attention to those on the outer boundaries of the reserve areas. Many of the stands appear to be under twenty years old and will likely receive the same treatment inside or outside the Conservation Areas. Consider as an alternative, removing these younger stands from the conservation areas and working in a collaborative process with the Forest Trust Land counties to identify older or biologically diverse stands that are outside of the conservation areas that could be added in to replace these acres.

It is important that this HCP is balanced, complies with greatest permanent value requirements, and minimizes the impact on timber revenues and jobs; while protecting important habitat.

Sincerely,

Mark Kujala

Mark Kujala
Chair, Clatsop County Board of Commissioners

ASSOCIATION OF NORTHWEST STEELHEADERS
P.O. Box 55400 Portland, OR 97238
office@anws.org • (503) 653-4176

April 20, 2021

Re: Association of Northwest Steelheaders Comments Regarding NOAA's Notice of Intent to Prepare an Environmental Impact Statement for the Oregon Western State Forests Habitat Conservation Plan (NOAA– NMFS–2021–0019)

Dear Michelle McMullin and NMFS staff:

The Association of Northwest Steelheaders was founded in 1960 and is one of the oldest recreational fishing and conservation advocacy non-profit organizations in the Pacific Northwest. We have eight chapters in Oregon and one in Southwest Washington, representing over 800 members and nearly 5,000 supporters dedicated to enhancing and protecting fisheries and aquatic habitats for today and tomorrow, with a vision of abundant, sustainable fisheries and healthy watersheds.

We have coordinated with the Oregon Department of Forestry (ODF) in advocating for fish-friendly forest management policies and projects for decades, including participating in the multi-year process of developing the draft Western Oregon State Forests Habitat Conservation Plan (HCP).

The HCP planning area encompasses 560,000 acres of Oregon's two largest state forests: the Tillamook and Clatsop state forests, in addition to other State-owned forests throughout western Oregon. The Tillamook and Clatsop state forests are especially important to our membership given that they comprise the only public lands on Oregon's North Coast. These forests provide significant aquatic and terrestrial habitat value and outdoor recreation opportunities in a region dominated by private timberlands and working forests.

Many North Coast rivers and streams are important salmon and steelhead strongholds: the Wilson, Salmonberry, Nehalem, Miami, Trask, and Kilchis rivers. These rivers and their tributaries provide direct salmon and steelhead spawning and rearing habitat, and feed two large and important estuaries: Tillamook Bay and Nehalem Bay. The Coast Range ecoregion of the plan encompasses over 8,700 miles of streams and 8,220 acres of wetlands. Estuaries and wetlands are especially important habitat for salmon and steelhead transitioning to and from marine environments; unfortunately, a vast majority of these habitats have been substantially degraded and 50% of Oregon's historic wetland area has been completely eliminated.

The Oregon Coast coho salmon is one of the ESA listed species covered by this HCP, and is currently the focus of a lawsuit. The predominant life history of the coho salmon is one year in freshwater and one year in salt water before returning to spawn (Pacific Salmon Life Histories, Groot and Margolis, eds., UBC Press. 1991). With climate change causing increased uncertainty about ecological linkages to the behavior of the Pacific Decadal Oscillation and North Pacific Gyre Oscillation, freshwater habitat quality may become even more important in supporting the persistence of the threatened coho salmon. NOAA's most recent status review (2016) stated that there was no information showing improvements in habitat quality, quantity, or function within the Oregon Coast Coho ESU. This follows a similar statement in the 2011 status review to the effect that in spite of population gains attributed to lower harvest rates, reduced hatchery production, and improved ocean conditions, an ODFW/NMFS analysis of freshwater habitat trends found little evidence for an overall improving trend in freshwater habitat conditions as well as evidence of negative population trends in some areas of the Coast Range ecoregion.

As an organization representing recreational anglers, we have a vested interest in protecting and restoring salmon habitat, including freshwater rivers and wetlands, from the detrimental impacts of unbalanced forest management policies. The HCP encompasses a vast ecological and recreationally important landscape within an area dominated by private timberlands. Poor timber harvest regulations may negatively affect anadromous fish populations along the Oregon Coast as well as the Columbia and Willamette rivers, fishing grounds that are frequented by our membership.

Forest management and conservation needs have been in conflict since the establishment of the Oregon Forest Practices Act in 1971, reaching a boiling point in the 1990's. Clearly there is a need to balance timber harvest opportunities with environmental conservation: management under the current regulations is dangerous for long-term conservation of at-risk and sensitive salmonid species. There is a need to define a more balanced approach to forest management in this region to provide stability and sustainability for the recreational fishing community and the $1.5 billion economy angling supports in Oregon.

ODF's draft HCP conservation strategy includes strong protections for sensitive aquatic species. Approximately 50% of the planning area is set aside for long-term conservation, designating 43% as Habitat Conservation Areas (HCAs), including riparian areas, and another 7% for riparian protection areas outside of the HCAs. Additionally, the draft HCP incorporates significant riparian buffers of up to 120 horizontal feet: the largest riparian buffers in any existing non-Federal salmon plan in the State.

However, there are a number components of the allowed activities that could cause potential adverse environmental impacts to aquatic habitat quality that should be assessed in NOAA Fisheries' subsequent Environmental Impact Statement and Biological Opinion. Specifically, we would like NOAA Fisheries to assess potential impacts associated with:

- ***Road Construction.*** There are conflicting numbers regarding estimated annual road mileages. Page 3-17 anticipates construction of "up to 40 miles per year of primary or secondary roads" while "on average 6 miles per year of roads would be decommissioned." Given that ODF maintains approximately 4,151 miles of road within the permit area, we would like to see a more in-depth analysis of the biological impacts of building more roads in the planning area. Roads are known to degrade salmon habitat by delivering fine sediment, increasing landslide frequency, and changing stream hydrology (Furniss et al., 1991, Boston 2016), but we are concerned that ODF explicitly allows additional road construction within Riparian and Habitat Conservation Areas in the conservation strategy (page 4-100). While the draft includes reference to attempting to reduce the hydrologic connectivity of the road network, it doesn't include any specific metrics for evaluating progress toward this goal. We would like to see the HCP include a specific percentage of hydrologic connectivity in Table 6-3 in relation with Conservation Action 5. We recommend a goal of limiting hydrologically connected roads to less than 5% at the watershed level. Further, the current draft assesses roads in the context of mileage, without a specific goal to work towards. We would like to see a specific road density goal to guide progress reports and monitoring.

- ***Upland Harvests.*** The Tillamook and Clatsop forests experienced four major stand-replacing wildfires dating back to 1933. Intensive replanting primarily in the 1950's and 1960's resulted in a large cohort of 60-80 year old second-growth Douglas fir (page 2-6). There is still evidence of this significant fire history through extensive erosion, landslides, and debris flows, which are known to adversely affect watershed health and fisheries. The Tillamook Forest is very steep: approximately half of the state lands have a slope greater than 60% (page 2-22) and the area is prone to "flashy, rapid runoff" events (page 2-25). The plan recognizes that headwater streams may comprise up to 80% of the overall length of a stream network (page 4-10). While the plan delineates RCAs and buffers around many stream categories, it may not provide sufficient protection for headwater streams. We are concerned about the adequacy of the 35 foot buffers proposed for 36% of stream miles (Table 4.5). We also question the assumption that no buffers are needed on the seasonal streams that make up an additional 35% of the stream network. During periods when seasonal streams are flowing, there is increased potential for fine sediment delivery farther down into the network. During those same periods, if no vegetative cover is present, nutrient availability for downstream delivery would be limited. We would like to see NOAA Fisheries assess the impacts of this proposed management strategy to assess whether the buffers are adequate to protect stream function and flow throughout the network.

- ***Harvests and Management Within RCAs.*** The HCP proposes management and yarding corridors inside riparian buffers. We are skeptical of the need for management within RCA's, and question whether potentially damaging yarding corridors should be allowed in RCA's. In the absence of a ban on such activities, we would like to see development of a framework for implementing mitigation measures if those activities occur.We would like to see NOAA Fisheries assess the environmental risks of allowing harvests and/or yarding corridors within RCA's.

- ***Pesticides and Herbicides.*** ODF's draft HCP currently allows for aerial broadcast of urea pellets and various pesticides, herbicides, and fertilizers, some of which are known to be detrimental to wildlife (page 3-10). Pesticides and metals can be toxic to fish at high concentrations and have been shown in the laboratory to affect fish behavior even at very low concentrations (page 5-15). While pesticides, herbicides, and fertilizers are restricted to backpack and truck spraying within RCAs, aerial spraying is allowed in HCAs, areas immediately adjacent to RCAs, and upland forests, posing serious risk that these chemicals could be introduced into the waterways through runoff and wind. ODF proposes to use "drift cards" to determine whether pollutants are entering the RCA, but those drift cards will only be monitored once a year and are not located in the waterway. We would like to see NOAA Fisheries investigate the practicality of eliminating aerial spraying of chemicals across the entire planning area to provide adequate protections for water quality and salmon habitat.

We look forward to engaging in the public NEPA process to ensure the resulting HCP ensures adequate environmental protections for endangered salmon and steelhead.

Thank you for your time and consideration.

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Council of Forest Trust Land Counties' Three Goal HCP Alternative

PRELIMINARY MATTERS

The following is submitted by the Council of Forest Trust Land Counties (CFTLC) in response to a request for comments pursuant to the National Environmental Policy Act ("NEPA"). CFTLC is a committee of the Association of Oregon Counties (AOC). Although it reflects viewpoints of commissioners of its member counties, it has no authority to bind the County governments that participate in its deliberations. Any attempt to bind a participating county must be made by way of county board resolution or ordinance.

- Most of the Counties which are members of CFTLC participated as class members in County of Linn v. State of Oregon, Linn County Circuit Court Case No. 16V07708 ("the County class members"). They obtained a class wide judgment against the State that included future damages, and the future damages were calculated based on the assumption that the State would achieve certain harvest levels identified in the 2018 Business Case Analysis ("BCA") published by the Oregon Department of Forestry.
- Unless the Counties and the State reach a final settlement agreement that expressly provides to the contrary, the Counties believe that the State will be have additional contractual liability if and to the extent that future harvest levels fall short of the BCA projections that were used to determine calculate future damages at trial.
- This proposed alternative HCP which CFTLC is suggesting for further consideration and refinement is provided based solely on the assumption that the State will either pay the full amount of the outstanding judgment or reach a final settlement agreement with the Counties.
- Moreover, if the judgment against the State is, for whatever reason, reduced or modified in any respect by the appellate courts, the Counties expressly reserve their rights to pursue all claims and remedies against the State for any and all harvest levels that fall below the revenue maximization standard (or any other standard adopted by the appellate courts).

Background

The Oregon Department of Forestry (ODF) has developed a draft Habitat Conservation Plan (HCP) for 638,000 acres of forest land managed by ODF. Most of these lands are State Forest Trust Lands that were transferred to the State by 15 Counties (the Counties).[1] Counties and Taxing Districts share 63.5% of the revenues from these lands, most of which come from commercial timber harvest.

The draft HCP proposes a set of "conservation strategies" designed to maintain and enhance habitat for a nine species of fish and seven terrestrial species, some of which are listed as threatened under the federal Endangered Species Act. As proposed, the HCP would result in a 70-year agreement with the US Fish and Wildlife Services and NOAA Fisheries (the Federal Agencies) under which ODF would not be prosecuted for incidental take of listed species.

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[1] Benton, Clackamas, Clatsop, Columbia, Coos, Douglas, Josephine, Klamath, Lane, Lincoln, Linn, Marion, Polk, Tillamook, and Washington Counties

Purpose and Need for A County Alternative

ODF's proposed HCP would establish 275,000 acres of Habitat Conservation Areas (HCA) and 77,000 acres of Riparian Conservation Areas (RCAs). Some incidental harvest will be permitted in the HCAs, but by and large the HCAs and RCAs would be unavailable for timber management. Only about 291,000 acres would be left for sustainable timber harvest. As proposed, ODF's draft HCP would result in a number of unfavorable outcomes; including:

- Under ODF's draft HCP, timber harvest will drop over time from the current 260 MMbf to about 205 MMbf. The reduction in harvest means a reduction in timber revenues and jobs and further exposure to the State for breach of contract.

- ODF projects that its annual share of harvest revenues will fall short of its budget $12 million in the short run, and that the deficit will climb to $25 million per year in the long term. In the absence of Oregon General Fund support, ODF will have no choice but to reduce programmatic expenditures.

- Annual revenues shared with Counties and Taxing Districts will fall from about $55 million to $42 million, putting additional financial pressure on current levels of service and constituting a new breach of the contract that exists between the state and the counties.

- The draft HCP did not estimate impacts on employment or wages in local communities. We expect that the harvest reductions would affect 500 jobs in the timber industry, at least 150 jobs in the Counties and Taxing Districts, as well as a significant number of jobs at ODF.

ODF's draft HCP measures conservation outcomes of the HCP in terms of the number of acres of suitable habitat, and appears to assume that suitable habitat will increase under the conservation strategies.

The HCP, however, <u>does not</u> estimate future populations of the subject species. For the Northern Spotted Owl (NSO) this is a serious shortcoming. Studies show that NSO populations have been steadily declining, in spite of the fact that large acreages of federal, state and private land have been dedicated to improving habitat. It is now known that competition and predation from Barred Owls is the primary cause of the continued decline of the NSO.

Recent research shows that controlling the Barred Owl can stabilize and ultimately increase NSO populations. ODF's draft HCP recognizes that effect but does not make a hard commitment toward controlling Barred Owl populations (see Attachment A).

ODF's HCP also seeks to develop extensive acreage in the HCAs for Marbled Murrelet (MAMU) nesting habitat. MAMU populations in Oregon have stabilized and are increasing over the last few years. Even so, MAMU populations can be improved by controlling and limiting exposure to egg and fledgling predators.

CFTLC offers an alternative HCP subject to the conditions above, – the Three Goals Alternative[2] – that will improve the financial, economic and conservation outcome by:

- Making a commitment to immediate and long-term control of Barred Owls in NSO core areas and Corvids in MAMU nesting habitat.
- Increasing financial returns to Counties and Taxing Districts, and providing at least current levels of employment.
- Maintaining the financial viability of ODF.

In offering the Three Goals HCP Alternative, CFTLC does not necessarily believe that an HCP is required for ODF to manage the State Forest Trust Lands for the greatest permanent value as defined at the time these lands were established.

As the BOF and ODF appear resolved to enter into some kind of HCP agreement with the federal agencies, however, the Counties propose the Three Goals Alternative as an HCP alternative that offers better economic, financial, social and conservation outcomes than ODF's draft HCP.

Design Principles for the Three Goals HCP Alternative

CFTLC's Three Goals HCP Alternative is designed under the following principles:

1. The State Forest Trust Lands should provide dependable, predictable levels of timber harvest to County and Taxing District beneficiaries in accordance with the contract that exists between the Counties and the State. Local economies will benefit from the family wage jobs provided by timber harvest and by revenue shared with the Counties and Taxing Districts.
2. Revenues derived from commercial timber harvest from the State forest Trust Lands should cover ODF's reasonable forest management costs.
3. Conservation strategies for listed species should represent the most cost-effective approach to meeting objectives.
4. Conservation objectives should include target populations as well as suitable habitat targets.
5. Funding for conservation should come from ODF's budget.
6. Oregon's State Forest Trust Lands should not be required to make a greater contribution to listed species than other State agencies or private landowners.

[2] "Twin Goals" refers to the charge given to ODF by then Gov. Kitzhaber: Find a way to manage the State Forest Trust Lands that increases conservation and financial returns. Since that time, ODF has viewed the "twin goals" as encompassing only conservation and financial viability for the ODF. The Counties have not been given priority within that calculus. Thus CFTLC's proposal for a "Three Goals" approach.

7. An HCP for State Forest Lands should recognize the unique role that State Forests play in Oregon's forest sector.

8. An HCP for State Forest Trust Lands should recognize that under the federal Endangered Species Act, state and private land managers have no obligation to create habitat for species recovery.

Goals and Objectives

ODF's draft HCP describes Goals focused on supporting the persistence of the covered fish and wildlife species. Measurable objectives are tied to each goal.

CFTLC's Three Goals HCP Alternative incorporates the same goals and most of the same species conservation objectives, as described in the conservation strategies below. In addition, the Alternative is designed to achieve the following economic and social goals:

1. Coupled with increases in suitable habitat, immediate and long-lasting competitor/predator control will allow regional NSO population trend to stabilize by increasing the population rate of change from -6.1%[3] to something greater than 0%.

2. Coupled with increases in suitable habitat, immediate and long-lasting predator control will allow MAMU populations to increase, if ocean conditions permit.

3. Sustainable levels of timber harvest will be sufficient to maintain payments to Counties as projected in ODF's 2018 Business Case Analysis (consistent with the jury verdict in *County of Linn v. State of Oregon*).

4. Sustainable levels of timber harvest will be sufficient to return revenue to Counties and Taxing Districts as projected in ODF's 2018 Business Case Analysis.

5. Sustainable levels of harvest will support current employment from forest management activities.

[3] Across the Northwest Forest Plan area, the NSO population rate of decline was 3.8% from 1985 to 2013. Over the same time period, the rate of decline in the Oregon Coast Range was 5.1% (Dugger et al. 2016). Most recently (2002-2017), the rate of decline in The Oregon Coast Range has increased to 6.1% (Wiens 2020).

The Importance of Population Modeling for NSO and MAMU

ODF's draft HCP measures progress toward species recovery by projecting and measuring suitable habitat. The implicit assumption is that suitable habitat is the primary factor affecting populations, and that creating additional suitable habitat will automatically buoy populations.

The current consensus of biologists studying the NSO, however, is that competition and predation from the Barred Owl has a larger impact on NSO population trends than does habitat conditions, and that without a reduction in Barred Owl populations, the NSO population will continue to decline regardless of the amount of suitable habitat. Predation also plays a significant role in MAMU population trends.

CFTLC's Three Goals Alternative addresses this dynamic head on by making an immediate and long-lasting commitment to predator control. This will allow NSO and MAMU populations to stabilize and, coupled with some level of additional habitat, populations can be expected to increase. In contrast, without predator control much of any new suitable habitat will likely be unoccupied by the species ODF seeks to protect.

The importance of competitor/predator control in recovering NSO and MAMU populations points to the need to evaluate HCP alternatives with population modeling, with suitable habitat, acreage being one of the inputs but not, in itself, the ultimate goal.

Population models for NSO and MAMU do exist and have been used to analyze long-term population trends under different forest management scenarios. While the initial NSO HCP developed by Washington State DNR in 1997 did not explicitly model population, the updated 2020 HCP reviewed NSO population dynamics modeling efforts and provided a novel matrix population stage model for MAMU[4]. In the final Environmental Impact Statement for its 2015 Resource Management Plan, The Bureau of Land Management adopted the USFWS parameterization of the HexSim model[5], a spatially explicit framework for NSO population projections. These models use information about the spatial distribution of habitat over time, the current distribution of the subject species, and assumptions about competitors/predators.

Employing the currently available population models along with findings from USFWS recent Barred Owl control research[6] will yield an appropriate comparison between alternatives that employ different amounts of competitor/predator control and habitat development.

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[4] https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan#FEIS

[5] Schumaker, N.H. *et al*. Mapping sources, sinks, and connectivity using a simulation model of northern spotted owls. Landscape Ecology. DOI: 10.1007/s10980-014-0004-4

[6] Wiens, J.D., Dugger, K.M., Lesmeister, D.B., Dilione, K.E., and Simon, D.C., 2020, Effects of barred owl (Strix varia) removal on population demography of northern spotted owls (Strix occidentalis caurina) in Washington and Oregon—2019 annual report: U.S. Geological Survey Open-File Report 2020–1089, 19 p., https://doi.org/10.3133/ofr20201089.

Design Elements of CFTLC's Three **Goals Alternative**

ODF's draft HCP identifies a set of conservation actions. The CFTLC's Three Goals HCP Alternative leaves many of the conservation strategies unchanged from ODF's draft HCP. Our approach as to each conservation action is set for below.

- Conservation Action 1: Establish Riparian Conservation Areas

  No changes

- Conservation Action 2: Riparian Equipment Restriction Zones

  No changes

- Conservation Action 3: Stream Enhancement

  No changes

- Conservation Action 4: Remove or Modify Artificial Fish-Passage Barriers

  No changes

- Conservation Action 5: Standards for Road Improvement and Vacating

  No changes

- Conservation Action 6: Establish Habitat Conservation Areas

  The Barred Owl control proposed in CFTLC's Three Goals Alternative will provide a larger effect on the recovery of NSO populations than would the extensive HCA's proposed in ODF's draft HCP. The proposed HCA acreage, therefore, can be substantially reduced while still providing a superior outcome for these listed species.

  Analysis with the population models will help establish the final HCA acreage for CFTLC's Three Goals Alternative. As a starting point, CFTLC proposes an HCA designation consistent with ODF's 2018 Business Case Analysis:

  > "Under an HCP, acres available for harvest are projected to increase [from] 51 percent to 63 percent of BOF forest lands."[7]

  Using that target would make about 402,000 acres available for sustainable timber harvest, leaving about 236,000 acres in RCAs, HCAs and any other ODF no-harvest land allocations.

  Our objective will be to ensure that the HCAs encompass most of the currently suitable habitat as well as lands most likely to become suitable habitat during the 70-year HCP term.

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[7] 2018, Oregon Department of Forestry, *Habitat Conservation Plan: A Business Case Analysis,* October 2018, page 40.

Specific HCA boundaries will be developed with assistance from ODF and the federal agencies.

- Conservation Action 7: Manage Habitat Conservation Areas

  No changes

- Conservation Action 8: Conservation Actions Outside HCAs and RCAs

  Outside the HCAs, ODF's draft HCP proposes rotations at culmination of mean annual increment (CMAI), claiming but not demonstrating social, environmental and economic benefits. CFTLC will need more information before proposing or approving such a policy.[8]

  ODF's draft HCP also proposes a harvest schedule that departs from even flow. The draft HCP does not make clear the benefits of such a departure.

  The dynamics between harvest flow and rotation ages can be best understood through use of ODF's timber harvest scheduling model. CFTLC experts look forward to working with ODF to do the analysis that will inform the design of CFTLC's Three Goals HCP Alternative on these points.

- Conservation Action 9: Strategic Terrestrial Species Conservation Actions

  ODF's draft HCP mentions but does not make concrete commitment to competitor/predator control. In contrast, CFTLC's Three Goals Alternative differs in that it commits to immediate and long-lasting competitor/predator control as a tool for increasing the populations of NSO and MAMU.

  Currently, NSO populations are declining at rates as high as 6.1% per year in the Coast Range, in spite of efforts to provide more suitable habitat on federal, state, and private lands in the region. The data reveal that competition and predation by Barred Owls outweighs the benefits of increasing suitable habitat.

  Under the CFTLC's Three Goals Alternative, initial Barred Owl control efforts will reduce the Barred Owl occupancy rate by 14%[9] (to 81% occupancy). According to recent research, that could improve the current NSO population rate of change from -6.1% per year to as much as 3.3% per year[10]. Even reducing the Barred Owl population by 32% (to 65% occupancy) – the lower limit found from previous studies – could allow NSO populations to recover at rates up to 10% per year.

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[8] Demonstrating in the field that a stand has reached CMAI is difficult and time consuming, if it is even possible at all. Given the 70-year term of the HCP, and given the propensity of those opposed to commercial timber harvest to use an agency's own standards against them (e.g. the USFS "survey and manage" language), we strongly recommend ODF to revisit the CMAI language in the draft HCP and come up with a rotation age standard that is demonstrable and incontrovertible.

[9] Per Wiens *et al*. 2020, assumes current occupancy of 93%.

[10] Dugger, K.M., et al. 2016. The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls. Ornithological Applications. 118, 57-116. http://dx.doi.org/10.1650/CONDOR-15-24.1

Population monitoring studies from 2000 to 2017 indicate MAMU populations in Oregon are increasing, demonstrating positive trends between 1.4% and 3.7% in the species recovery zones that are wholly or partially within Oregon's borders. Key threats to the long-term maintenance of the species that are actionable in the terrestrial habitat include nesting habitat loss and ongoing nest predation associated with habitat fragmentation. Protection of suitable nesting habitat is a commonly applied conservation tool for MAMU, but reducing nest predation can also significantly affect MAMU population resiliency.[11] One study demonstrated corvids were responsible for nearly 33% of nest predation events in a Washington population, and a subsequent modeling exercise for MAMU in California found that reducing corvid predation by 60% could stabilize a local population.[12]

CFTLC's Three Goals HCP Alternative will contribute to maintaining a positive or stable population trend for MAMU by protecting the existing occupied habitat in the HCAs, spatially arranging HCAs to provide larger blocks of habitat over time as younger forest matures to fill in gaps, and by implementation of targeted actions to address fragmented areas that are currently experiencing high levels of nest predation. These actions could include relocating campgrounds currently within occupied habitat and deploying corvid control or conditioned taste aversion techniques in specific areas where removal of recreational facilities is not feasible.

Predictions of the actual population depends in part on the spatial arrangement of suitable habitat over time. Population models have been developed and used in other large-scale planning processes and should be used here to compare the outcomes of HCP alternatives in terms of the population of the NSO and MAMU.

- Conservation Action 10: Seasonal Operations Restrictions

  No changes

- Conservation Action 11: Road Construction and Management Measures

  No changes

- Conservation Action 12: Establish and Maintain Conservation Fund

  Funding for predator control should come from ODF's share of harvest revenues. The additional harvest will be more than sufficient to cover the costs of predator control.

[11] Marzluff, J. and E. Neatherlin. 2006. Corvid response to human settlements and campgrounds: Causes, consequences, and challenges for conservation. *Biological Conservation* 130: 301-314.

[12] Peery, M.Z., and R.W. Henry. 2010. Recovering marbled murrelets via corvid management: A population viability analysis approach. *Biological Conservation* 143(11): 2414-2424.

Next Steps

Any HCP entered into by ODF will be comprehensive and complex plan that purports to guide management of the State Forest Trust Lands for a 70-year period. In this document, CFTLC outlines an alternative approach for managing these lands that should provide better conservation outcomes in terms of NSO and MAMU population recovery; more revenue to ODF, the Counties and the Taxing Districts; and support more jobs and income than ODF's draft HCP.

A complete specification of the CFTLC's Three Goals Alternative will require additional work. CFTLC hopes and expects to work shoulder-to-shoulder with ODF and the federal agencies to turn the ideas here into a full-fledged alternative. CFTLC, furthermore, stands ready to help ODF and the federal agencies develop and implement NSO and MAMU population models to fairly project the population impacts of the proposed HCP alternatives.

Attachment A: Barred Owls Implicated in Northern Spotted Owl Decline

Wildlife biologists continue to refine our understanding of Northern Spotted Owl (NSO) population dynamics, and recent studies suggest that NSO recovery will require complementary strategies. When NSO was listed in 1993, loss of habitat was thought to be the biggest threat to the species' survival. The Northwest Forest Plan (NWFP) was adopted in 1994 by several agencies to resolve controversy over management of federal forestland[1] throughout the geographic range of NSO. The NWFP conferred some level of NSO protection on more than 20 million acres of federal land in Washington, Oregon and California. Despite receiving listed status and millions of acres of reserved habitat, the NSO population has steadily declined. **In this analysis, we contrast the influence of habitat availability versus the impact of competition from barred owls on the success of NSO. According to US Fish and Wildlife Service (US FWS) biologists, the barred owl is becoming a significant inhibitor of NSO recovery**.

Spotted owl populations were in decline prior to implementing the NFWP, so biologists expected that trend to continue while reserved habitat on federal lands re-grew the older forest structure NSO needs for successful breeding and foraging. Signs of NSO recovery should have begun to register within ten to 15 years after the timber harvest moratorium imposed by the NWFP, at least on federal lands with relatively larger initial NSO population. Across long-term study areas in all three states, however, NSO occupancy consistently decreased after 1994 (Figure 1, right), even accelerating in some locations due to habitat losses from wildfire[2]. Some of the continued decline was attributable to demographic trends, which take time to reverse, but the sustained decline is inconsistent with improving habitat.

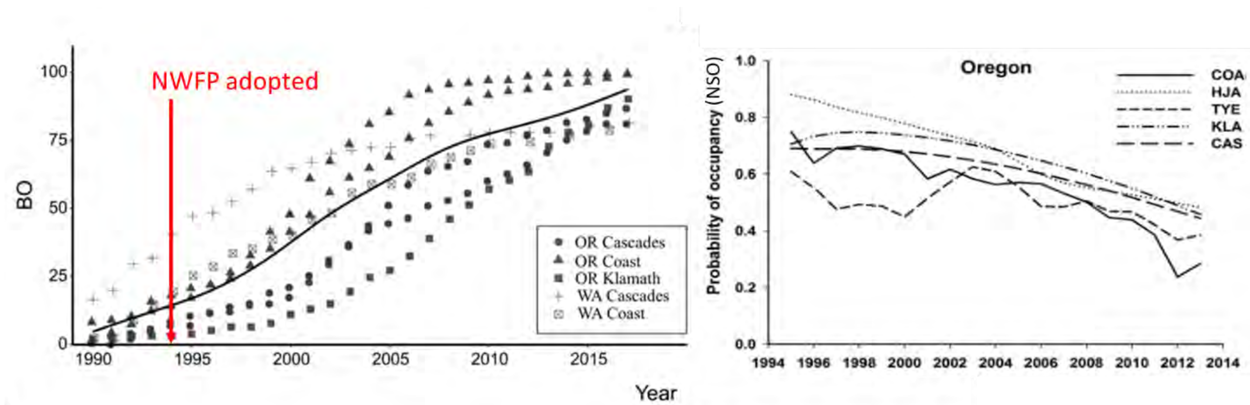

Figure 1. Trend in percent of NSO territories where at least one barred owl (BO) was detected each year (left), coinciding with sustained decline in NSO occupancy in suitable habitats (right). Adapted from Figure 2 in Jenkins et al. 2019 (left) and from Figure 8 in Dugger et al. 2019 (right).

The barred owl originated in eastern North America but gradually dispersed across the continent during the last century[3]. It is not known whether human activity facilitated barred owl range expansion. When intensive monitoring of NSO began under the NWFP, the number of NSO territories in which barred owls were present ranged from undetectable to around 20% of territories[4]. Now, barred owls are present on between 75% and 100% of NSO territories (Figure 1, left). This dramatic expansion coincided closely with

[1] https://www.fs.fed.us/r6/reo/
[2] Dugger et al 2016. http://dx.doi.org/10.1650/CONDOR-15-24.1
[3] Weins *et al*. 2019 https://doi.org/10.3133/ofr20201089
[4] Jenkins *et al*. 2019 https://doi.org/10.1093/condor/duz055

adoption of the NWFP. In the early 2000's, biologists hypothesized that NSO decline could be a result of habitat limitations, barred owl competition, or both, among other factors such as climate and fire[5].

In 2016, the US FWS started experiments to remove barred owls from NSO habitat. Results from these removal experiments have been reported for sites in Cle Elum, WA, the Coast Range in OR, and the Klamath region in OR. At all three locations, barred owl removal appears to have stabilized NSO populations (Figure 2). In the Coast Range in OR, removals were relatively modest, reducing barred owl occupancy from 93% to 81%[6], yet by 2019 the NSO population appears even to have started increasing (Figure 2). At the Cle Elum site in WA, barred owl occupancy was reduced by 40%, but NSO continued to decline in both treatment and control because wildfires reduced habitat availability on that site.

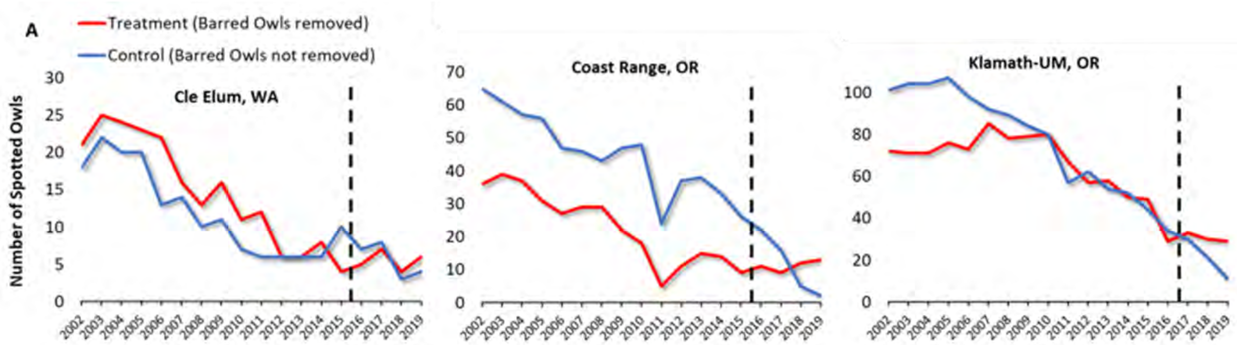

Figure 2. NSO populations stabilize after four years of sustained barred owl removal (red lines), whereas NSO populations continue to decline (blue lines) when barred owls are not removed. Adapted from Figure 6 in Weins et al. 2019.

While these barred owl removal experiments are still in their initial phase, early results suggest a promising management strategy to help restore NSO where suitable habitat already exists. Quality habitat with older forest structure is undoubtedly a critical requirement for NSO, but biologists now acknowledge the significance of the barred owl threat. We quote at length from a recent article[7] in which Jerry Franklin, one of the main originators of the NWFP and now Professor Emeritus at the University of Washington, discussed the implications of barred owl competition and removal:

> "The FWS's Oregon office says that so far, removing barred owls in a given location stabilizes the spotted owl population there. No one has seen spotted owl recovery yet, but at least whacking the competition has stopped the decline. I think all of us really know what's going on—there's no future for the Northern Spotted Owl without such a program." [In reference to the NWFP] "The people who devised the plan knew barred owls were out there. We just didn't want to believe that the barred owl was going to be this much of a problem. … We were wrong. We were doing wishful thinking."

After decades of inexorable NSO decline, even with the advantage of 20 million acres of reserved habitat, barred owl removal may prove to be the management tool that can reverse the trend and help NSO back on the path to eventual recovery.

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[5] Kelly and Forsman 2004. https://academic.oup.com/auk/article-pdf/121/3/806/29688981/auk0806.pdf
[6] Weins *et al*. 2019 https://doi.org/10.3133/ofr20201089
[7] https://www.postalley.org/2021/01/16/parting-gift-trumpers-whack-the-northern-spotted-owl/

Attachment B: Marbled Murrelet Status Brief

The marbled murrelet (*Brachyramphus marmoratus*) is a small, long-lived seabird known for its unusual use of coastal old-growth forests as nesting habitat. Marbled murrelets typically nest on large, moss-covered branch platforms in coniferous trees. Nest trees are most often located in contiguous old-growth forest patches within 50 miles of the coast. Marbled murrelets typically produce one egg during an annual nesting attempt, and both parents raise the chick by foraging for small fish in nearshore marine areas and transporting the catch to the chick until it fledges.

The United States Fish and Wildlife Service (USFWS) listed the species as threatened under the federal Endangered Species Act in 1992 (Federal Register 50 CFR 17: 45328-45337) due to a combination of anthropogenic-based threats. The top two threats driving the listing decision were loss of nesting habitat primarily from commercial timber harvest and forest management, and poor reproductive success due to nest predation stemming from changes to the forest landscape that resulted in habitat fragmentation and greater edge effects. Additional threats were added during subsequent status reviews, most notably the destruction, modification, or curtailment of the marine environmental conditions needed to support marbled murrelets and their prey species. The species is also likely to be vulnerable to the increasing effects of climate change on Pacific northwest ecosystems including both the marine and forest habitat components.

Management commitments to aid the recovery of marbled murrelet have focused primarily on protecting suitable terrestrial habitat. The Recovery Plan (USFWS 1997) established six Conservation Zones which serve as recovery units in the contiguous United States. Within those zones, recovery actions described in the Recovery Plan focused on identifying and protecting habitat, including the marine environment. This was accomplished through implementation of the Northwest Forest Plan, the designation (Federal Register 50 CFR 17:26256-26320) and later revision (Federal Register 76 (193): 61599-61621) of critical habitat, and better use of existing laws and other methods to protect remaining habitat (*e.g.* HCPs). Recovery actions also focused on monitoring populations and habitat, implementing short-term actions to stabilize and increase the population (*e.g.* conserving large continuous blocks of habitat with buffers, reducing nest predation), and implementing long-term actions such as providing replacement habitat over time and improving marine habitat conditions that ultimately would reverse declining populations.

Conservation Zones 3 and 4, covering Oregon and northern California, account for 47% of the MAMU population in the contiguous U.S. Based on annual at-sea surveys, McIver et al. (2019) reported the annual rate of population change within Conservation Zones 3 and 4 between 2000 and 2017 as positive (1.4% and 3.7%). Over nearly the same period (2001-2017) the species demonstrated a decline of 3.0% in Conservation Zone 2 (Washington). In all six zones, McIver et al. (2019) reported an annual rate of change of 0.34% between 2001 and 2017. Therefore, as of 2017, the MAMU population was declining in Washington but not in Oregon or northern California.

Marbled Murrelet and the Western Oregon State Forests Habitat Conservation Plan

Goal 6 of the Western Oregon State Forests Habitat Conservation Plan (HCP) (Sec 4.6.7, pg 4-18) seeks to support the persistence of marbled murrelet on the permit area. The HCP proposes to reach this goal through implementation of two objectives:

Objective 6.1. Conserve, maintain, and enhance at least 15,000 acres of habitat where occupancy has been previously documented, or is modeled as suitable or highly suitable.

Objective 6.2. Increase the amount of suitable or highly suitable habitat by at least 80,000 acres in locations that increase interior forest and minimize hard-edge effects.

The key component of the Terrestrial Conservation Strategy of the HCP intends to meet the two objectives and ultimately Goal 6 through the establishment of Habitat Conservation Areas (HCAs). As proposed, the HCAs cover a much larger area than the existing patches of occupied suitable marbled murrelet habitat. Over the 70-year-long permit term, protection of the HCAs will increase habitat quality and quantity for marbled murrelet in a passive manner, primarily by allowing the natural progression of forests from earlier seral stages to old growth during the permit period. Active management within the HCAs is also mentioned within the draft Conservation Strategy (Section 4, see Table 4-2 for a summary). Specific actions would include using silvicultural treatments to accelerate development of suitable habitat characteristics, but these are secondary to the establishment of the HCAs at the onset of the HCP permit term.

Effectiveness monitoring for Goal 6 of the HCP (see Chapter 6) would be completed by the Oregon Department of Forestry (ODF) every five years, focused primarily on habitat-based metrics (*e.g.* acres and spatial distribution of habitat by suitability category). Actual use of the habitat in the HCAs by marbled murrelet would not be assessed until 20 years into the permit term when ODF would collect data on nesting activity in the permit area.

An Opportunity to Directly Address the Threat of Nest Predation

A potential downside of the HCP is its nearly exclusive reliance on terrestrial habitat conservation to offset the anticipated effects of the covered activities on marbled murrelet. In Oregon, at-sea monitoring indicated an increasing trend in the marbled murrelet population between 2012 and at least 2017 (McIver et al. 2019). The monitoring surveys indicated marbled murrelet populations were recovering in Conservation Zones 3 and 4 despite on-going habitat loss on non-federal lands. This increasing population trend suggests habitat availability is not the only key driver of the marbled murrelet population.

The Recovery Plan (USFWS 1997) noted corvid (*e.g.* jays, crows, and ravens) predation on nestlings and eggs can significantly impact marbled murrelet reproductive success and the more recent literature further develops our understanding of this threat. In California, Peery et al. (2004) found evidence that marbled murrelet reproductive success was limited by nest predation and other factors such as the quality of the marine food resource rather than availability of suitable nesting habitat. Later studies similarly demonstrated the importance of corvid nest predation on marbled murrelet reproductive success (Marzluff and Neatherlin 2006, Hébert and Golightly 2007). In a modeling exercise based on

California populations of marbled murrelet, Peery and Henry (2010) found a strong positive effect of corvid control on the marbled murrelet population when combined with sufficient habitat resources. Their modeling exercise demonstrated an extinction probability of zero for marbled murrelets once corvid predation was reduced by more than 60% (see Figure 5, below).

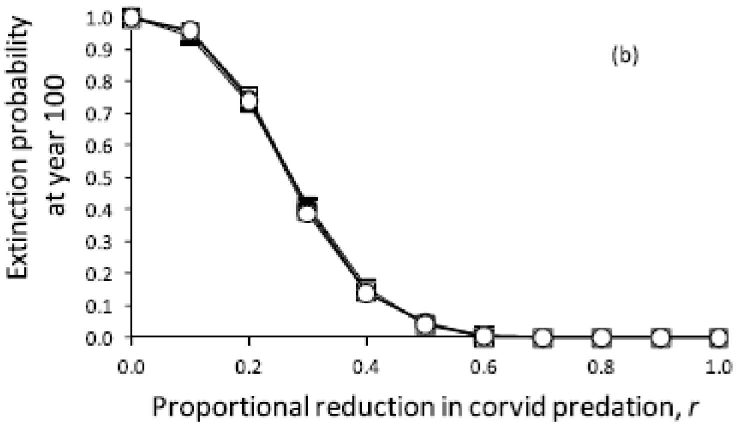

Figure 5(b) from Peery and Henry (2010).

More recent studies explored management techniques to behaviorally condition local populations of Steller's jays to avoid marbled murrelet eggs (Gabriel et al. 2012). The conditioned taste aversion (CTA) technique was effective in reducing corvid predation of marbled murrelet eggs in California and could be a useful tool in other parts of the range where Steller's jays are a key predator, including Oregon.

The positive effect of reducing nest predation on marbled murrelet population maintenance points to additional opportunities that could be more formally included in the HCP. There is a habitat quality component of the threat; corvids are associated with edge habitat and especially areas where habitat fragmentation is associated with human activity (Marzluff et al. 2004). While protecting occupied suitable habitat in the HCAs and buffering existing habitat with areas that will eventually develop into contiguous habitat blocks will likely reduce the impacts of habitat fragmentation over time, ODF could also consider actions specifically targeted at reducing nest predation. Those could include refining and more efficiently focusing HCAs in areas away from existing campsites or other recreational facilities that also support corvids, closing or relocating some recreational facilities to areas farther away from marbled murrelet habitat patches, and deploying corvid control or conditioned taste aversion techniques in specific areas where removal of recreational facilities is not feasible.

References

Gabriel, P.O., P. Halbert, and R.T. Golightly. 2013. Steller's jay conditioned taste aversion treatment in the Santa Cruz Mountains in 2012. Report to COSCO BUSAN Trustee Council. Humbolt State University and California State Parks. 22 pgs.

Hébert, P. and R. Golightly. 2007. Observations of Predation by Corvids at a Marbled Murrelet Nest. *Journal of Field Ornithology*, 78 (2) 221-224.

Marzluff, J.M., J.L. Millspaugh, P. Hurvitz, and M. Handcock. 2004. Relating resources to a probabilistic measure of space use: Forest fragments and Steller's jays. *Ecology* 85(5): 1411-1427.

Marzluff, J. and E. Neatherlin. 2006. Corvid response to human settlements and campgrounds: Causes, consequences, and challenges for conservation. *Biological Conservation* 130: 301-314.

McIver, W., Pearson, S.F., D. Lynch, N. Johnson, J. Baldwin, M.M. Lance, M.G. Raphael, C. Strong, and R. Young, T. Lorenz, and K Nelson. 2019. Marbled murrelet effectiveness monitoring, Northwest Forest Plan: 2018 summary report. 22 pp.

Peery, M.Z., S.R. Beissinger, S.H. Newman, E.B. Burkett, and T.D. Williams. 2004. Applying the declining population paradigm: diagnosing causes of poor reproduction in the marbled murrelet. *Conservation Biology* 18(4):1088-1098.

Peery, M.Z., and R.W. Henry. 2010. Recovering marbled murrelets via corvid management: A population viability analysis approach. *Biological Conservation* 143(11): 2414-2424.

USFWS (U.S. Fish and Wildlife Service). 1997. Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. Fish and Wildlife Service, Portland, Oregon. 203 pp.

Notice and Comment

Proposed Rule: (Posted by the National Oceanic and Atmospheric Administration) NOAA_NMFS-2021-0019 Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan (WOSF HCP).

Summary: NMFS intends to prepare an Environmental Impact Statement (EIS), in accordance with the requirements of the National Environmental Policy Act (NEPA), to determine the possible impacts on the human (biological, physical, social, and economic) environment caused by the WOSF HCP and a range of alternatives. The Western Oregon State Forests Habitat Conservation Plan is prepared in support with the Endangered Species Act (ESA) authorizing incidental take of covered species by covered activities.

Comment: The National Marine Fishers Service is in preparations to make an Environmental Impact Statement for the Western Oregon State Forest Habitat Conservation Plan (WOSF HPC); this statement will deal with factors such as the National Environmental Policy Act (NEPA) which basic policy is to assure that all branches of government give proper consideration to the environment prior to the undertaking of any major federal action that likely will have significant affects on the environment (EPA.gov). It is from my understanding that the Western Oregon State Forests Habitat Conservation Plan was developed by the Oregon Department of Forestry (ODF) which performs a wide range of functions that relate and or deal with the management, protection as well as overall regulation of both the private and public forest lands in the state of Oregon (Oregon.org). I believe that the plan proposed by the National Marine Fishers Service, has good intentions for the protection of the forests and wildlife residing in the state of Oregon and to determine how greatly the human population alters those environments. In an age of population growth and mass migration between states it has become increasingly important that these states natural forests and wildlife be protected and secure. In order to ensure that the natural forests and wildlife will be there for the public to respect and reside by, there needs to be extensive research done to see how greatly the human populations affect them and put a halt or change to said human influence. In order to truly understand our impact, we must be made aware of the causes; overpopulation, pollution, burning of fossil fuels, and of course deforestation (National Geographic). Due to these human influences and impacts it will lead to climate change as well as undrinkable water, causing wildlife to leave their once safe habitat in search for a safer one which can have drastic effects of its own. The animals leaving usually aren't adapted all the way to newer areas with different climates and an altogether different ecosystem causing them to die off and for the ones not able to leave their original habitat, they die off from starvation and habitat loss caused by deforestation as well as possibly runout the wildlife residing in those areas. The wildlife and forests residing in these areas pay the ultimate price for human development and expansion. It is the unfortunate fact that with the expansion and development of the modern world that we cause the ones native to regions, the wildlife, to go extinct and or migrate to different areas. The fad of a public forest also plays a key role in the issue involving habitat loss, you walk around your city and may have "green" spaces where you can sit or walk, and you may see wildlife around; but it is these spaces that aren't natural and were only possible with deforestation and pushing out of the original wildlife. Public Forests require a type of maintenance which is spraying for weeds and clearing of new growth in order to maintain the appeal to the humans that inhabit the area, a natural forest does not require any of that because as I have already stated they are natural. The wildlife that inhabits an area play a key role in the maintenance and overall prosperity of the land, when you make a public forest, it ends the role wildlife plays and requires for more human intervention to insure the aesthetic and growth of the forest. The issue does not only involve the area of land you are viewing, but it also deals with upstream wildlife and neighboring ecosystems, with the deforestation and human influence wildlife moves and may start to dominate areas that once before had a dominating species now being challenged by a species looking for a new safe home. It is not only the wildlife that is affected by things like deforestation and the building of public forests, but also the humans residing in nearby areas and in the state. The majority of Oregon gets their drinking water from the forest streams, lakes and rivers, those resources provide about 70 percent of all water used in the state with 163 communities being dependent on the water to run their everyday lives (Ecotrust.org). The human impact whether that be biological, physical, social, or economic has an impact on humans of that area; with cutting forests and natural areas for residential areas, highways, and other necessities for populated areas, can possibly lead to less water sources for these areas increasing the development of harmful buildings and chemical plants to maintain drinkable/usable water for the residents; increasing climate change to those areas possibly leading them away from recovery. The release of greenhouse gases such as carbon dioxide into the air causes the atmosphere to warm because they are trapped in, causing for heat waves, wildfires, and drought; all of these impacts the remaining natural forests and wildlife. It is known that humans can cause such drastic impacts to the environment they inhabit, and the environmental impact statement should address the major human influence on the area around them and the harm they will cause wildlife and themselves. Humans have seen the changes to their communities whether it be by road construction to major metropolitan development; these changes are even evident where I am from, all around you see less and less natural forests and more paved walks and little parks to fill a city quota. While these quotas are in good thought, they are far from the proper environment areas need, less and less you see simple wildlife such ass deer and foxes and more dogs being walked in a safe public forest. We must understand that we are the visitors; as humans it is hard to fathom that we aren't as important as we like to think. The argument that we are the top species is a sad excuse, if we desire to live in a safe environment, we must make that same environment safe for wildlife and forests that contribute to our needs. Apart from the forest depletion and more industrialization for humans, this is also dealing with the possible endangerment of species and the effects that has on the environment and entire legacy of said species. In order to fight against deforestation and or bring up the consequences of said actions, we can look back at the Endangered Species Act of 1973 (ESA). The Endangered Species Act of 1973 claims to provide a framework to conserve and protect endangered and or threatened species and their habitats; that is accomplished by providing states with financial assistance and incentives to maintain conservation as well as funding projects that aim to conserve and protect endangered species (fws.gov). It is with the Endangered Species Act (ESA) that we can try to ensure the protection of endangered species whether that be by stopping the destruction of certain environments; as well as notify the public of animals put on the endangered species list. The proposed rule by the National Oceanic and Atmospheric Administration for a notice of intent to prepare an Environmental Impact statement for the Western Oregon State Forests Habitat Conservation Plan (WOSF HCP) with requirements of the National Environmental Policy Act, is in reality in the best interests of Western Oregon and the forests and wildlife of that area. As stated previously the biological effects that humans implement on said wildlife will also in the end have drastic effects on the humans of that area as well as people and communities of surrounding areas. While it is in good interests to prepare an environmental impact statement, it is much better to have a clearly stated out plan in the opening intention. By just saying that you see that there are indeed issues that will have drastic impact, and you intend to do something about it the issue already gets worse, when the first signs of a drastic environmental impact began showing that is when something should have been in the works; we do see that back in 1973 the Endangered Species Act was established but if it was almost 50 years ago then why have we as the people allowed for it to continue down this path. But it is because of organizations like the National Oceanic and Atmospheric Administration as well as actions like National Environmental Policy Act (NEPA) that we can start to determine the cause of these changes and label the effects and propose isolations for fixing or mending the hurt we have caused the environment; and maintaining the ecosystems of forests in places like Oregon where the people depend on the natural lakes, streams and rivers for their water supply and wildlife that depend on the natural forests and ecosystem in order to survive. Again, I believe that this notice of intent will do much good to Western Oregon as well as possibly set the tone for major environmental changes around the country; places like Western Oregon aren't the only areas that are becoming increasingly deforested as well as the millions of species losing their homes and possibly losing population at the expense of urban growth for the United States.

Work Cited:

"Endangered Species Act." *Official Web Page of the U S Fish and Wildlife Service*, www.fws.gov/international/laws-treaties-agreements/us-conservation-laws/endangered-species-act.html.

"Energy in Oregon." *State of Oregon: Energy in Oregon - Addressing Climate Change*, www.oregon.gov/energy/energy-oregon/Pages/Climate-Change.aspx.

Regulations.gov, 2021, www.regulations.gov/document/NOAA-NMFS-2021-0019-0001.

Scientist, Sara Loreno Natural Resources Data. "Drinking Water Data for Coastal Communities." *Ecotrust*, 26 Nov. 2020, ecotrust.org/drinking-water-data-for-oregon-coast-communities/.

Society, National Geographic. "Human Impacts on the Environment." *National Geographic Society*, www.nationalgeographic.org/topics/resource-library-human-impacts-environment/?q=&page=1&per_page=25.

"Summary of the National Environmental Policy Act." *EPA*, Environmental Protection Agency, 15 Aug. 2019, www.epa.gov/laws-regulations/summary-national-environmental-policy-act.

"Welcome." *Oregon Department of Forestry : Welcome : State of Oregon*, www.oregon.gov/odf/Pages/index.aspx.

Boise Cascade Company
Habitat Conservation Plan Scoping Comments

The following comments are submitted on behalf of Boise Cascade Company's Western Oregon Region. Boise Cascade is a frequent purchaser of timber from the state forests that are subject to the Habitat Conservation Plan, HCP. The purpose of our comments is to urge the Oregon Department of Forestry, ODF, to add an alternative for consideration in addition to the Draft HCP.

Analyzing another alternative will provide the public with valuable information necessary for consideration of ODF's HCP. The 638,000 acres of forest land managed by ODF covered by the HCP, of which include 275,000 acres of Habitat Conservation Areas, HCAs, and 77,000 acres of Riparian Conservation Areas, RCAs. By and large the HCAs and RCAs would be unavailable for timber management.

ODF's proposed HCP would establish 275,000 acres of Habitat Conservation Areas (HCA) and 77,000 acres of Riparian Conservation Areas (RCAs). Some incidental harvest will be permitted in the HCAs. Only about 291,000 acres would be left for sustainable timber harvest. As proposed, ODF's draft HCP would result in unfavorable outcomes:

- Under ODF's draft HCP, timber harvest will drop over time from the current 260 MMbf to about 205 MMbf. The reduction in harvest means a reduction in timber revenues and jobs.

- ODF projects that its annual share of harvest revenues will fall short of its budget $12 million in the short run, and that the deficit will climb to $25 million per year in the long term.

- Annual revenues shared with Counties and Taxing Districts will fall from about $55 million to $42 million, putting additional financial pressure on current levels of service.

- The draft HCP did not estimate impacts on employment or wages in local communities. We expect that the harvest reductions would affect 500 jobs in the timber industry, at least 150 jobs in the Counties and Taxing Districts, as well an unknown number of jobs at ODF.

ODF's draft HCP measures conservation outcomes of the HCP in terms of the number of acres of suitable habitat, and suitable habitat will increase under the conservation strategies.

The HCP, however, doesn't estimate future populations of the subject species. For the Northern Spotted Owl (NSO) this is a serious shortcoming. Studies show that NSO populations have been steadily declining, in spite of the fact that large acreages of federal, state and private land have been dedicated to improving habitat. It is now known that competition and predation from Barred Owls is the primary cause of the continued decline of the NSO.

The Council of Forest Land Trust Counties have submitted a viable alternative, they've titled Three Goals, for ODF to consider. Boise Cascade agrees with the Counties that ODF should add an alternative for their consideration.

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District 4 Commissioner

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Subject-Public Comment-NEPA-HCP

I do not support the HCP developed by the Oregon Department of Forestry. I wish to be very clear; I am not contesting whether or not we need an HCP, I am contesting the high number of acres set aside, the 25% reduction of harvestable land, and the damage the current plan will do to our county budget and socioeconomics over the life of the plan. I am advocating for my county's financial and social outlook. The most overlying impact is a direct 25% reduction of our available acres which will result in a correlated reduction in funding. The trickle effect of that reduction in funding on county programs, small taxing districts, and jobs is extreme. This HCP will draw very clear winners and losers, and the people of Clatsop County will be the losers. I am requesting that through this process that you not only look at the direct impacts of our reduction in harvest and funding but also the indirect impacts. The decrease of volume will correspond to a decrease in mill and logging jobs which will cause a ripple effect throughout our local economy that depends on these high paying jobs. As it sits, our mills are part of the top 10 employers in our county, the reduction in harvest will directly affect trade and commerce in our communities. I'm advocating for the greatest permanent value of our state forest and for the health of our socioeconomics in the county as a whole. Each acre matters for each individual taxing districts and for the programs our general fund assists. We may find that Hammond or Elsie Vine maple is an 80% reduction. Basically, some districts are at risk to lose all of their funding. Given the size of the reserve areas and ODFs mandate to manage each acre on greatest permanent value, it is pretty clear that the HCP will no longer be providing that balance.

I am of a belief that each acre/stand should be able to be "explained" or accounted for, especially those that are on the edges of the reserve areas. I am not feeling confident that this is the case. My feeling is we could turn around today and "find" 5 acres (a teacher for 1 year using current market price) or a hundred acres (2 teachers for a decade). Could we find stands that didn't need to be included in order to get this HCP approved? I am confident that the answer is sadly, yes. Our school districts, care center, rural law enforcement, 4-h and extension services, Port, and numerous other county services will be hit with a very direct impact of this 25% loss. Not only will our variety of small taxing districts be hit hard, but many of our outside programs will be negatively impacted with these loss of funds such as our food bank program, houseless population services. This economic impact will result in reduced services to our communities (teacher layoffs, fewer Clatsop Care Center beds, fewer deputies, etc). Based on the experience of other rural counties who have lost major resource-based employers or the related tax revenue, the path towards revenue replacement is long, steep and uncertain. This type of resource depletion directly impacts the quantity and quality of a broad range of public services and impacts community livability. Each acre set aside for habitat conservation is an acre unavailable to support the stability of our economy and public institutions.

Despite the assurances in the HCP on the robust stakeholder engagement the counties were specifically kept out of both the Steering Committee and the Scoping Team despite the administrative statute requiring them to advise the Oregon Board of Forestry and the state forester on management of State Lands. Stakeholder engagement meetings were kept primarily informative with the ability for functional feedback kept to a minimum. I respectfully request the set asides (acres and stands) be reviewed and justified with particular attention to those on the outer boundaries of the reserve areas.

I respectfully request that through this process you consider the full economic and social impacts that this large reduction in harvestable land will have. The immediate impact of lost revenue to the taxing jurisdictions and the potential corresponding loss of staffing positions will be compounded by a loss in jobs in the local logging and milling industries. At least one of the local mills relies on the larger logs being produced on ODF lands and may not be able to remain open on a reduced volume schedule. This loss of good high paying jobs will cause a ripple effect throughout our economy as other jobs and services depend on these workers to frequent their businesses.

Lastly, the Oregon Department of Forestry provides staff to State, Private, and Federal lands to fight wildfires. If reduced revenues lead to a reduction in staff these resources will not be available to help keep these blazes contained. During the summer of 2019 Oregon experienced the most historic fire season on record. Both public and private lands were lost in fires that swept across the landscape. Heroic efforts were taken to put a stop to these fires. Managed and maintained forest roads were used to access and fight the fires. On State Forest Land these roads are maintained using funds from nearby timber sales. Without those sales the cost of this maintenance will still fall on the Department of Forestry. Additionally, the forest as it stands today is fire resilient. ODF responds to fires on Private, State, and Federally owned lands. When the fire bell rings firefighters not only respond from the protection division of ODF but also from State Lands. As harvest levels decrease there will need to be a correlating drop in available personnel in State Lands in order to keep ODF. This will mean there are less firefighters to fight not only fires on State Land but also on their Federal and privately owned neighbors. This decrease in personnel will have state wide impacts. Along with a direct depletion in State personnel, we will face a depletion in local and private industry personnel due to job loss. When Tillamook County forest burned this past summer, the state couldn't provide resources, therefore the response fell onto the shoulders of the local industry members. With a future projected local industry job loss, our abilities to fight local wildfire will become depleted potentially leading to great catastrophe.

I will reiterate two requests. First, that through this process you consider the full economic and social impacts that this large reduction in harvestable land will have in correlation with the immediate impact of lost revenue to the taxing jurisdictions and the potential corresponding loss of staffing positions will be compounded by a loss in jobs in the local logging and milling industries. Secondly, I respectfully request the set asides (acres and stands) be reviewed and justified with particular attention to those on the outer boundaries of the reserve areas.

Thank you for your time,

Courtney D Bangs

Courtney Bangs
District 4 Clatsop County Commissioner

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April 21, 2021

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In Response to: Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

Dear Ms. O'Rourke, Mr. Henson and Mr. Daugherty,

Introduction

Associated Oregon Loggers (AOL) is a local trade association which represents nearly 1,000, family-owned forest contractors. Our members have been involved in the management of the Western Oregon State Forests (WOSF) for decades. Our members are essential to conduct any activity in the woods, be that road work for access, timber falling for management and restoration, reforestation for sustainability, trucking for product transportation, and many other services. AOL's members provide a diverse array of services that are necessary for Oregon Department of Forestry (ODF or the applicant) to conduct all of their forest management activities in order to achieve the goals and objectives of their Forest Management Plan (FMP). A new FMP is being developed and the WOSF Habitat Conservation Plan (HCP) will inform the allowable actions under the new Plan. ODF has acknowledged the need to have an incidental take permit (ITP) in order to allow meaningful forest treatments across its managed lands. It is vital to the success and long-term stability of AOL's members to ensure their voice is heard during this National Environmental Policy Act (NEPA) process allowing ODF to obtain an ITP ensuring compliance to the Endangered Species Act (ESA). The notice of intent (NOI) opened the scoping comment period and AOL believes the best way to ensure economic viability and operational feasibility of the HCP is to work with the forest contracting sector.

Background

AOL wants to thank ODF for considering the lengthy process of HCP development. The current FMP was developed to work in consort with an HCP. Regrettably, an HCP was not developed and a take avoidance strategy was adopted. Although we believe alternatives to the current take avoidance strategy could have been implemented, producing a similar outcome to the path we now find ourselves on, we understand the decision ODF had to make. AOL agrees with the applicant that take avoidance is cumbersome and can result in less work on the ground. Inherently, the assumptions made under the current plan which focuses on structure-based management, would lead to this recognition.

AOL supports a well-reasoned HCP approach, but unfortunately, the proposed HCP fails on multiple counts.

A big focus of the plan is, of course, on the northern spotted owl. Regrettably, the draft HCP does not prioritize the survival and recovery of the spotted owl by addressing its greatest threat: the invasive barred owl.

U.S. Fish and Wildlife Service (USFWS) own research has demonstrated that the barred owl, which is now abundant in our northwest forests, is the primary driver in the spotted owl's demise. Instead, ODF's HCP focuses entirely on creating new habitat, setting aside 60% of state forests and significantly reducing timber harvests. This is the same thing we've been doing unsuccessfully on federal forests since the early 1990s, when millions of acres were set aside for owl habitat. Decades later, spotted owl populations continue to decline.

While the conservation outcomes of the HCP are suspect, the financial implications are clear. If implemented, the HCP will not even produce enough revenue for ODF to keep its lights on. ODF has the unique ability to generate its own revenue through sustainable timber harvest, which pays for the costs of managing these forests, keeping them open to the public and free of wildfire.

AOL believes a different path could have been taken and that more strategic and well thought out take avoidance could have resulted in a more balanced result for all stakeholders, but AOL hopes these comments can be incorporated into the decision-making process moving forward.

Purpose and Need

The purpose of this NEPA process, as described by the NOI, is to issue an ITP to ODF for the protection of "covered species and their habitat while allowing the applicant to manage WOSF lands in compliance with the ESA." AOL intents to work with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) and the USFWS, together identified as "the services", in order to ensure the approved HCP and chosen alternative meet permit issuance criteria to the best of its ability.

As the applicant, ODF has applied for the ITP from the services and it is AOL's understanding that any alternative determined by the services to be implementable by ODF and that meets the purpose and need of the NOI, is to be analyzed in detail at the request of ODF.

Although this NEPA process is not required to consider the state's greatest permanent value mandate, the forthcoming FMP revision is required to consider the greatest permanent value mandate. Because the FMP will be informed by and need to be consistent with the HCP in order to maintain coverage of the ITP, comments regarding the all pillars of greatest permanent value should be included in the NEPA analysis. This includes environmental, social and economic.

AOL has a responsibility to advocate for our members and ensure the work that ODF is proposing in this NEPA process is the best option for the covered species, but also rural communities and the industries (such as timber and recreation) that are directly impacted by the decisions of both the federal services and the department moving forward.

Please ensure the decision to be made for issuance of an ITP is tied to the HCP alternative that best meets the purpose and need of the EIS and that best sustains or improves population dynamics for the covered species.

Covered Species

Many of the covered species are warranted for inclusion in this 70-year HCP and under the proposed ITP. However, AOL believes species that are not currently federally listed should not be included. AOL believes the department is giving up more than it needs to by covering these additional species rather than waiting to make decisions on them with additional information after litigation, review and additional research is done to determine weather or not ESA protection is warranted.

If species are not currently covered under the federal ESA, AOL believes it is outside of the purpose and need of this specific EIS to issue an ITP for them. Protections under the federal ESA are not currently required for these species and until the time they are determined warranted for listing it is our view that it is unreasonable to include them in this EIS for an ITP from the federal services.

Red Tree Vole

According to the USFWS's document titled *Endangered and Threatened Species: Five Species Not Warranted for Listing as Endangered or Threatened Species - North Oregon Coast DPS of Red tree vole* which was published on Dec. 18, 2019, "After a thorough review of the best scientific and commercial data available, we find that it is not warranted at this time to list the […] red tree vole (North Oregon Coast distinct population segment (DPS))" (FWS-R1-ES-2019-0096-0001). The USFWS goes on to say in the *Species Status Assessment – Red Tree Vole* that "the northern portion of the north coast subregion […] has blocks of tree vole habitat on the Clatsop State Forest, [but] surveys have not yielded any voles" (FWS-R1-ES-2019-0096-0002). This can be observed on page 23 of the *Species Status Assessment* in Figure 11. Elsewhere on State forest lands, there exists two additional vole clusters (Tillamook SF Nehalem and Tillamook SF Kilchis) with moderate resiliency scores. The USFWS notes that most RTVs exist on State and Federal lands, but it is the Federal lands where persistence is key to species success. The two largest blocks (Nestucca Block and South Block) occur almost exclusively on the Siuslaw National Forest and the Northwest Oregon District of the Bureau of Land Management (BLM) as shown in Figure 1 of this document (found on page 21 of the *Species Status Assessment* in Figure 9). The document goes on to say, "Federal land management practices of surveying and managing for tree voles, combined with large areas of land-use allocations where programmed timber harvest does not occur, should allow for maintenance of the species in all but perhaps the more isolated checkerboard blocks of ownership."

Because the North Oregon Coast DPS of the RTV has not been listed and persistence on Federal Lands will drive success of the species, AOL believes including the North Oregon Coast DPS of the RTV as a covered species is not warranted. An incidental take permit is not needed for this species because it has not been listed and thus consultation and protection under the ESA is not required. Moreover, we believe management under a finalized HCP will achieve habitat goals regardless of the RTV being identified as a covered species. Habitat conservation areas will be identified and habitat goals for other covered species will inherently achieve goals and needs for the RTV as well.

Other options outside of the HCP process that could exist in the FMP include:

- Simply being silent on the RTV similar to the BLM's Resource Management Plan or
- Perusing something similar to the Forest Service's new model of high-priority site designation where the HCAs could suffice as high-priority sites or a determination could occur in development of the FMP. See the High-Priority Site Management Recommendations Document (Huff, 2016).

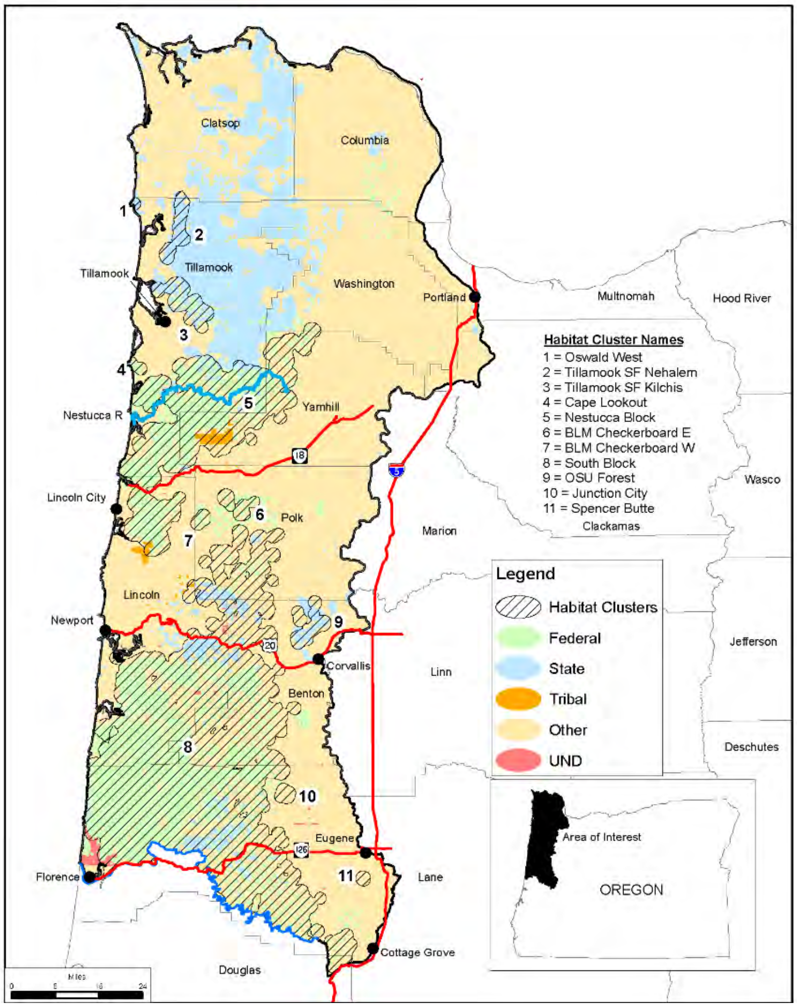

Figure 1 (As found on page 21 of the Species Status Assessment in Figure 9): "Red tree vole occupied habitat clusters and associated ownership. Clusters are derived from Lesmeister and Linnell (2019, entire) (see Appendix A [of the Species Status Assessment])".

Oregon slender salamander

Because this is a federal process, AOL believes species that are not listed by the federal agencies should be outside of the scope of this EIS and the issuance of a federal ITP. Federally, the Oregon slender salamander is a *Species of Concern*. In the state, the species is listed as *Sensitive* and is an Oregon Conservation Strategy Species in the West Cascades and Willamette Valley ecoregions. AOL believes simple conservation strategies can be incorporated into the revised FMP to protect this species rather than through an unwarranted ITP issued by the federal services that do not consult on nor have this specific species listed under the ESA. AOL believes no species identified as an Oregon Conservation Strategy Species should be covered by this ITP EIS if it is not also listed under the federal ESA.

Species Under Review

For reasons previously mentioned, AOL believes it should not the responsibility nor role of the federal services to consult on nor grant ITPs for species that are not listed under the ESA. Until the three species identified as "under review" in the draft HCP have a final rule in the Federal Register identifying them as listed under the ESA, they should not be included in this EIS as covered species to receive an ITP. If they are listed as threatened or endangered in the future, AOL believes then and only then should they be reviewed for a suit of options. These options could include take avoidance, coverage under the ITP (if needs are met under the standing HCP) or amendment to the HCP/ITP (if the HCP does not meet the needs of the species).

Northwest Forest Plan and BLM Resource Management Plan

On page 2-15, the draft HCP notes that regarding the Northwest Forest Plan (NWFP), "The conservation strategy of the HCP was greatly informed by the science presented in the science-synthesis, including information related to the biological needs, threats, and management recommendations for covered species, particularly covered fish, marbled murrelet, and northern spotted owl."

Regrettably, the results of federal lands being managed for 24 years under the NWFP as presented in the 2018 NWFP Science Synthesis (Spies et al, 2018), showed that, "Despite continued management and conservation of suitable forest cover on federal lands, the long-term persistence of spotted owls is questionable without additional management intervention. Experimental removal of barred owls on one study area in California suggests that removal of barred owls may have positive effects on population trends of spotted owls." The synthesis illustrated that even when the vast majority of lands are in reserves with goals to increase older forests suitable for the northern spotted owl, their populations continued to decline. In the BLM's 2016 Resource Management Plan (RMP), they found that under the no action alternative where approximately 2.5 million acres of forest lands were left untouched, NSO populations would still decline.

With the lack of success and bleak modeling completed on these federal lands, AOL is left extremely concerned regarding ODF's belief that mimicking this management approach will lead to a different result for the Northern Spotted Owl on the fraction of land that the department manages compared to the millions of acres managed by the Forest Service and BLM.

AOL asks the federal services to please acknowledge the declining population of the NSO as a result of current reserve and no touch strategies. We ask the services to accept the need to approach species improvement from a different angle.

We believe alternatives need to be created in order to find the best habitat conservation plan that will leads the services to achieve the most balanced approach for issuance of the ITP.

Northern Spotted Owl

Habitat Management

The department should ensure consistency with the Northern Spotted Owl (NSO) Recovery Plan. The Recovery Plan acknowledges that active forest management is radically important to help mitigate additional losses of habitat from wildfire and other threats to the owl. The Plan actually supports active management even if such treatment temporarily degrades the species habitat. It says, "Long-term spotted owl recovery could benefit from forest management where the basic goals are to restore or maintain ecological processes and resilience. Therefore, we recommend application of disturbance-based principles to such decisions (Franklin et al. 2002, 2006, 2007, Drever et al. 2006, Noon and Blakesley 2006, Carey 2007, Long 2009, Swanson et al. 2010). For example, some treatments may accelerate the development of spotted owl nesting habitat (Wimberly et al. 2004, Andrews et al. 2005), even if it temporarily degrades existing dispersal habitat (Franklin et al. 2006)" (Page II-18).

Additional Literature:

Larry L. Irwin, Dennis F. Rock, Suzanne C. Rock, Craig Loehle, Paul Van Deusen. 2015. Forest ecosystem restoration: Initial response of spotted owls to partial harvesting

Among other findings, this study concluded that partial-harvest forestry, primarily commercial thinning, has the potential to improve foraging habitats for spotted owls.
In addition, tall patches of trees may be more important for the vitality of NSOs. We suggest looking at this article to understand why downgrading habitat may be better than maintaining canopy cover.

North, M. P., Kane, J. T., Kane, V. R., Asner, G. P., Berigan, W., Churchill, D. J., . . . Whitmore, S. (2017). Cover of tall trees best predicts California spotted owl habitat. Forest Ecology and Management, 405, 166-178. doi:10.1016/j.foreco.2017.09.019

Key Points:
- Focus on preserving patches of large/tall trees rather than canopy cover
- High canopy cover does not incorporate important habitat components

When identifying habitat needs for the NSO, determine the effects of maintaining, downgrading, and removing it. Please identify clearly why it is necessary (legally and scientifically) to do a more restrictive activity. We recommend review the following PNW paper if you have not already:

Garman, Steven L.; Cissel, John H.; Mayo, James H. 2003. Accelerating Development of Late-Successional Conditions in Young Managed Douglas-fir Stands: A Simulation Study. Gen. Tech. Rep. PNW-GTR-557. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

This study suggests that heavy thinning promoted rapid development of large boles, vertical diversity, and tree-species diversity, but required artificial creation of dead wood. Treatments that retained more than 40 percent of the overstory delayed attainment of late-successional conditions by 10 to 30 years but resulted in higher levels of most late-successional attributes at the end of a rotation.

AOL requests that an alternative be developed that allows landscape level ecological needs, climate change mitigation and sustainable forestry on ALL LANDS to drive management decision rather than singular species needs. Without this comparison, there is no way to know if a better path can be laid for the covered species.

We request that this alternative significantly reduces the size of the HCAs and acknowledges the social and economic benefits in a balanced way with NSO needs such that all three can be better off in the end.

NSO and Fire

Our comments in the RTV section touch on fire's destructive effects on the RTV populations in the state. AOL would like to note that fire can wreak havoc on NSO habitat as well.

Recent statistics illustrate the impacts of catastrophic wildfire on NSO habitat. Oregon's 2020 wildfires burned more than 560 square miles of suitable nesting and roosting spotted owl habitat. Of that, over 300 square miles are no longer considered viable for the owl.

Many NEPA Projects across federal lands have also started to consider the effect of fire on NSO populations and their habitat. Utilizing the research related to the interplay between fire and owls is key to fully understanding the tradeoffs of doing management in NSO habitat, especially in areas with frequent fire. For instance, the Calf Copeland EIS developed by the Umpqua National Forests says, "simply doing what is best for the ecological function of the Project Area and increasing resiliency of the forest to wildfire risk is the best thing for the NSO".

The fact is, wildfire intensity typically decreases in the long term after forest management tools are applied to the landscape. Land managers then take steps to address short-term fire severity risks that might result from the treatment. This is good for the NSO and all of the covered species in the draft HCP.

AOL requests that an alternative be developed that focuses on the risk from wildfires to NSOs, other covered species as well as their habitats. AOL believes this alternative should also recognize the changing climate and the positive benefits that sustainably managing ALL LANDS provides. These include environmental, economic and social benefits.

NSO and the Barred Owl

FWS now says it has "further research and analysis to determine that the aggressive and invasive barred owl is the primary threat to the northern spotted owl."

Thankfully, USFWS finalized a new rule on Jan. 15, 2021 that allows science to drive active forest management and economic growth once again. It recognizes the barred owl — not logging — as the greatest threat to the NSO.

AOL would also like the services and ODF to review the analysis completed in the Revised North Landscape Environmental Assessment developed by the Klamath Falls Field Office of the Lakeview BLM District. It has a very thorough analysis of NSO which incorporates current and relevant scientific findings.

The BLM found that reproductive success of the NSO "is largely believed to be driven by competition with the barred owl irrespective of the area of forest cover type associated with use by NSO (Wiens 2012, Yackulic et al. 2014, Dugger et al. 2016)" and "stochastic environmental effects such as breeding season temperature and precipitation can affect reproduction (Olson et al. 2004, Dugger et al. 2005, Glenn at al. 2009, Dugger at al. 2016)" (page 39 of Revised North Landscape EA). It is also likely that barred owls are already in the Buckeye Project Area and because they proffer the same habitat type as NSO, "the barred owls already in and around the project area are very likely to displace NSOs inside and outside of the project area going forward regardless of […] timber harvest" (page 42 of the Revised North Landscape EA).

Even for this Project which proposes treatment on almost 12,000 acres, the BLM says, "It is illogical to conclude that providing additional refugia at the scale of the North project area could positively influence the [NSO] population range-wide when detailed analysis and modeling (in the BLM's RMP) has demonstrated that providing refugia at the scale of the entire western Oregon BLM forest land base (approx. 2.5 million acres) cannot."

Dugger, K. M., F. Wagner, R. G. Anthony, and G. S. Olson. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. Condor 107:863–878.

Dugger, K.M, E. D. Forsman, A. B. Franklin, R. J. Davis, G. C. White, C. J. Schwarz, K. P. Burnham, J. D. Nichols, J. E. Hines, C. B. Yackulic, P. F. Doherty, Jr., L. Bailey, D. A. Clark, S. H. Ackers, L. S. Andrews, B. Augustine, B. L.Biswell, J. Blakesley, P. C. Carlson, M. J. Clement, L. V. Diller, E. M.Glenn, A. Green, S. A. Gremel, D. R. Herter, J. M. Higley, J. Hobson, R. B. Horn, K. P. Huyvaert, C. McCafferty, T. McDonald, K. McDonnell, G. S. Olson, J. A. Reid, J. Rockweit, V. Ruiz, J. Saenz, and S. G. Sovern. 2016. The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls. The Condor: Ornithological Applications 118:57–116.

Glenn, E. M., R. G. Anthony, E. D. Forsman, and G. S. Olson. 2011. Local Weather, Regional Climate, and Annual Survival of the Northern Spotted Owl. The Condor 113:159-176.

Holm, S. R., B. R. Noon, J. D. Wiens, and W. J. Ripple. 2016. Potential trophic cascades triggered by the barred owl range expansion. Wildlife Society Bulletin: 40(4): 615-624.

Olson, G. S., R. G. Anthony, E. D. Forsman, S. H. Ackers, P. J. Loschl, J. A. Reid, K. M. Dugger, E. M. Glenn, and W. J. Ripple. 2005. Modeling of site occupancy dynamics for northern spotted owls, with emphasis on the effects of barred owls. Journal of Wildlife Management 69:918-932.

Olson, G. S., E. M. Glenn, R. G. Anthony, E. D. Forsman, J. A. Reid, P. J. Loschl, and W. J. Ripple (2004). Modeling demographic performance of Northern Spotted Owls relative to forest habitat in Oregon. Journal of Wildlife Management 68:1039– 1053.

Wiens, J. D., R. G. Anthony, and E. D. Forsman. 2014. Competitive interactions and resource partitioning between northern spotted owls and barred owls in western Oregon. Wildlife Monographs 185:1-50.

Yackulic, C. B., J. Reid, J. D. Nichols, J. E. Hines, R. J. Davis, and E. Forsman (2014). The roles of competition and habitat in the dynamics of populations and species distributions. Ecology95:265–279.

Yackulic, C. B., L. L. Bailey, K. M. Dugger, R. J. Davis, A. B. Franklin, E. D. Forsman, S. H. Ackers, L. S. Andrews, L. V. Diller, S. A. Gremel, K. A. Hamm, D. R. Herter, J. M. Higley, R. B. Horn, C. McCafferty, J. A. Reid, J. T. Rockweit, and S. G. Sovern. 2019. The past and future roles of competition and habitat in the range-wide occupancy dynamics of northern spotted owls. Ecological Applications 29:e01861.

AOL requests that an alternative with a comprehensive barred owl management plan is developed to best meet reproductive needs for persistence of the NSO. The marbled murrelet may also benefit from predator management and this option should be worked into an alternative as well.

Treatments in the HCP

AOL is extremely concerned about the ability of the applicant to achieve its environmental goals relative to the forested ecosystem by reducing contracting capacity and the economic stability of the department.

Contracting capacity will decline under this plan as hundreds of thousands of acres are tied up in conservation areas and harvest levels plateau below a sustainable level. AOL cannot support an HCP nor ITP that results in budget deficits and severely negative effects to the forest products sector and local communities.

If a no-action is to be analyzed or any such alternative that does less work in the woods than the current HCP, AOL urges the federal services to not include any pieces from it into their decision.

That is to say, AOL does not support any alternative or amendments to the current HCP that would increase the size of Riparian Conservation Areas, Riparian Equipment Restriction Zones and Habitat Conservation Areas.

Conclusion

AOL would like to see a more balanced approach to the HCP and believes the services have a duty to ensure the plan which the ITP is tied to is implementable and cost effective. The decision should be based on an alternative that best meets the purpose and need of the EIS to assist in the survival of the covered species.

We believe an alternative that includes increased treatment, improved profitability/stable funding for the department and local governments, a recognition of wildfire effects on the covered species, and the need for predator management (including barred owl management) needs to be developed and analyzed.

This type of comparison is necessary for the services to make the most informed decision that would best meet the purpose and need of the EIS for enhancement of covered species.

AOL's nearly 1,000 members rely on the level of harvest currently occurring on WOSF. This work is their livelihood and how they support their families and communities. These member companies support around 23,000 Oregonians.

AOL would like to see a greater effort by the applicant and the services to engage these Oregonians that are most severely impacted by the decisions in front of the federal services.

Thank you for the opportunity to provide written comment on this NOI for AOL's members who depend on a sustainable and predictable supply of timber across Oregon.

Sincerely,

Amanda Astor
Associated Oregon Loggers
Forest Policy Manager
aastor@oregonloggers.org

Cascadia Wildlands | Center for Biological Diversity | Oregon Wild

April 19, 2021

Via electronic filing at www.regulations.gov

Angela Somma
Chief, Endangered Species Division, Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, 13th Floor
Silver Spring, MD, 20910

Re: NEPA Scoping Comments for Proposed Incidental Take Permit and Habitat Conservation Plan; Docket No. NOAA–NMFS–2021–0019

Please accept the following comments on behalf of Cascadia Wildlands, Center for Biological Diversity, and Oregon Wild on the National Marine Fisheries Service's ("NMFS") scoping notice for an Environmental Impact Statement (EIS) to analyze the potential impacts of the Western Oregon State Forests Habitat Conservation Plan ("WOSF HCP"). The WOSF HCP is being prepared by the Oregon Department of Forestry ("ODF") in support of a request for Endangered Species Act (ESA) incidental take permits (ITPs) authorizing incidental take of covered species by covered activities, primarily logging.[1]

This multispecies HCP is being prepared in order to streamline applicant Oregon Department of Forestry's (ODF) forest management activities in ODF-managed forest lands in western Oregon. Its provisions would cover the following species, most of which are ESA-listed or under review for listing: Northern spotted owl c marbled murrelet (*Brachyramphus marmoratus*), Coastal marten (*Martes caurina*), red tree vole (*Arborimus longicaudus*), Oregon slender salamander (*Batrachoseps wrighti*), Cascade torrent salamander (*Rhyacotriton cascadae*), Columbia torrent salamander (*Rhyacotriton kezeri*), Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (O. *kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), and Eulachon (*Thaleichthys pacificus*).

ODF will concurrently update its western Oregon Forest Management Plans (FMP) to bring them into compliance with this HCP and related ITPs, if approved, and is currently preparing for NEPA scoping on the relevant FMP(s).

[1] 86 FR 13337, Mar. 7, 2021.

I. Requirements of the Environmental Impact Statement

As an initial matter, the EIS must independently evaluate the effectiveness of all HCP components and outcomes. A NEPA document for a forest HCP that simply reiterates the rationale for the plan found in the HCP (in this case, drafted by ODF), and does not provide any additional, objective information, is insufficient. An EIS that simply paraphrases or otherwise reiterates the discussion in the HCP, or is artificially constrained by the assumptions and conclusions in the HCP, will be insufficient to meet the agencies' obligations under NEPA.

A. Habitat model suitability

Sierra Club v. Bruce Babbitt held that replacement habitat must be provided for habitat destroyed pursuant to ITPs.[2] The draft HCP proposes to enter into a 70-year permit term, and some of the future habitat modeling appears to have been designed so as to predict habitat conditions within that time frame. We question whether the 70-year time frame for certain habitat recovery into replacement habitat is meaningful on a time scale that is relevant to species persistence and recovery on the landscape scale. The EIS should fully evaluate the timeline of proposed set-asides for development into replacement habitat as mitigation for incidental take and loss of critical habitat outside the HCAs.

The HCP Handbook states that mitigation habitat should be permanently protected.[3] The EIS should fully evaluate whether the proposed HCP or alternatives would provide adequate assurance that sufficient protection for mitigation habitat is provided to meet this standard.

B. Data Gaps

The pre-eminent national scientific review of HCPs found that: when basic data on species, their conservation needs, resulting levels and impacts of "take," and other considerations are unavailable, data gaps should be filled *prior* to developing HCPs; fewer data gaps should be allowed with plans covering larger areas, longer time frames, irreversible impacts, or multiple species; if HCPs proceed in the absence of needed data, then approaches which provide greater levels of certainty for the species should be used; and that managers should adopt risk-averse strategies in the face of uncertainty.[4] Accordingly, we will discuss further below the possibility that some of the species requested to be "covered" by this HCP are unsuitable due to lack of accurate or reliable population data, or unavailability of habitat modeling.[5] In particular, we are concerned that the available information regarding population and habitat for Coastal marten,

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[2] *Sierra Club v. Babbitt*, 15 F.Supp.2d 1274 (S.D. Ala. 1998).
[3] USFWS et al. 2016. Endangered Species Habitat Conservation Planning Handbook ("HCP Handbook"). US Fish & Wildlife Service and the National Marine Fisheries Service. Washington, D.C., pp. 9-14.
[4] Kareiva, Peter, et al. (1999) Using Science in Habitat Conservation Plans. National Center for Ecological Analysis & Synthesis, Santa Barbara, CA, and the American Institute of Biological Sciences, Washington, D.C.; HCP Handbook, pp. 10-27 – 10-28.
[5] See *Sierra Club v. Babbitt.*

eulachon, and red tree voles is not sufficiently developed to allow the Services to provide coverage under this HCP and associated ITPs.

C. Best Available Science

ESA section 7(a)(2) and the Act's administrative rules require agencies to use the best available science.[6] Where possible, assertions made in HCPs should be supported by quantitative information.[7]

Independent (and presumably, academic) scientific peer review panels should be consulted during HCP development, particularly for more significant plans, like this one.[8]

Under NEPA, sufficient, accurate, and current data must be used. Accurate projections of affected species' populations under the Take Permit and HCP must be compared with accurate historical baseline populations, as well as populations that would occur *in the absence of* the Take Permit and HCP. Population trends should be compared with minimum viable population data to help assess impacts.[9]

D. Consideration of Alternatives

The EIS will consider a No-Action alternative and a reasonable number of action alternatives, including ODF's draft HCP and other habitat management strategies. Consideration of alternatives is the heart of an EIS.[10]

Under NEPA, an EIS must "[e]valuate reasonable alternatives to the proposed action."[11] An agency may not "consider only those alternatives with [the same] end result."[12]

The range of reasonable alternatives is dictated by the "nature and scope of the proposed action," and must be sufficient to permit the agency to make a "reasoned choice."[13] The analysis must include the alternative of no action.[14]

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[6] 16 U.S.C. § 1536(a)(2).
[7] Kareiva et al. (1999).
[8] *Id.*
[9] *Sierra Club v. Bruce Babbitt.*
[10] 40 C.F.R. § 1502.14.
[11] 40 C.F.R. § 1502.14(a).
[12] *Resources Ltd. v. Robertson* (35 F.3d 1300, 1307 (9th Cir. 1994), as cited in Arum (1998).
[13] *Alaska Wilderness Recreation and Tourism v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995).
[14] 40 C.F.R. § 1502.14(c).

The existence of a "viable but unexamined alternative renders an environmental impact statement inadequate."[15] Likewise, an agency may not "consider only those alternatives with [the same] end result."[16]

The EIS must include "reasonable options" for avoiding or mitigating to insignificance any significant cumulative effects identified.[17] The review may not omit any alternative that remains economically feasible but takes fewer lives than the proposed HCP; to do so is to fail to consider a reasonable range of alternatives.[18]

The EIS must explain how each alternative will or will not achieve the policies of NEPA and other relevant environmental laws and policies.[19]

To be credible and accurate, the "no action" alternative must accurately describe baseline conditions and assume full compliance with, and enforcement of, existing federal and state laws. Specifically, the "no action" alternative must assume the State and landowners' full avoidance of "take" of all covered listed species. A "no action" alternative that assumes minimal compliance with or enforcement of the ESA, and therefore seriously overestimates the purported benefits of the HCP's mitigation program, is not acceptable.

The no action alternative must also account for the likelihood that unlisted sensitive and imperiled species will be listed in the future and subject to ESA restrictions.

The draft HCP proposes an ITP term of 70 years. The EIS should evaluate an alternative that analyzes a shorter permit term of perhaps 30 years. Western Oregon state forests are currently subject to a range of variability that will likely increase in intensity in the near-term. While some of these changes, related to climate, wildlife populations, and human demographics, among others, are somewhat predictable, many are not. A range of confounding variables and assumptions make these changes hard to predict.

For example, it is fairly well accepted that the next decade or so of climate action on the part of industrial society will determine the Earth's climate scenario for the centuries to come. IPCC modeling predicts a wide swing of future climate conditions based on actions that are happening (or as it may be, failing to happen) this decade. Until the scientific community has a clearer sense of what "climate path" we are on, trying to predict habitat conditions in 2080, for example, for many of the climate-sensitive species proposed to be covered for 70 years by this HCP, is likely a fool's errand.

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[15] *Alaska Wilderness Recreation & Tourism v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995).
[16] *Resources Ltd. v. Robertson*, 35 F.3d 1300, 1307 (9th Cir. 1994).
[17] 40 C.F.R. § 1508.25.
[18] *Union Neighbors United, Inc. v. Jewell*, 831 F.3d 564 (D.C. Cir. 2016).
[19] 40 C.F.R. § 1502.2(d).

On top of this uncertainty, populations for many, perhaps most, of the species proposed to be covered by this HCP are in rapid decline. While we certainly advocate for proactive, protective planning to be implemented as quickly as possible based on the knowledge now available to us, we cannot advocate for the potential management inflexibility that could result from an HCP with a seven-decade term.

An additional point is that relatively little is known about one or more of the species proposed to be covered, prime among these being the coastal marten and the red tree vole. (See below.) We suggest the EIS consider whether these species can properly be covered under this HCP in the face of this uncertainty. The EIS should also consider whether a 70-year permit term can realistically be placed for species about which there is so little knowledge. A shorter permit term might account better for the uncertainty around the habitat needs and population trends for these species, and perhaps others proposed for take permits here.

E. Evaluation of Species

Impacts should be assessed explicitly for each listed and unlisted species covered by the HCP, as should the relationship between the landowner's forest management practices and each species' conservation needs, including the species' recovery needs.

The EIS must include a detailed biological analysis of the impacts of timber harvesting, resource extraction and other activities authorized by the HCP and Take Permit on *each* wildlife and plant species (whether listed or unlisted) to be "covered by" the HCP and all designated critical habitat areas.

Impacts to all threatened, endangered, candidate, proposed-listed, sensitive, rare, endemic, or otherwise at-risk or ecologically, socially, or economically important plant and animal species should be assessed, *regardless* of whether those species are officially "covered" by the HCP.

The EIS must analyze the impact of activities on all species "occurring or potentially occurring" on all lands subject to the HCP, regardless of whether they will be "covered" by the HCP. If any wildlife or plant species occurring or potentially occurring on lands subject to the HCP will *not* be covered by the plan, the EIS must analyze the impacts of the HCP on these species, why they are not covered, and include mitigation measures for any significant impacts identified.

The HCP Handbook notes that the Services must consider impacts on Federally-listed plants, during ESA section 7 consultation, regardless of whether those plants are "covered" by the HCP. Plants protected by state laws are among those which must be addressed, pursuant to ESA section 9.[20]

For each species, the analysis must: (1) specifically indicate how the HCP and Take Permit will affect species' survival *and* recovery prospects; (2) describe activities that may result in take of

[20] HCP Handbook, pp. 1-8, 7-2, 7-6

covered species; and (3) *quantify* the anticipated level of take resulting from all activities authorized under the HCP. The EIS must indicate whether the impacts of the HCP and Take Permit on each of these species will be significant, and if so, include *species specific* mitigation measures and management actions for *each* significant impact identified.[21]

The EIS likewise must objectively analyze the likely short-term *and* long-term effectiveness of each of the HCP's proposed measures to minimize and mitigate incidental take of covered species and provide a scientifically justifiable reason why and how these measures will mitigate any significant adverse impacts to species to a level of insignificance.[22]

Only mitigation and other conservation measures provided *by the applicant* may be considered in making the finding.[23] Conservation values provided by neighboring landowners or entities may not be considered.[24]

The EIS must analyze the reasonably foreseeable biological impacts of including a "no surprises" provision in the HCP and implementing agreement. The effects of the "no surprises" policy over both the short and the long term are extremely likely to be significant. Thus, if 1) the HCP fails to achieve its stated goals, 2) the HCP conditions prove inadequate to protect species, 3) new scientific information is discovered which affects the assumptions in or conclusions of the HCP, and/or 4) unanticipated circumstances significantly change the environmental baseline, then federal and state agencies may be restricted in their enforcement and ability to respond in order to conserve the species.

The EIS must assess impacts to all environmental values in the plan area, including both direct and cumulative effects. These values include, but are not limited to, unlisted, sensitive, rare or endemic, or otherwise at-risk fish, wildlife, and plant species; water quality; water supplies and the timing of flows; air quality; open space; soil productivity; and the sequestration and storage of atmospheric carbon dioxide.

The alternatives' impacts on the covered species' existing and likely-to-be-designated critical habitats must also be carefully examined, since the proposed HCP and Take Permit or other "assurances" may not be legally issued if they adversely modify the species' critical habitats, as per ESA section 7(a)(2).

The EIS must fully assess the impacts of each forest management activity (*i.e.*, specific types of logging operations, site preparation operations, road construction plans, specific herbicide applications, specific silvicultural regimes and resulting forest growth, etc.) permitted by the

[21] 40 CFR s. 1502.16(h).
[22] HCP Handbook, § 9-5
[23] *Klamath-Siskiyou Wildlands Center et al. v. NOAA et al.*, Case No. 13-cv-03717 (2015 U.S. Dist. LEXIS 44872 & 2015 U.S. Dist. LEXIS 70622) (N.D. Cal. 2015).
[24] *Id.*

Take Permit on all environmental resources, including water quality, air quality, watershed and geologic impacts, land use, and so forth.

In order to adequately evaluate the impacts of the HCP on water quality, the EIS must include adequate baseline data which specifically describes the habitat structure and quality of different streams and watersheds in the HCP area. This includes stream temperature, sedimentation and turbidity, percentage of shade canopy, and the location, quality and quantity of large woody debris, spawning gravel, riffles, pools, fish spawning and rearing sites, and key forest plant and animal species. Streams, roads, road crossings, landings and skid trails should be described and mapped. In addition, the EIS must identify the steepness, stability and erosion hazard rating of slopes, and the location of any previous slope and road failures, erosion and mass wasting incidents. The EIS also must assess and map upslope activities that would potentially deliver sediment to streams and are potential sources of slides, erosion and mass wasting.

The EIS must analyze impact of the HCP on each of these baseline parameters, including stream sedimentation, temperature and turbidity; canopy retention; recruitment of large woody debris; late seral forest characteristics of stream corridors; and wildlife and vegetative structure and diversity, both during harvest and over the long term. The EIS must examine the impact of construction and maintenance of roads, road crossings, landings and skid trails, wet weather operations, operations on steep slopes and near watercourses, and the ability of culverts to accommodate projected and unanticipated storm events.

The EIS also must evaluate the impact of timber harvesting and other activities authorized by the HCP on the different streams and watersheds in the HCP area to meet applicable basin plan limitations, water quality objectives, total maximum daily loads, and antidegradation requirements over the life of the HCP. Finally, the EIS must evaluate the adequacy of the HCP's mitigation measures, such as leave tree standards, stream buffers, canopy retention and recruitment of large woody debris to offset the adverse impacts of the HCP.

Determinations of which species are likely to be using the covered lands should be based primarily on field surveys. It is not safe to assume that past land management eliminated all sensitive species and their habitats, or on state species databases, which are notoriously inadequate. Determinations about species which will need habitats to be restored on the property for their recovery should consider the site’s potential natural habitats, based on soils, potential vegetation, elevation, local climate, etc.

The EIS must provide: 1) detailed, thorough, and quantitative descriptions of the habitat and population conditions that will correspond to each covered species’ recovery, 2) detailed, quantitative habitat and population projections for each species covered by the HCP, for each alternative, and 3) compare the alternatives’ outcomes identified in step (2) with the indicators of recovery identified in step (1).

The analyses for HCPs, particularly those covering large areas or large amounts of a species' range, should inventory, summarize, and document available data on each species and their distribution, abundance, population trends, ecological requirements, life history, and causes of endangerment.[25]

Quantitative estimates of the impacts of "take" on species' viability should be provided, especially for larger or more significant plans. At a minimum, best and worst-case scenarios should be identified.[26]

Impacts of "take" should also be evaluated, particularly for larger or more significant plans, including by determining whether the habitats being "taken" correspond to population "sources" or "sinks," whether genetically unique subpopulations are being "taken," and whether unique habitat/species combinations are being impacted.[27]

The analyses for HCPs must address each of the following: species status reviews, analyzing the proposed "take," assessing the impacts of "take," planning and assessing mitigation measures, and planning and assessing monitoring provisions.[28] Assertions made in the analyses for HCPs should be supported by quantitative information.[29]

The analysis in the EIS must be supported by accurate and adequate baseline data (including field surveys), scientific studies, population viability analyses, and other information which provides a scientifically justifiable basis for the environmental document's conclusions. Specifically, the EIS must include comprehensive biological assessments for each covered species (and particularly listed species), and their associated habitats. Such assessments should address such issues as species abundance and distribution, habitat requirements (*e.g*. important food sources and foraging habitat, and nesting, roosting and dispersal habitat), biologically important symbiotic relationships with other species, life history and population trends, both range-wide and within the plan area.

F. Evaluation of Cumulative Impacts

The analyses for HCPs should evaluate the cumulative impacts of multiple plans and their interactions. The percentage of local *and* global populations that will be "taken" should be assessed.

A thorough cumulative effects analysis should be conducted to address all federal and non-federal actions affecting each species covered by the ITP and HCP. The analysis should also address all past, present, and reasonably foreseeable actions across the species' ranges. This

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[25] Kareiva et al. 1999.
[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] *Id.*

includes timber harvest: the EIS must adequately identify and analyze the impacts of all past, present, and reasonably foreseeable timber harvest projects in the action area.[30]

An EIS must analyze cumulative actions, which when viewed together have cumulatively significant impacts. Where several foreseeable similar projects in a geographical region have a cumulative impact, they should be evaluated in a single EIS. Cumulative effects analyses are also required as part of the ESA section 7 consultation process for HCPs.[31]

In addition to cumulative impacts, this discussion must address the direct and indirect impacts of the project. Direct effects are those which are immediately caused by the action; indirect effects are those which will be caused by the action at a later time, but which are nevertheless reasonably foreseeable.

Of note, this draft HCP repeatedly failed to perform a cumulative impacts analysis for proposed covered species.[32] The EIS may not do so.[33]

G. "Hard Look" and Other NEPA Requirements for an HCP EIS

The Services must take a "hard look" at the environmental consequences of approving an action, *i.e*., an ITP and HCP.[34]

NEPA requires an EIS to include a discussion of significant adverse effects which cannot be avoided if the proposal is implemented.[35] NEPA requires a discussion of any irreversible or irretrievable commitments of resources which would be made if the proposal is implemented.[36]

The EIS must objectively and independently evaluate any assertions by the HCP applicant that certain mitigation measures are "impracticable" or "infeasible." Such assertions must be supported by reliable and specific documentation of impracticability or infeasibility.[37]

Activities on other lands not subject to the HCP's Implementation Agreement should be considered as speculative, and not counted as mitigation for "take" authorized by the Take

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[30] Klamath-Siskiyou Wildlands Center et al. v. NOAA et al., Case No. 13-cv-03717 (2015 U.S. Dist. LEXIS 44872 & 2015 U.S. Dist. LEXIS 70622) (N.D. Cal. 2015).
[31] 50 C.F.R. § 402.14.
[32] See, *e.g*., Draft HCP 5-27, 5-64 – 5-65.
[33] Inasmuch as the September 14, 2020 NEPA Rule would alter requirements for a cumulative impacts analysis, the Department of the Interior is now operating under a Secretarial Order directing it to apply NEPA regulations as they existed prior to the 2020 Rule. (Secretarial Order No. 3399 (Apr. 16, 2021) §5(a).) While a non-DOI agency is the lead preparer on this EIS, the partner agency, USFWS, is an Interior agency and it is advisable to prepare a cumulative-impact review as per previous guidance.
[34] *Kleppe v. Sierra Club*, 427 U.S. 390, 410 n.21 (1976).
[35] 40 CFR § 1502.16.
[36] *Id.*
[37] HCP Handbook, pp. 9-32 – 9-33.

Permit. The EIS must also account for any new information which has come to light during development of the HCP.

H. Implementation Issues

The EIS must analyze the adequacy of the commitments for funding the mitigation and monitoring measures in the HCP to support long term species conservation. The analysis must include financial and other data, which accounts for inflation, depreciation of assets, increased real estate values, and other contingencies, to support the conclusions reached. If the EIS concludes that the funding mechanisms are inadequate, it must propose alternate funding mechanisms which would achieve long term conservation of species for the life of the permit.

The EIS should evaluate the availability of federal and state funds to meet any future mitigation requirements. If the availability of federal and/or state funds is a likely possibility, then the EIS must also analyze the biological effects resulting from the permittee's and/or the government's future unwillingness or inability to provide adequate mitigation or HCP implementation funding on USFWS and NMFS determinations pursuant to ESA section 7.

The EIS should fully analyze the impacts of both foreseeable and unforeseeable changed circumstances on the assumptions, conclusions and mitigation measures contained in the HCP, and how these changed circumstances will affect species survival and recovery, population trends, habitat quality and quantity, water quality, and other environmental factors. Foreseeable circumstances include fire, flood, lightning, disease and other stochastic events. The HCP must contain mitigation measures to address such foreseeable circumstances, and specific, detailed procedures to address any unforeseen circumstances, as required by the ESA and its implementing regulations. These critical provisions cannot simply be passed off as a federal government obligation under the "no surprises" policy.

The details of the HCP's mitigation measures must be explicitly described and accompanied by data on their effectiveness. The likely success of each measure must be evaluated, as must the overall effectiveness of mitigation measures at minimizing and offsetting "take."[38]

II. HCP – Administrative Draft (March 2021)

<u>Proposed Covered Species</u>

A. Coho

NMFS first listed coho salmon (*Oncorhynchus kisutch*), on the Oregon Coast—*i.e.*, the Oregon Coast coho salmon evolutionary significant unit (ESU)—as a "threatened" species under the ESA

[38] Kareiva et al. 1999.

in 1998.[39] Following several court challenges and status reviews, NMFS reaffirmed the need for listing of the ESU in 2005, 2008, and 2011.[40]

NMFS listed the Oregon Coast ESU due to declining abundance from the loss of freshwater habitat, the consequence of (among other human activities) logging—in particular, clear-cutting trees on steep, unstable slopes and along debris flow paths—and road construction associated with log-hauling in the Oregon Coast range.[41] Soil erosion and stream sedimentation from logging, road construction, and repeated log-hauling with heavy logging trucks "seriously degrade[]" pools and side channels where coho spawn and spend their first phases of life.[42]

Lack of proper management and protections on the state forests that are the subject of this HCP were a primary justification for listing Oregon coast coho with NMFS concluding in the most recent reaffirmation of the need to list that: "we are unable to conclude that the state forest management plans will provide for OC coho salmon habitat that is capable of supporting populations that are viable during both good and poor marine conditions."[43] This conclusion was repeated in the 2016 recovery plan for coho when NMFS again determined that the State's plans and rule changes were inadequate to conserve the ESU.[44]

ODF first produced a draft HCP for coho and other species in 1997, but never finalized this plan in large part because of disagreements between ODF and NMFS concerning buffering of the first order streams that, following clearcutting, spawn landslides and debris flows that deposit harmful fine sediments in coho bearing streams. We remain concerned that this problem is not sufficiently addressed by ODF's proposed avoidance and mitigation measures.

The WOSF HCP acknowledges the well-studied fact that "vegetation removal and ground disturbance increase the likelihood of slope failure" and that when slope failures lead to debris flows that reach fish-bearing streams it can "deteriorate instream habitat and water quality."[45] To address this problem, ODF proposes 35-foot buffers on potential debris flow tracks "from the aquatic zone to the potential initiation site."[46]

ODF, however, has steadfastly refused to identify the specific initiation sites that will be buffered. Instead, ODF rates sites by hazard based "on professional experience and field observation" with only sites rated as high hazard receiving a buffer on the initiation site. We have little confidence that this approach will result in buffers on a sufficient proportion of

[39] 63 Fed. Reg. 45,587, Aug. 10, 1998.
[40] 70 Fed. Reg. 37,160, June 28, 2005; 73 Fed. Reg. 7830, Feb. 11, 2008; 75 Fed. Reg. 29,489-29,290, May 26, 2010.
[41] 73 Fed. Reg. 7816, 7821, Feb. 11, 2008.
[42] 60 Fed. Reg. 38,011, 38,024, July 25, 1995; see also 62 Fed. Reg. 24,588, 24,592-93, May 6, 1997: logging removes natural vegetation, destroys riparian areas, reduces large woody debris, and triggers soil disturbance, mass wasting events, surface erosion, and sedimentation.
[43] 75 Fed. Reg. at 29500, May 26, 2010.
[44] See COHO RECOVERY PLAN at S-6; 73 Fed. Reg. at 7821.
[45] Draft HCP 4-45.
[46] Draft HCP 4-38.

landslide initiation sites to prevent logging related increases in landslides and debris flows and corresponding impacts to coho and their habitat. We base this conclusion on expert modeling, as well as field observations, demonstrating that ODF timber sales on the Tillamook State Forest planned in the 2021 annual operations plan, which ODF represented were developed in accordance with the HCP, failed to buffer most of the landslide initiation sites.

To determine the degree to which ODF is buffering landslide initiation sites, we used modeling and mapping of landslide risk in combination with data obtained from ODF showing the boundaries and buffers of the 2021 sales. Based on our results, it is apparent that ODF is not identifying or buffering most landslide initiation sites as proposed in the WOSF HCP. We are thus concerned that timber harvest in steep landslide prone areas of the State Forests, particularly on the Tillamook District, will continue to increase the number and severity of landslides and debris flows with harm to coho survival and recovery.

As explained in great detail in expert reports by Dr. Josh Roering and Dr. Kelly Burnett, provided with these comments, extensive research in the Oregon Coast Range demonstrates:

- ❖ steep convergent terrain characterized by topographic hollows is the primary source of shallow landslides in the Oregon Coast Range, which are a dominant geomorphic process.

- ❖ the highly dissected and channelized topography of the Coast Range makes it likely that shallow landslides will become debris flows.

- ❖ logging by reducing root strength in the shallow soils of the Coast Range greatly increases the likelihood, occurrence and density of shallow landslides.

- ❖ the proximity of steep slopes to coho bearing streams on the state forests means that in many cases these debris flows will deliver to coho bearing streams.

Reflecting these well-established principles, we modeled landslide initiation risk across the Tillamook and Clatsop State Forest. We relied on available data, including ODF timber sale boundaries with riparian buffers, lidar-based digital elevation models, roads and haul routes, ODFW-identified coho streams, and slopes greater than 45 degrees. We used two well-supported models that were developed and evaluated for the Oregon Coast Range: 1) areas of steep, convergent terrain, which are the primary source of shallow landslides in the Oregon Coast Range, were identified with the SHALSTAB model; 2) areas where shallow landslides are likely to generate debris flows that deliver harmful fine sediments to coho streams were identified with the LAHARZ model. The Laharz model uses catchment area in combination with simple flow and channel mechanics to predict runout.

The results of these models are presented for one of ODF's timber sales, Coast Bill, and show that numerous landslide initiation sites that present a clear risk to occupied coho streams in the

South Fork of the Trask River and Joyce Creek are unbuffered. This point is further highlighted by the fact that a unit of an older timber sale called Alder Joy just below landslide terrain on Coast Bill has already caused two landslides. The timber sale layout did not buffer the initiation sites or debris-flow runout paths and so the landslides delivered fine sediments to the South Fork of the Trask River.

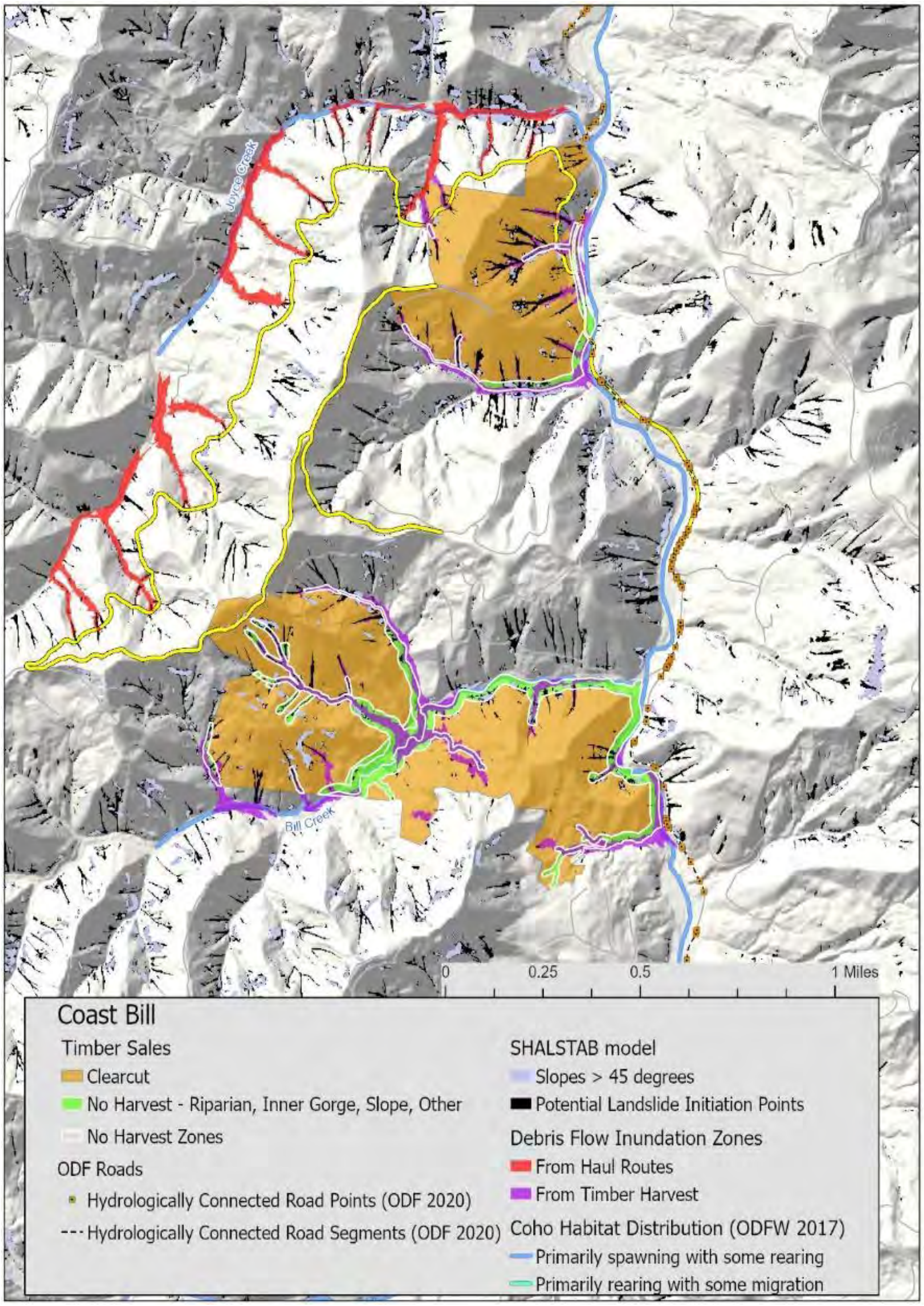

Figure 1. the Coast Bill Timber Sale from the Tillamook District's 2021 AOP, including unit boundaries, buffers and haul routes from ODF and modeling by the Center for Biological Diversity.

ODF provides no explanation as to why it is not identifying buffers for landslide initiation sites as part of the HCP, which puts NMFS in the untenable position of having to make a jeopardy determination for coho with incomplete information. The impact of fine sediments from landslides and debris flows generated by clearcutting on coho salmon and their habitat are severe and well documented (see expert report of Dr. Tom Quinn), yet NMFS will have little to no basis for concluding that ODF's buffering of landslide initiation sites is sufficient to mitigate this harm, in the absence of better information.

ODF's reticence to identify and buffer landslide initiation sites is puzzling because as part of developing the HCP, it contracted with Terrainworks to model landslide and debris flow likelihood, which like us, used SHALSTAB. Based on this modeling, ODF has identified buffers for the stream network everywhere except landslide initiation sites. Our understanding is that the buffers were specifically designed to protect the reaches that are likely to carry debris flows to fish-bearing streams and thus deliver wood, meaning ODF has already identified the landslide initiation sites most likely to spawn landslides and debris flows that need buffering. We obtained ODF's layer of proposed buffers and have overlain it on the Coast Bill map (Figure 2). This map makes clear that ODF could map and buffer landslide initiation sites and that the additional buffering needed to cover landslide initiation sites is relatively small. The areas we're concerned about are the landslide initiation sites above the buffers (green) identified by ODF, which by definition are areas that are likely to experience debris flows and deliver to fish bearing streams. **As part of the EIS, we request that you consider an alternative that buffers landslide initiations sites above the areas identified by ODF as likely to deliver to fish bearing streams, as shown in the below map (buffer the black areas above the green areas). To facilitate evaluation of such an alternative, we are glad to provide you our SHALSTAB files. All of our modeling as well as additional information from ODF and other sources is also available on a mapserver that we can provide access to upon request.**

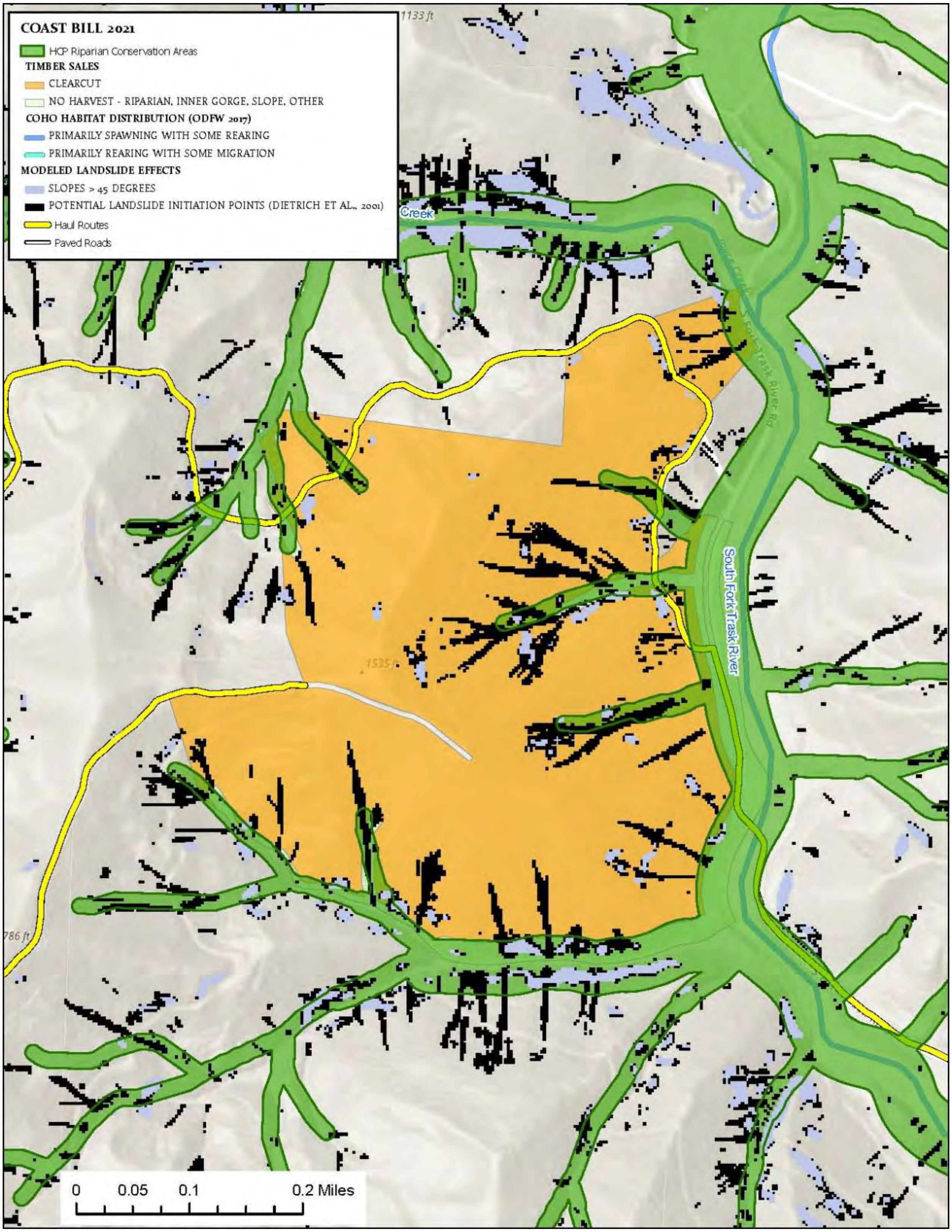

Figure 2. Proposed buffers in the WOSF HCP overlain on the Coast Bill Timber Sale and modeling of landslide hazard.

The Coast Bill map highlights another issue we are concerned about—problematic roads (Figure 1). The haul route for this sale includes extensive stretches of mid-slope road that cross multiple landslide initiation sites with the potential to deliver fine sediments to coho streams. Indeed, the slides from Alder Joy initiated at the mid-slope road that is proposed as the haul route for Coast Bill. The WOSF HCP states that unstable roads will be closed, which seems appropriate for this road, likely meaning the Coast Bill Sale could not be logged as planned.[47] The haul route also includes the South Fork Trask River Road, which is stream parallel and based on data from ODF shown on the map, has multiple points of hydrologic connectivity. Overall, road densities on the Tillamook and Clatsop are over 4 miles per square mile, exceeding harmful thresholds for coho salmon. We would like the HCP to include considerably more specifics about where roads will be closed to reduce the many problems associated with this road network.

In sum, ODF's buffer strategy for the stream network specifically excludes the headwater reaches most likely to generate landslides and debris flows when clearcut or intersected by roads. ODF also fails to identify or set targets for reducing the road network to lesson impacts on coho and their habitat. As such, NMFS will have little to no basis for concluding the WOSF HCP provides sufficient mitigation and avoidance to avoid jeopardy of coho salmon. We believe this is sufficient basis to reject the permit application and request that ODF buffer landslide initiation sites and identify specific roads that will be closed to lesson impacts to coho salmon and streams.

B. Chinook, Steelhead, Chum

Our concerns regarding implementation of the HCP as designed, in reference to the other potentially covered salmonids, mirror those described above for coho. The draft HCP commits to protecting within RCAs all aquatic critical habitat within the permit area. Again, the sufficiency of that approach must be evaluated in light of the concerns raised above regarding RCA buffering guidelines and roads.

The 2011 Recovery Plan for Upper Willamette River Chinook and steelhead, for example, lists as primary threats:

- Timber harvest on unstable slopes and riparian areas as leading to the decoupling of watershed processes.
- Improperly located, constructed, or maintained roads have degraded stream flow and sediment supply processes.[48]

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[47] Draft HCP 4-62.

[48] Oregon Department of Fish and Wildlife and National Marine Fisheries Service (ODFW and NMFS). 2011. *Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead.*

We discuss concerns with these management impacts in other sections of these scoping comments, but highlight them here with regard to specific threats previously identified by NMFS to the Upper Willamette fish.

Regarding Columbia River chum salmon, the ESU is in significant decline, with just a few thousand returns expected annually versus perhaps around a million per year historically. 14 of 17 of the historical spawning populations have been extirpated or functionally extirpated.[49] Ongoing barriers to recovery for many of the populations include impacts caused in large part by logging, such as increased fine sediment, lack of channel complexity, and lack of large woody debris.[50]

Restoration of tributary spawning habitat is essential to the recovery of the species. The draft HCP notes:

> The most recent status review that addressed Columbia River chum salmon synthesized previous status conclusions and evaluated recent data and observations (NWFSC 2015). The status review determined that, as of 2015, some improvements and declines in individual populations have been observed, but the majority of DIPs in the ESU remain at a high or very high risk category, and most chum populations require substantial improvements to meet their recovery viability goals.[51]

Please be certain the EIS contains a full analysis of whether and how this plan would contribute to restoration of chum habitat.

In regard to Oregon Coast spring-run Chinook, one of us (Center for Biological Diversity) noted in a recent letter to NMFS that "From the 1950s to the present, Oregon coast spring Chinook populations have faced significant declines, and spawning runs now are only a very small fraction of historical abundance. . . . Oregon coast spring Chinook face multiple threats. . . . Logging and roads in Oregon's Coast Range have degraded habitat by reducing stream shade, increasing fine sediment loads, reducing large woody debris instream, and altering watershed hydrology—depleting flows that support spring Chinook migration, holding, and spawning."[52] The Service has recently determined to undertake a status review to determine whether a threatened or endangered listing is warranted.[53] Again, many of the impacts discussed in this section and in the sections on coho and forestry practices must be evaluated in the context of this declining ESU.

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[49] National Marine Fisheries Service (NMFS). 2013. *ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead. Northwest Region*.
[50] Draft HCP C5-12 – C5-13.
[51] *Id.* at C5-12.
[52] Center for Biological Diversity, et al., "60-day Notice of Intent to Sue for Violations of the Endangered Species Act Relating to the Service's Late Finding on a Petition to List the Oregon Coast ESU of Spring-Run Chinook Salmon (*Oncorhynchus tshawytscha*) as an Endangered Species" (Mar. 31, 2021).
[53] 90-Day Finding, 85 FR 20476 (Apr. 13, 2020).

An additional consideration is that, overall, while the draft HCP punted on preparing a reasonable cumulative impacts analysis for salmonids, the EIS may not do so. "ODF is not aware of any future state or local actions that may contribute to cumulative effects that are reasonably certain to occur."[54] Whether or not it is possible for that statement to be true, the Services are aware of such actions and must fully evaluate them for the length of the chosen permit term. Continued heavy logging and some road-building, for example, are "reasonably certain" to occur in the next 70 years in the range of covered fish species, on federal and private industrial timberlands. Ongoing increased peak flows and reduced summer flows are also certain to result rangewide for the covered fish species due to ongoing clearcut harvesting on a range of land ownerships across the region.

C. Eulachon

Given the high importance of this once very-abundant forage species to the marine food web and the relatively limited current knowledge regarding its distribution or occurrence in the permit area, we question whether eulachon (*Thaleichthys pacificus*) should be "covered" by this HCP and associated ITP. The draft HCP gives some conclusory and not particularly compelling statements regarding whether eulachon might be present in the plan area. ODF has determined that based on the location of critical habitat, eulachon are "unlikely" to reside within the HCP's geographical boundaries.[55]

That misses the point in at least two ways. One, the critical habitat designation does not indicate the only places where the species might occur. Two, even if eulachon are not living in streams within state lands, ODF remains responsible for downstream impacts its practices might have on the species. In addition, the draft HCP notes that there is a Washington Department of Fish and Wildlife monitoring site for eulachon across the Columbia River from ODF lands, but does not mention what data has been collected there or why that would help ODF determine whether eulachon are present in the permit area.

The HCP Handbook is worth quoting at length here:

> A key factor in determining whether to cover a species is how much is known about the species. If there is not enough information available . . . to develop a conservation strategy for a particular species, choosing not to cover the species may be best. In this case, take of an ESA-listed species must be avoided or the permit cannot be issued as it will be difficult to understand the impacts of the taking, and it will be difficult to develop a conservation strategy that will mitigate those impacts. Another key factor is whether the species occurs in the permit area. If there is not enough information available to determine if one of the covered species occurs within the plan area or not, there is unlikely to be sufficient information for an adequate effects analysis, which are required

[54] *Id.* at 5-27.
[55] Draft HCP at C10-2.

> contents of an HCP, National Environmental Policy Act (NEPA) document, and Section 7 analysis. An additional consideration is the option of including species that do not currently occur in the plan area, but are reasonably likely to move into and occur in the area during the life of the plan, *e.g.*, due to a range shift related to climate change effects or for other reasons.[56]

According to commercial catch data, the eulachon catch "declined from 2.1 million pounds annually from 1938–1989 to 5,000 pounds in 1999."[57] This is a massive decline and a real emergency.

As the draft HCP states:

> The current abundance of eulachon is low and declining in all surveyed populations throughout the DPS (NMFS 2011). Eulachon populations spawning in the Klamath River, lower Columbia River Basin, and Fraser River have declined substantially, and the southern DPS will likely become endangered in the foreseeable future if ongoing threats are not addressed (NMFS 2011). Past and ongoing federal, state, and local protective efforts (many of them habitat-based) have contributed to the conservation of the southern DPS, but these efforts alone do not sufficiently reduce the extinction risks faced by the southern DPS (NMFS 2011).[58]

This deadly serious situation requires a full evaluation and consideration as to whether a take permit could, in good conscience, be issued for this species.

D. Northern Spotted Owl

The Northern spotted owl (*Strix occidentalis*) was listed as threatened under the federal ESA in 1990, and USFWS issued a determination that an uplisting to endangered was warranted but precluded by higher-priority actions in late 2020.[59] The owl is listed as a state threatened species under the Oregon ESA.

The owl's continued decline in the 30 years since its listing provides ample reason for its uplisting but also serves as an indication that business-as-usual operations accompanied by previous conservation measures, have failed to provide for the persistence or recovery of the species. At this point, if we hope to ensure persistence and recovery of the spotted owl, we have to be willing to embrace much more protective conservation measures than we have done, to date.

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[56] HCP Handbook, p. 7-3.
[57] Draft HCP at C10-5.
[58] Draft HCP, p. C10-5.
[59] USFWS, NSO WBP Finding, 85 FR 81144 (2020).

As USFWS recently stated:

> Habitat loss was the primary factor leading to the listing of the northern spotted owl as a threatened species, and it continues to be a stressor on the subspecies due to the lag effects of past habitat loss, continued timber harvest, wildfire, and a minor amount from insect and forest disease outbreaks. The most recent rangewide northern spotted owl demographic study (Dugger *et al.* 2016, entire) found that nonnative barred owls are currently the stressor with the largest negative impact on northern spotted owls through competition of resources. The study also found a significant rate of decline in northern spotted owl populations (3.8 percent per year for all study areas combined but as high as 8.4 percent per year in one study area in Washington), and the rate of decline has increased noticeably since the 2011 5-year Review for the Northern Spotted Owl (USFWS 2011b, p. 3). Populations of northern spotted owls in several long-term demographic monitoring areas have declined more than 70 percent since the early 1990s, and the extinction risk for northern spotted owl populations has increased, particularly in Washington and Oregon.[60]

As regards threats posed by state-level management, USFWS found that "[o]n non-Federal lands, State regulatory mechanisms have not prevented the continued decline of nesting/roosting and foraging habitat; the amount of northern spotted owl habitat on these lands has decreased considerably over the past two decades, including in geographic areas where Federal lands are lacking."[61]

This raises a number of concerns, all of which should be evaluated in the EIS. One, if state regulatory mechanisms in Oregon and Washington (as applicable here, the Oregon Forest Practices Act) have been insufficient to prevent owl decline, then perhaps this HCP should not use those as a baseline for its management scheme. While we appreciate that almost half the permit area would be incorporated into HCAs with the purpose of providing—now or in future decades—functioning owl habitat, we remain extremely concerned that the over 50% of non-HCA acres on ODF's forests will be treated as de facto "sacrifice zones." The current draft of the HCP proposes to manage non-HCA stands pursuant to the minimally protective standards of the Oregon Forest Practices Act, which, as USFWS noted, have done little or nothing to prevent owl decline in recent decades (or perhaps have actively contributed to the decline).

In addition, the HCP proposes that some 40% of non-HCA stands will be managed in such a way as to provide owl dispersal habitat, *i.e*., by leaving some stands with at least 40% canopy cover.[62] As discussed further below, this stand structure may not sufficiently provide for dispersal. As a consequence, the conservation value of the non-HCA lands may be even lower than ODF assumes in the draft HCP.

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[60] *Id.*, 81145.
[61] *Id.*
[62] Draft HCP 4-85.

E. Marbled Murrelet

Commenters here submitted a state petition to uplist the marbled murrelet (*Brachyramphus marmoratus*) from threatened to endangered pursuant to the Oregon Endangered Species Act (OESA) in 2016. A series of decisions and reversals by the Oregon Fish & Wildlife Commission will culminate in a hearing on the petition and potentially a final decision in summer 2021. The species is currently listed as threatened under the federal ESA and as endangered under both the Washington and California state ESAs.

According to the 1997 USFWS recovery plan for murrelets, "Marbled murrelet occupied sites along the western portion of the Tillamook State Forest are especially important to maintaining well-distributed marbled murrelet populations. Efforts should focus on maintaining these occupied sites, minimizing the loss of unoccupied but suitable habitat, and decreasing the time for development of new habitat."[63]

One of the goals of this HCP is to support the persistence of the murrelet, and the plan proposes to do so primarily through the mechanism of designating HCAs on state forests within the bird's range. Accordingly, the EIS must very carefully evaluate whether the HCAs as designed suffice for this purpose, given the predictably heavy logging that will occur outside the HCAs on ODF lands in the decades to come, in addition to the very heavy, short-rotation clearcut logging that is rampant on private industrial timberlands throughout the murrelet's range in Oregon. In other words, while the HCP and associated FMP may provide more protection for murrelet habitat on ODF lands than current management assures, will it be enough? Significant cumulative impacts across land ownerships and management schemes in the Coast Range may cast doubt on that.

From ODFW's status review for the uplisting petition:

> Marbled Murrelets have narrow habitat requirements and limited geographic distribution. Occupied landscapes tend to have large amounts of cohesive (unfragmented) older forest nesting habitat. Once nesting habitat is lost, high breeding site fidelity and limited flight range from the coast to inland forests may further restrict distribution. Contemporary events that remove old-growth or mature forests may be difficult or impossible for the species to compensate for in the short-term since suitable habitat takes many decades or centuries to develop.[64]

The status review highlights the critical importance of state-owned and managed lands in the Coast Range for murrelet persistence:

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[63] USFWS, "Recovery Plan for the Threatened Marbled Murrelet" (1997) at 127.
[64] ODFW. 2018. Status review of the Marbled Murrelet (*Brachyramphus marmoratus*) in Oregon and evaluation of criteria to reclassify the species from threatened to endangered under the Oregon Endangered Species Act at ii.

> Remaining nesting habitat persists mostly on public lands, including the Siuslaw and Rogue River-Siskiyou National Forests, forests owned by the Bureau of Land Management, and the state-owned and managed Tillamook, Clatsop, and Elliott State Forests. Older forest remnants are highly fragmented and contain a high proportion (>70-90%) of edge. Forest fragmentation and "edge effects" can increase predation rates and may result in other adverse effects to remaining patches (*e.g.*, greater windthrow damage, microclimates less suitable to epiphyte growth).
>
> While natural disturbances have always shaped Oregon forests, climate change is expected to increase potential for habitat loss from catastrophic wildfires, insect infestations, disease outbreaks, and severe storms, and to exacerbate conditions unfavorable to murrelets in the marine environment.[65]

Unfortunately, while state-owned land is crucial habitat for murrelet persistence, state-directed management of those lands has not prioritized conservation. And, ODFW's review acknowledges that "Oregon population may now be fluctuating around a new, lower baseline," but states that there is a wide confidence interval with this data due to "the challenges of monitoring a highly mobile seabird that is sparsely and patchily distributed, as well as constraints on survey effort."[66] Finally, "[r]atios of juveniles to adult birds counted at sea provide recent productivity indices of 0.025-0.060 for Oregon; while these juvenile:adult ratios have known limitations, they are an order of magnitude lower than what population models indicate is necessary to maintain stable populations (0.18-0.28)."[67]

ODF has indicated that the HCP itself will provide *all* the conservation action it is going to take on its lands should the Oregon Fish & Wildlife Commission decide to uplist the species. Should that occur, the Commission "must establish quantifiable and measurable guidelines considered necessary to ensure the survival of individual members of the species. These survival guidelines may include take avoidance and measures to protect resource sites (*e.g.*, nest sites and spawning grounds) and only apply to state-owned or -leased land."[68] In sum, "[s]urvival guidelines would become obligatory on state lands should the Commission decide to uplist the species, and ODF would have to develop a management plan for marbled murrelet. ODF will rely on measures in this HCP as the means of protecting these state-listed species."[69] In light of the myriad concerns raised by the state's own status review, and as ODF has stated it does not intend to implement additional murrelet conservation actions should the species be uplisted, it is crucially imperative that the conservation planning incorporated into the HCP itself suffice to fulfill those requirements.

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[65] *Id.* at iii.
[66] *Id.* at iii.
[67] *Id.* at iii-iv.
[68] Draft HCP 1-12.
[69] *Id.*

F. Coastal Marten

The Coastal/Humboldt marten (*Martes caurina humboldtensis*) is a stealthy, mid-sized forest carnivore related to minks and otters that lives in coastal old-growth forest and dense coastal shrub. The species has experienced an overall range decline of 95 percent and there are only four known populations of Humboldt martens, one in central coastal Oregon, one in southern coastal Oregon, one in California near the Oregon border, and one in northern California. Each of the surviving populations is estimated to consist of fewer than 100 individuals per population.

The coastal marten is threatened by multiple factors which include trapping, vehicle mortality, habitat loss and fragmentation, population isolation, predation, wildfire, poisoning, and global climate change. The marten recently received protection under the federal ESA, but is currently unprotected by Oregon law.

The body of science around coastal marten and their habitat needs is evolving as ongoing research adds to the knowledge base. In the draft HCP, a habitat model was not developed because the data are too limited and/or habitat conditions studied for coastal marten were not analogous to covered state forests:

> A habitat model was not developed for coastal marten. Not enough is known about current coastal marten habitat relationships and distribution in the types of forests that occur within the permit area. Most information on coastal marten habitat relationships is from studies in the Central Coastal Oregon Dunes, Southern Coastal Oregon, and Northern Coastal California Extant Population Areas (USFWS 2015). Multiple entities (e.g., USFWS, USDA Forest Service Pacific Northwest Research Station and Pacific Southwest Research Station, the National Council for Air and Stream Improvement, Oregon State University, and Humboldt State University) have been working to refine and improve existing habitat models to better inform conservation planning. All of the areas for which models are available have habitat characteristics different enough from the forests in the permit area to make extrapolating habitat relationships from Extant Population Areas to the permit area unreliable. This HCP assumes that all of the permit area from the northern boundary of Lane County south to the California border and west of Interstate 5 could provide suitable habitat for coastal marten.[70]

However, the historical range of the marten includes the Coast Range north to the Columbia River, and expansion of the species to its historical home range likely requires establishment in the state forests of the Coast Range. The EIS must fully evaluate the best available science and consider the proposed alternatives within that framework. If the habitat modeling is too speculative, then no take permit should be issued for the marten.

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[70] Draft HCP 2-56 – 2-57.

G. Red Tree Vole

Although not yet listed, the WOSF HCP includes the North Oregon Coast population of red tree vole (*Arborimus longicaudus*) ("tree vole"), a truly arboreal mammal that rarely frequents the ground and one of the few that feeds primarily on the needles and twigs of conifers. The tree vole is both closely associated with old forests and highly sensitive to forest fragmentation from clearcutting, placing it at immediate risk of extinction.

In 2011, FWS determined the North Oregon Coast population of red tree vole (living in the Oregon Coast Range, north of the Siuslaw River and south of the Columbia River) qualified as a distinct population segment (DPS) that warranted listing as a threatened or endangered species, but that such listing was precluded.[71] FWS cited the "historical losses of late-successional forest and ongoing management of most forests on State, County, and private lands for harvest" as a primary basis for determining the tree vole warranted listing.[72] Unfortunately, the finding that the tree vole's protection was precluded meant that it received no protection.

Despite the fact that the tree vole was found to be at risk of extinction and that lack of protection on state lands was a primary basis for the warranted finding, ODF took no action to protect or even survey for tree voles from 2011 to the present when it is now applying for a permit to take the species. The WOSF HCP acknowledges that "current knowledge of this species presence is limited within the permit area."[73] This lack of knowledge is particularly problematic for the tree vole because of its limited ability to disperse to new areas, particularly when the forest is fragmented by clearcutting, meaning FWS will have little confidence or basis for concluding the logging allowed under the WOSF HCP will not jeopardize the tree vole or correspondingly, that the HCAs will be sufficient to ensure the tree voles' survival let alone recovery. Perhaps recognizing this fact, the FWS withdrew proposed listing of the tree vole in 2019. A number of groups submitting these comments have challenged this withdrawal in federal court.

The WOSF HCP acknowledges 85,900 acres of suitable red tree vole habitat will be logged under the HCP, most in the first 40 years of the permit.[74] This loss is to be offset by ingrowth leading to 171,072 acres of suitable habitat in HCAs after 70 years. Critically, the WOSF HCP doesn't discuss the distribution of this habitat, which is critical for this sessile species, or its proximity to currently occupied habitat that could potentially facilitate recovery of tree voles to the HCAs. This point is underscored by the fact that the HCAs were primarily designed to incorporate habitat occupied either currently or formerly by northern spotted owls or marbled murrelets, both of which can fly and readily colonize developing habitat.

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[71] 76 FR 63720.
[72] 76 FR 63735.
[73] Draft HCP 6-38.
[74] Draft HCP 5-95.

The WOSF HCP also fails to account for the likelihood that some proportion of tree vole habitat is likely to be lost to fire, potentially a large proportion. ODF may be able to ignore this fact, but FWS cannot in determining whether issuance of the permit will jeopardize the species. The best available science indicates that the most assured approach to avoiding jeopardy of the tree vole is to either protect all existing suitable habitat or conduct pre-disturbance surveys for the tree vole and if found, set that habitat aside. In the absence of such an approach, there is a real likelihood that ODF could wipe out critical populations of the tree vole without even knowing it, an inherently precarious situation. We thus request FWS reject the permit if these improvements are not made to the HCP.

Other Environmental Impacts

A. Carbon Storage and Sequestration

The EIS should consider the economic benefits of keeping carbon stored in unlogged forests by calculating the avoided costs of global climate change. The draft HCP is scant on details regarding this issue, which should be top-of-mind for all current planning processes. The EIS should disclose the Social Cost of Carbon Dioxide (SCC) as a proxy for the impacts of GHG emissions. GHG emissions from fossil fuels, logging, and other land management activities impose significant costs on society, such as the cost of damage caused by climate change and the costs of adapting to climate change and the cost of sequestering carbon to mitigate emissions.

The NEPA analysis should carefully disclose these social costs. The express purpose of SCC analysis is to provide an apples-to-apples basis for comparing a project's economic benefits with GHG pollution impacts (costs). Where SCC is not analyzed and disclosed, these impacts (costs) are hidden from the public and, in fact, often "paid for" by the broader environment and public in the form of degraded ecological resiliency, public health impacts, and more.
The agency must recognize that the federal estimate of SCC likely underestimates—perhaps significantly—the climate impacts of GHG pollution. As the U.S. Environmental Protection Agency has concluded:

> given current modeling and data limitations, [the federal SCC values] do[] not include all important damages. As noted by the IPCC Fourth Assessment Report, it is "very likely that [SCC] underestimates" the damages. The models used to develop SCC estimates, known as integrated assessment models, do not currently include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages and because the science incorporated into these models naturally lags behind the most recent research.[75]

[75] https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf

This plan should seek harmony between species conservation and climate mitigation. Listed fish are imperiled by climate change and ocean acidification, and this can be mitigated by reducing logging and storing more carbon in the carbon-rich watersheds where these listed fish spawn and rear. This will benefit protected resources in two ways, by enhancing watershed function and stream complexity, and by avoiding climate effects. The adverse effects of climate change include amplification of the hydrologic cycle which can be mitigated by reducing cumulative watershed effects, reducing road density, reducing logging (wider stream buffers and longer rotations), and emphasizing connectivity of aquatic systems.

The plan should incorporate strategies for contributing to carbon storage, and the EIS should fully evaluate impacts of proposed management activities in light of the recent slate of research highlighting the importance of intact forests in climate mitigation efforts.[76]

B. Streamflow Issues

As drafted, the HCP fails to properly incorporate much of the best-available science on logging's impacts to streamflow. The EIS must take a hard look at the three interrelated but different effects of (1) reduced low flows, (2) higher peak flows, and (3) changes to overall water yield.

We are concerned that current conditions on ODF-managed forests, especially on many of the smaller streams, is likely in a flow deficit. Views of state forest land show large number of drainages in a fast-growing forest plantation condition, exactly the conditions we expect to result in summer low flow.[77] On-the-ground conditions in streams, as well as reported data, seem consistent with many being in a reduced low-flow state, with high temperatures and intermittent flow impacts. We are concerned with streams that may disappear entirely as a result of management activities. Another pressing issue is high temperature regimes, which, in combination with shortages of rearing habitat, are imminent threats to covered fish populations.

While the most recent draft of the HCP does include some reference to the relevant research, it does not fully analyze the implications inherent in ODF's typically heavy style of timber harvest. For example, the HCP divulges that:

[76] See, *e.g.*, Moomaw WR, Masino SA and Faison EK (2019) *Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good*. Front. For. Glob. Change 2:27. doi: 10.3389/ffgc.2019.00027; Beverly Law, et al. (2018) *Land use strategies to mitigate climate change in carbon dense temperate forests*. PNAS. doi:10.1073; Heather Keith, Brendan G. Mackey, David B. Lindenmayer (2009) *Re-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests PNAS 106 (28) 11635-11640, doi:10.1073.*

[77] See, *e.g.*, Catalina Segura, Kevin D. Bladon, Jeff A. Hatten, Julia A. Jones, V. Cody Hale, George G. Ice (2020) *Long-term effects of forest harvesting on summer low flow deficits in the Coast Range of Oregon*, Journal of Hydrology, Volume 585, 124749; Perry, Timothy D.; Jones, Julia A. (2017) *Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA*. Ecohydrology. 10(2): 1-13.

> Once forests are 10+ years old and regrowing rapidly, they transpire more than three times the amount of water as mature forests (Moore et al. 2004). This increased transpiration can further exacerbate summer low flows, reducing available habitat for covered salmon and steelhead. In an analysis of 60 years of daily stream flow records from eight paired-basin experiments, Perry and Jones (2016) found that average daily streamflow in basins with 34- to 43-year-old Douglas-fir plantations was 50% lower than reference basins of 150- to 500-year-old mixed species forests, with the greatest deficit occurring in August and September. Thinning of young replanted forests did not alleviate this effect.[78]

However, it then goes on to draw the conclusion that mitigation for upslope logging practices on the watershed level will be provided by "[t]he creation of RCAs under Conservation Action 1: Establish Riparian Conservation Areas and HCAs will provide a buffer of mature trees that will protect summer low flows across the permit area."[79] NMFS should look at this more carefully than the draft HCP did: summer low-flow impacts and associated effects to aquatic organisms must be evaluated at the watershed scale. Narrow, uncut riparian buffers may not provide the desired protection against low-flow impacts; instead, the analysis must focus on the acreage logged within each watershed and predict from there, potential summer (and into spring and fall, as the climate changes) low-flows.

The EIS should incorporate the relevant science on plantation-forestry impacts to riparian zones. Include recent research suggesting that typical plantation-density stocking levels are not appropriate in riparian areas due to dewatering concerns.[80] As an example, the Segura et al. 2020 analysis does not appear in the draft HCP. ODF should provide specific information on current acreage inside the HCAs and RCAs that is in a plantation-level stocking density, and do the same for areas outside the conservation areas. Only with this fuller picture can the EIS adequately predict streamflow impacts of ODF's upcoming 70 years of logging, plantation forestry, and restoration.

The EIS should at a minimum fully evaluate (1) whether the RCAs as designed will provide sufficient buffering to streams to reduce adverse temperature and flow effects; (2) whether potential improved habitat conditions in the RCAs fully mitigate for unprotected stream reaches outside the RCAs, and (3) should situate these analyses within the larger context of historical and ongoing regionwide streamflow impacts due to logging practices.

C. Covered Timber Harvest Activities

1. Management within HCAs

[78] Draft HCP 5-17.
[79] *Id.*
[80] Segura et al. 2020, Perry and Jones 2017.

We have some particular concerns regarding management language proposed in the HCP, and request that the EIS fully evaluate the environmental impacts of the following.

- "[M]anagement of existing late-seral habitat in HCAs will be limited to treatments that will clearly enhance habitat in the near-term by creating specific habitat components such as snags or small (0.5 to 2 acres) stand gaps to increase stand heterogeneity."[81]

- Logging of trees and/or stands showing signs of Swiss needle-cast infection. HCP stands are not designated to reach commercial goals; therefore it is questionable whether infected stands need to be "reset" (clearcut?) if Swiss needle-cast is primarily a concern for commercial harvest value.[82]

- Thinning prescriptions intended to promote future late-seral forest conditions (see section above on thinning).[83]

- Any timber harvest activities, even restoration activities, intended to provide, or incidentally providing, commercial products to the timber market.

Specifically, Section 4.7.7.4, "Managing In Covered Species Habitat," requires a very close review. This section proposes a wide range of timber management activities within HCAs, including the possibility of heavy thinning down to 15 trees per acre; it also includes the possibility of regeneration harvest and "modified clearcut." While we agree that there are likely portions of the HCAs that are in plantations and for which some judicious management might increase habitat viability for the covered species, we are extremely concerned at the license given to future land managers by this over-broad menu of management options within the HCA. Please carefully consider whether these types of management practices are commensurate with covered-species habitat needs and evaluate an alternative that does not include regeneration harvest, heavy or moderate thinning, or any form of clearcutting withing the HCAs, and furthermore, that prohibits commercial benefit from management activities in the HCAs.

2. Management Outside of HCAs

In addition to the specific scientific controversy (discussed below) regarding spotted owl dispersal habitat standards, other aspects of ODF's management plans for non-HCA forest lands should be analyzed carefully. For the most part, ODF proposes to manage the non-HCA forests pursuant to the Oregon Forest Practices Act (OFPA) standards. The statute is widely considered to be weakly protective of habitat and conservation values, and a choice to implement forest management under its broad leeway is certain to have significant environmental impacts.

[81] Draft HCP 4-69.
[82] Draft HCP 4-71.
[83] Draft HCP § 4.7.7.

For example, the HCP proposes to manage the non-HCA areas using clearcuts of up to 120 acres in size; minimal buffers between adjacent clearcuts; only two leave trees per acre clearcut; only two snags per acre clearcut; and a low volume of large downed wood per acre.[84] Logging with these very minimal habitat safeguards has massive environmental impacts to soil, wildlife, water quality, water quantity, and carbon storage (all outcomes that are known from decades of mismanagement of Oregon's state and private timberlands that has, in large part, resulted in the endangerment of the species proposed to be covered here) that must be fully evaluated in the EIS.

The HCP also proposes site-specific evaluation by ODF staff prior to logging in order to locate and protect old-growth stands (>175 years) from the surrounding clearcuts.[85] That is a good idea, but ODF already knows where any remnant old-growth patches exist on its lands. It can and should disclose these in the HCP; these should be mapped now and there must be a commitment not to manage them. In other words, there is no need to rely upon future field surveys to "find" them. Perhaps a few hidden remnant patches of old-growth exist on ODF land, unknown to the state, and if so, then these future foresters will find them in field surveys. But all, or almost all, of existing old-growth is well-known to the department and can easily be delineated and protected through the HCP and upcoming new FMP. We additionally suggest that an alternative to the HCP as designed include buffer stands around the old-growth patches on non-HCP lands; if any exist, these rare and valuable habitat fragments should not border on 120-acre clearcuts, as would appear to be allowed under currently proposed HCP guidelines.

In addition, the HCP contemplates the broad use of pesticides outside the HCAs as part of its rotational harvest strategy. The draft HCP suggests that "chemical site preparation" with pesticides prior to replanting will be an integral part of stand management.[86] After a plantation is established, "chemical release" by wide broadcast herbicide application can occur one or more times.[87] Herbicide use on Oregon's forests has widespread environmental impacts to human health, water quality, and wildlife, among other impacts that require full evaluation. We are particularly concerned with the draft HCP's proposal to allow pesticide application within one mile of "modeled nesting and roosting habitat and any active northern spotted owl nest locations, highly suitable habitat modeled habitat and any designated occupied habitat for marbled murrelets, and highly suitable modeled habitat for red tree vole . . . ."[88] The EIS must very carefully evaluate the potential impacts to covered species of pesticides such as Dicamba, Imazapyr, Glyphosate, and several others being sprayed within one mile of occupied or unoccupied terrestrial habitat. While the draft HCP does include some best practices for pesticide application, pesticides have been shown to drift up to several miles from their intended application site.[89]

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[84] Draft HCP 4-85.
[85] *Id.*
[86] Draft HCP 3-8.
[87] Draft HCP 3-9 – 3-10.
[88] Draft HCP 3-11.
[89] See, e.g., Caroline Cox (1995) *Pesticide Drift*, Journal of Pesticide Reform, 3.

The draft HCP also proposes to allow several pesticides of high- and moderate-risk to aquatic organisms to be sprayed, in some cases, within 50 feet of streams.[90]

Finally, the HCP proposes reforestation of clearcuts into tree plantations per the OFPA, which can have serious impacts to streamflow and fire risk.

The EIS should evaluate an alternative that incorporates significantly more protective management standards than the minimums allowed by the OFPA.

D. Scientific Controversy Regarding Thinning for "Restoration"

The EIS should acknowledge and carefully evaluate the uncertainty regarding whether thinning speeds the development of late-seral conditions. The draft HCP appears to proceed under the assumption that thinning in certain stands within HCAs will propel them toward the late-seral habitat goal, but the EIS must give full attention to whether this is in fact so.

1. Thinning in the HCAs

It remains controversial whether "restoration" logging within reserve designations accomplishes the goal of speeding stand development into mature or complex forest conditions needed for habitat. Recent federal court cases have acknowledged the scientific controversy surrounding this issue. For example, the Ninth Circuit panel in a case challenging the Crystal Clear restoration project on the Mount Hood National Forest found that scientific controversy regarding whether thinning in older stands benefitted or detracted from habitat health and fire risk required the agency to revise its EIS.[91] In another case, the court held that the BLM improperly relied on limited science regarding commercial thinning in older stands, purportedly for restoration purposes, and that the unacknowledged scientific controversy required new NEPA analysis.[92]

The draft HCP failed to incorporate important information regarding the efficacy of thinning and other active management strategies intended to speed stand development to mature or late-seral habitat structure. These considerations likely vary between upland stands and riparian stands, with a range of trade-offs between flow issues and late-successional stand development that should be weighed. The EIS should incorporate analysis of the best available science on this topic.

2. Thinning outside the HCAs

Somewhat analogous to federal "matrix" lands under the NWFP, non-HCA areas of the state forests are to be managed in part to provide spotted owl dispersal habitat. This is a laudable

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[90] Draft HCP, Table 3-4 at 3-14.
[91] *Bark v. USFS*, 958 F.3d 865 (9th Cir. 2020).
[92] *Or. Wild v. BLM*, 2015 WL 1190131, *7, *9 (D. Or. March 14, 2015).

goal, but unfortunately, the draft HCP relies on an outdated view that 40% canopy cover is sufficient to provide functioning dispersal habitat.[93]

The EIS should give full consideration to more recent and robust research which demonstrates that as much as 80% canopy cover is in fact needed for viable dispersal habitat.

> **Roost Site Selection**. In contrast to the assumption that stands with relatively open canopies provide suitable dispersal habitat for spotted owls, our results suggest that dispersing juveniles selected stands for roosting that had relatively high canopy closure (x = 66 $\pm$ 2%). … Two hypotheses could explain why dispersing owls selected closed-canopy stands. First, several researchers (Barrows 1981, Forsman et al. 1984, Weathers et al. 2001) have shown that temperature and precipitation appear to influence selection for roost trees and attributes within a roost tree, such as perch height and percent overhead cover. … Second, juvenile northern spotted owls may have selected for closed-canopy forest because their preferred prey were most abundant … **Landscape Scale Selection**. … [O]ur mean estimate of canopy closure from plots at roosts (66%), which was likely an underestimate of canopy cover, was considerably higher than the minimum values recommended by Thomas et al. (1990) [i.e. 50-11-40]. … **Management Implications**. … Based on our study, we recommend that managers should pursue a strategy that exceeds the canopy cover guidelines recommended by Thomas et al. (1990) when managing dispersal habitat for spotted owls. Based on our estimate of mean canopy closure (66%), and our estimate of mean canopy cover from overlaying a dot grid on the same areas (approx. 14% larger), we recommend that the target for canopy cover in stands managed for dispersing spotted owls should be at least 80%.[94]

ODF may still plan to thin down to 40% canopy cover in the non-HCA lands, but it should not "count" those as dispersal acres for purposes of landscape design and planning. As mentioned in the section on NEPA Alternatives, the EIS would do well to consider an alternative that includes less uniform, heavy logging outside the HCAs and implements a more ecologically sound management outcome such as variable-density thinning (VDT).

VDT can improve connectivity by enhancing foraging opportunities for dispersing predators such as spotted owls (and other raptors), marten, fisher, etc. Young and mid-seral forest may not provide ideal nesting/denning conditions but they often do provide for important dispersal functions. If these young and mid-seral forests are species-diverse and structural complex, they are more likely to have healthy populations of small mammals, birds, and other prey species relied upon by predator species of concern.

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93 Draft HCP 4-85.

94 *See* Stan G. Sovern, Eric D. Forsman, Katie M. Dugger, Margaret Taylor. 2015. *Roosting Habitat Use and Selection By Northern Spotted Owls During Natal Dispersal*. The Journal of Wildlife Management 79(2):254–262; 2015; DOI: 10.1002/jwmg.834.

E. Scientific Controversy Regarding Fire Risk Inherent in Rotational Harvest Management

The EIS should fully analyze the increased potential fire risk of ODF's proposed harvest management scheme outside the HCAs. At a minimum, a full analysis should include discussion of the findings of the following research and decisions:

- Taylor et al 2020 - Does forest thinning reduce severity in Australian Eucalypt forests?[95]
- Zald and Dunn 2018 - Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape[96]
- Bradley et al 2016 - Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States?[97]
- Stone et al 2008 - Forest Harvest Can Increase Subsequent Forest Fire Severity[98]
- González-Cabán, Armando 2008 - Proceedings of the second international symposium on fire economics, planning, and policy: a global view[99]
- Franklin et al. 2006 - Simplified Forest Management To Achieve Watershed And Forest Health: A Critique.[100]
- Countryman, C.M. - Old-growth conversion also converts fire climate.[101]
- *Miller v. Mallery*, 410 F.Supp. 1283, 1294-1296 (D. Or 1976).

F. Dead Wood/Ecosystem Debt Due to Logging

Forestry-related environmental impact analyses often undercount the severity and importance of the short- and long-term "ecosystem debt" created by logging and associated practices. Logging and roads will reduce recruitment of snags and dead wood and all the ecosystem services they provide. One of the most significant and lasting effects of stand replacing disturbance, including regeneration logging, is to bring the process of snag recruitment to a virtual standstill for many decades. Especially when trees are removed by logging, the snag population is directly reduced to ensure safe conditions for workers, and remains low for many

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[95] https://phys.org/news/2020-10-thinning-forests-defence.html; https://conbio.onlinelibrary.wiley.com/doi/10.1111/conl.12766

[96] https://www.researchgate.net/publication/324786837_Severe_fire_weather_and_intensive_forest_management_increase_fire_severity_in_a_multi-ownership_landscape

[97] https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1492

[98] Carter Stone, Andrew Hudak, Panelope Morgan 2008. Forest Harvest Can Increase Subsequent Forest Fire Severity. PSW-GTR-208, pp 525-534.

[99] https://www.fs.fed.us/psw/publications/documents/psw_gtr208en/psw_gtr208en_525-534_stone.pdf, *In* González-Cabán, Armando, tech. coord. 2008. Proceedings of the second international symposium on fire economics, planning, and policy: a global view. Gen. Tech. Rep. PSW-GTR-208, Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 720 p.

[100] Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. Simplified Forest Management To Achieve Watershed And Forest Health: A Critique. National Wildlife Federation. https://web.archive.org/web/20061008082841/http://www.coastrange.org/documents/forestreport.pdf

[101] Countryman, C.M. 1955. Old-growth conversion also converts fire climate. Fire Control Notes 17(4): 15-19. https://www.fs.fed.us/sites/default/files/legacy_files/fire-management-today/017_04.pdf

decades because the pool of green trees available for snag recruitment is greatly reduced. This results in a multi-decade “snag gap” that has serious adverse consequences for habitat and many other ecological processes.[102]

The impacts of thinning, as widely proposed by this HCP both within and outside the HCAs and RCAs, must be fully considered in this light, as well. Thinning does not always accelerate development of late successional forests, and in particular commercial thinning has an adverse effect on snags and dead wood that are defining characteristics of late successional habitat. Thinning might produce the first large trees, but those trees Could be vigorous and less likely to experience mortality, so developing large snags is not direct and immediate result of growing large trees. Thinning also dramatically reduces the pool from which future mortality can be recruited so thinning actually retards development of some attributes of late successional forest and spotted owl habitat including snags and down wood.

NEPA analyses often assert that "As a result of thinning, growth of retained live trees would be accelerated, so larger trees would be available sooner for recruitment as snags and CWD than without thinning." This is only half the story and it is very misleading about the effects of logging—unless statements like this are followed by a loud and clear acknowledgement that accelerating development of a few larger live trees (that might become snags if a few of them happen to die) comes at the cost of a significant reduction in the number of medium and large snags over time. From an ecological perspective, the net result of commercial logging is undeniably adverse to snag habitat. This plan cannot present logging as a benefit to snag habitat when it is really a cost that needs to be mitigated.

G. Roads

In general, road impacts are extremely detrimental to a wide range of conservation values: they cause habitat fragmentation, reduction in quality and persistence of habitat values, increased edge effects, negative impacts to hydrology, reduced water quality, increased fire ignition risk, reduced air quality, among other problems. Western Oregon’s forests are highly roaded, and as the draft HCP notes, many or most of the existing roads were not built to current standards and cause ongoing harmful impacts. And, even when constructed per modern standards, new roads remain highly impactful.

A rough calculation suggests that the permit area has about 4.15 miles of road per square mile of forest. Certain subsets of the permit area are even more densely roaded: for example, the Santiam State Forest suffers a road density of perhaps 5 miles of road per square mile.

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[102] See Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf.

Existing roads are chronic sources of soil erosion and sediment pollution with significant degrading effects to aquatic habitat.[103] Any new road construction and renovation contribute additive resource damage including soil erosion and sedimentation of streams.[104] Increased soil erosion and stream sedimentation are unavoidable even when the most cautious road construction methods are used.[105]

Road-stream crossings cause significant downstream sedimentation and exacerbate alterations of channel morphology both upstream and downstream of the crossings.[106] Common mitigation measures ("best management practices") fail to prevent sediment production from heavy truck traffic, side casting and road grading, and such activities often trigger fill slope erosion and failures. Even with maximum mitigation effort, total accelerated erosion and sediment yields will be at least 50 percent greater than unmanaged conditions over a decade or longer.[107]

Buffers of riparian vegetation adjacent to streams are a standard mitigation practice intended to reduce adverse effects of soil erosion and sediment pollution of aquatic habitat resulting from road building and logging operations. Scientific controversy and uncertainty exist regarding the site-specific effectiveness of riparian buffers for sediment filtering.[108] Without clear understanding of surface and subsurface hydrology in riparian areas, it is impossible to accurately predict the effectiveness of riparian vegetation trapping sediment.[109] Sediment accumulation in riparian buffers and trapping efficiency over time almost never are monitored or validated.[110] It is necessary to account for sediment accumulation over time because the buffers do not revert to an undisturbed condition after storm events. Any additional sediment transported downslope from management activity may be cumulatively significant depending on the trapping effectiveness of buffers.

The draft HCP states:

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[103] Gucinski, H., M.J. Furniss, R.R. Ziemer and M.H. Brookes (eds.) (2001) *Forest Roads: A Synthesis of Scientific Information.* USDA For. Serv. PNW-GTR-509. Portland, OR.

[104] McIver, J.D., and L. Starr (2000) *Environmental Effects of Postfire Logging: Literature Review and Annotated Bibliography*. USDA For. Serv. PNW-GTR-486. Portland, OR; Robichaud, P.R., L.H. MacDonald and R.B. Foltz (2010) Fuel management and erosion. Ch. 5 in: W.J. Elliot, I.S. Miller and L. Audin (eds.). Cumulative Watershed Effects of Fuel Management in the Western United States. USDA For. Serv. RMRS-GTR-231. Fort Collins, CO; Trombulak and Frissell (2000) *Review of ecological effects of roads on terrestrial and aquatic communities*. Conservation Biology 14:18-30.

[105] Gucinski et al. 2001.

[106] Furniss, M.J., T.D. Roelofs and C.S. Yee (1991) *Road construction and maintenance*. Pp. 297-323 in: W.R. Meehan (ed.). Influences of forest and rangeland management on salmonid fishes and their habitats. Am. Fish. Soc. Spec. Publ. 19. Bethesda, MD; Trombulak and Frissell 2000.

[107] Gucinski et al. 2001.

[108] Reeves, G.H., P.A. Bisson, B.E. Rieman and L.E. Benda (2006) *Postfire logging in riparian areas*. Conservation Biology 20:994-1004.

[109] Gilliam, J.W. (1994) *Riparian wetlands and water quality*. Journal of Environmental Quality 23:896-900.

[110] Dillaha, T.A. and S.P. Inamdar (1996) Buffer zones as sediment traps or sources. Pp. 33-42 in N.E. Haycock, F.P. Burt, K.W.T. Goulding and G. Pinay (eds.). *Buffer Zones: Their Processes and Potential in Water Protection*. Proc. Intl. Conf. on Buffer Zones. Sept. 19-22: Hertfordshire, U.K. Quest Environmental, Inc.

> Legacy road conditions from historical logging practices, especially old (sometimes abandoned) hauling and skid roads that were built before current Best Management Practices were in effect, have increased the probability of slope failure in some locations. The Tillamook State Forest has legacy road conditions throughout the forest. In some areas, the legacy conditions pose serious threats to water quality, fish, and aquatic habitats.[111]

The draft HCP appears to propose construction of up to 40 miles per year of new permanent or temporary roads.[112] New roads, even when constructed according to modern standards and best management practices, have unavoidable negative impacts to hydrology, habitat, and stream values, among others. In an already highly roaded system, the impacts of the additional yearly road mileage are likely to be severe and widespread. The EIS must take a very careful look at the potential impacts.

Temporary roads have many of the same impacts as permanent roads, including complete vegetation removal, severe soil disturbance and compaction, severe modification of the flow of water and air through the soil, impairment of soil biological activity, wildlife habitat fragmentation (especially for microfauna), and wildlife cover loss. In spite of the fact that some roads may only be used by heavy equipment on a temporary basis, the biophysical effects of temporary roads can be long-lasting. ODF will likely reuse these temporary roads for future vegetation management or fire management. The temporal effects of temporary roads can also be extended by legal or illegal use by off highway vehicles, woodcutters, hunters, mushroom collectors, etc. The November 2000 National Forest Roadless Area Conservation FEIS says that temporary roads are often not designed and constructed to the same standard as classified roads and therefore result in a "higher risk of environmental impacts."[113] The HCP must account for this increased risk of temporary roads compared to permanent roads.

The EIS should evaluate the use of hydrologic connectivity (HC) of roads as a key performance measure for water quality in the state forests. The HCP discusses HC, but the document currently lacks any actual metrics for evaluating progress/goals.

The current proposal seems to summarize actions by miles of roads, but provides no goal to be attained. For example, setting a goal in a given HUC size, and then monitoring over time (via inventories) would improve upon the current plan to track projects or miles without specified targets and goals. The HCP should include a hydrologic connectivity indicator and attainment targets. This analysis should not be deferred to implementation.

[111] Draft HCP 2-33.
[112] Draft HCP 3-17.
[113] 3-30

H. Post-fire Timber Harvest

The draft HCP gives minimal consideration to the issue of post-fire timber salvage operations.[114] Recent events in Oregon, following in the wake of over 1,000,000 acres of wildfire west of the Cascade Crest in fall 2020, have proven that responsible forest planning must proactively include robust protective provisions and sideboards regarding post-fire logging.

A timely example is illustrative. ODF is currently planning and selling up to 3,500 acres of clearcut salvage harvests in the Santiam State Forest. This is the entirety of the acreage of the Forest that is recoverable, and includes acreage within areas designated for HCAs and RCAs in the draft HCP. Salvage harvest in the Santiam for this year is expected to triple the usual yearly output from that Forest. From our organizations' group comments to ODF regarding this proposal:

> The Department's post-fire surveys of the [Santiam State] Forest determined that while approximately 24,700 acres, or just over half of the Forest, was within the fire perimeter, only about 16,600 acres were impacted by the fires. The Department assessed approximately 14,000 of these acres for post-fire logging "because the remaining acres are mostly in the low burn severity class and many are located within scattered ownership blocks." Of these 14,000 acres, the Department determined that 5,400 acres were unable to be logged because there were "operability issues, low volume, low value, high landslide hazard locations, non-forest, administrative sites, etc.," 5,100 acres were young plantations that burned so intensely that logging was not an option, and the Department is proposing to log the remaining 3,500 acres. The Department is proposing to post-fire log every acre that is feasible for them to log.[115]

Many of the acres to be clearcut harvested currently meet conditions for complex, older forest that burned in a mosaic pattern of severity and consequently provide quality habitat for a variety of species, including spotted owls. Given this ongoing intensive logging of ODF-managed lands, the HCP and EIS must thoroughly analyze and guard against future such post-fire mismanagement.[116]

First, the HCP/EIS must make a thorough accounting of where future HCAs have been burned, stand conditions pre- and post-fire, and which of those are proposed for logging. We are aware that habitat values of post-fire forests can be quite significant, as discussed in greater detail below, but logging and replacing them with young plantations negates many of the benefits of natural early-seral regeneration. Accordingly, if plans to log future HCAs (specifically, on the Santiam State Forest) proceed, then HCA boundaries will likely need to be adjusted with

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[114] Draft HCP 3-16.

[115] Comments of Cascadia Wildlands, Center for Biological Diversity, Oregon Wild, and others on the Revised 2021 Annual Operations Plan for the Santiam State Forest, attached.

[116] Commenters are currently litigating the 2021 revised implementation plan (that authorizes this logging) for failing to incorporate Forest Management Plan requirements for complex forest conditions. *Cascadia Wildlands et al. v. Peter Daugherty and ODF*, Multnomah County Circuit Court, Case No. 21CV14589.

increased acreage included in an HCA designation to account for those acres whose habitat values were removed or reduced through logging. The HCP and EIS must account for this shift in habitat conditions, whether the HCA-salvage logging occurs or not.

Second, as the current planning effort on the Santiam State Forest demonstrates, state forest managers are inclined to view burned forests as commercial timber harvest opportunities, regardless of post-fire habitat values. HCP planning should incorporate the best and most recent research on ecosystem benefits of unlogged, post-fire forests, and should include strict sideboards on salvage logging. At a minimum, no post-fire timber salvage should be allowed in HCAs or RCAs, regardless of fire severity. The EIS should consider the HCP as it stands, without any protective guidelines, and base the analysis on a presumption that ODF will jettison HCA management directions in the event of wildfire. With supportable climate modeling regarding likelihood of future wildfires during the permit term, the HCP should be able to predict future acreage burned and likelihood of post-fire logging.

I. Wildfire Impacts – Not Unforeseeable

It is very important in the "new normal" climate regime with increasingly impactful disturbance regimes including wildfire, drought, and severe wind events, that the HCP and EIS fully and accurately model wildfire risk for the permit area. Management responses to such disturbances are likewise foreseeable. As noted above, forest management has a tendency to skew toward commercial logging after disturbance in order to capture residual financial value, with less emphasis on habitat value. Unless the HCP and associated Forest Management Plan are written with clear guidance regarding salvage logging, then widespread salvage logging following disturbance is likely and its environmental impacts should be accounted for.

1. Impacts of Post-Fire Logging

Multiples lines of research positively correlate post-fire logging with severe fire effects to soil, vegetation and wildlife habitat.[117] Post-fire logging increases the likelihood of catastrophic reburn at short timescales.[118] Slash fuel created by the proposed action will make direct attack of a future wildfire more difficult and hazardous, and will increase the likelihood of severe soil heating with corresponding losses of forest productivity.[119] Further, post-fire logging removes

[117] D. C. Donato, J. B. Fontaine, J. L. Campbell, W. D. Robinson, J. B. Kauffman, B. E. Law (2006) *Post-Wildfire Logging Hinders Regeneration and Increases Fire Risk*. Science 20 Jan 2006: Vol. 311, Issue 5759, pp. 352; Dennis C. Odion, Evan J. Frost, James R. Strittholt, Hong Jiang, Dominick A. Dellasala, and Max A. Moritz (2004) *Patterns of Fire Severity and Forest Conditions in the Western Klamath Mountains, California*. Conservation Biology. Volume 18 Issue 4 Page 927 - August 2004; Weatherspoon, C.P. and C.N. Skinner (1995) *An assessment of factors associated with damage to tree crowns from the 1987 wildfires in northern California*. Forest Science 41(3): 430-451.

[118] Odion et al. 2004; Jonathan R. Thompson, Thomas A. Spies, and Lisa M. Ganio (2007) *Reburn severity in managed and unmanaged vegetation in a large wildfire*. Proceedings of the National Academy of Sciences.

[119] Reinhardt, E.D., Ryan. K.C. (1998) *Analyzing effects of management actions including salvage, fuel treatment and prescribed fire on fuel dynamics and fire potential*, pp 206–209. In: Pruden and Brennan (Ed.), Fire in ecosystem management: shifting the paradigm from suppression to prescription, Tall Timbers Fire Ecology Conference Proceedings, No 20. Tall Timbers Research Station, Tallahassee, FL.

snags not consumed by a wildfire, and replaces them with planted stands of highly flammable young trees. Young planted stands established over a fuel bed of woody slash will dramatically increase fire hazard and dispose the landscape to favor highly intense fire behavior and severe fire effects.[120]

A study of the portions of the Biscuit fire that were previously burned by wildfire revealed that salvage logging did not reduce the severity of subsequent fires, and in fact salvage logging appeared to increase the severity of subsequent wildfires. (Thompson et al. 2007: **"**In places that burned with high severity in the Silver Fire, areas that were salvage-logged and planted burned with even higher severity than comparable unmanaged areas.")[121] The best available science indicates that salvage logging increases small fuels that are most hazardous, and reduces large wood which is most valuable to wildlife.[122]

Additionally, soil displacement and exposure caused by road work and harvest operations can impair the competitive success of native plants and spread highly flammable invasive weeds.[123] Biological invasion of exotic weeds caused by post-fire logging can persist for decades. Weed establishment and spread over time will produce a less fire- resilient landscape with negative impacts to forest productivity.[124]

Portions of the permit area affected by severe fire in the future, combined with salvage logging, will experience lost recruitment of snags and coarse woody habitat for several decades or longer. Fires create a large pulse of snags, and likely also consume snags and large downed logs. Wood deterioration in fire-killed Douglas-fir happens more slowly than in pine species and large snags (>50 cm dbh) may remain standing for decades before falling to the ground. Post-fire logging prolongs a foreseeable deficit of snag and downed log recruitment caused by wildfires, and reduces the number and extent of snags that may become downed logs over time.

Post-fire logging can preclude recovery of biologically critical forest habitat elements.[125] Retaining large woody legacies provides important habitat elements representative of old forests which allows some late-successional wildlife species to use young stands after fire. Salvage logging removes these legacy features and renders young stands inhospitable to late successional wildlife. Furthermore, natural vegetation recovery (as opposed to replanting) occurs unevenly over space and over time, which means that tree regeneration is spread out

[120] Odion et al. 2004; Jonathan R. Thompson, Thomas A. Spies, and Lisa M. Ganio (2007) *Reburn severity in managed and unmanaged vegetation in a large wildfire*. Proceedings of the National Academy of Sciences.
[121] Thompson et al. 2007.
[122] Peterson, David W.; Dodson, Erich K.; Harrod, Richy J. 2015. *Post-fire logging reduces surface woody fuels up to four decades following wildfire*. Forest Ecology and Management. 338: 84-91.
[123] Lindenmayer, D.B., P.J. Burton and J.F. Franklin (2008) *Salvage Logging and Its Ecological Consequences.* Island Press: Washington, D.C.
[124] Brooks, M.L., C.M. D'Antonio, et al. (2004) *Effects of invasive alien plants on fire regimes*. BioScience 54:677- 88.
[125] Lindenmayer et al. 2008; Lindenmayer, D. B. and R. F. Noss (2006) *Salvage Logging, Ecosystem Processes, and Biodiversity Conservation*. Conservation Biology 20, 949-958; Spies 2004.

with clumps and gaps. A few trees get a 20-30 year head start on other trees. This results in a layered forest condition much sooner than a planted forest with trees all the same age.

Mid-seral stands that result from past clearcutting leave few if any legacies from the previous stand. Natural young stands tend to have abundant snags and dead wood, but clearcut stands are artificially deprived of dead wood for several decades.

Fire as a disturbance provides the ideal conditions for a complex early seral ecosystem to emerge and flourish at least until conifer regeneration develops and dominates the site. In a forest experiencing natural recovery, the heterogeneous early seral ecosystem stage can persist for decades. However, this biodiverse condition can be brought to a screeching halt with salvage logging and conifer replanting that removes complex legacy structures, damages regenerating vegetation diversity, and accelerates conifer dominance. In fact, forests with structurally complex beginnings due to fire can develop desired old growth forest characteristics twice as fast as forests simplified by salvage logging and replanting. The role of complex post-disturbance forest types is not well recognized in current management plans.

Logging emits far more carbon than even severe wildfire.[126] While fire-killed trees may take several decades or even centuries to decompose, during the logging and milling process, most of the carbon is rapidly released into the atmosphere.[127] Post-fire logging undercuts the natural sequestration and storage capacity of post-fire forests and contributes to carbon emissions that worsen climate change.

2. Use of Best Available Science Regarding Species Use of Post-Fire Landscapes in Western Oregon

As the federal Services are aware, recent research demonstrates a wide variety of wildlife species thrive in burned forests in the Pacific Northwest. The EIS should fully incorporate a review of the best available science regarding use of burned forest habitat by songbirds, spotted owls, woodpeckers, salamanders, and other species.[128]

Black-Backed Woodpecker (*Picoides arcticus*), for example, preferentially uses post-fire forests for its life cycle stages. Although a petition for federal listing was rejected by USFWS in 2017, the small, genetically distinct population in Oregon is likely of conservation concern.

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[126] Law et al. 2018.

[127] James E. Smith, Linda S. Heath, Kenneth E. Skog, Richard A. Birdsey (2006) *Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States*. USFS General Technical Report, https://doi.org/10.2737/NE-GTR-343.

[128] Lee, D. E. (2020) *Spotted Owls and forest fire: Reply*. Ecosphere 11(12):e03310; Lee, D. E. (2018) *Spotted Owls and forest fire: a systematic review and meta-analysis of the evidence*. Ecosphere 9:e0235; Hanson, Chad and Tonya Y. Chi (2021) *Impacts of Postfire Management Are Unjustified in Spotted Owl Habitat*, Frontiers in Ecology and Evolution__, February 2021.

"[M]ost postfire specialist species are completely absent from burned forests that have been (even partially) logged."[129] "Most cavity-nesting species do not use severely salvaged burns, whereas some cavity-nesters persist in partially salvaged burns. Early post-fire specialists, in particular, appear to prefer unsalvaged burns."[130]

From a group of researchers in the journal *Science*:

> The effects of post-disturbance logging require careful consideration of whether to log at all, and if so, how to conduct such logging to minimize negative consequences. If we must conduct post-disturbance logging for timber production, stringent ecological safeguards must be in place to minimize impacts to terrestrial and aquatic ecosystems. When viewed through an ecological lens, a recently disturbed landscape is not just a collection of dead trees, but a unique and biologically rich environment that also contains many of the building blocks for the rich forest that will follow the disturbance.[131]

From a peer-reviewed paper published in *Conservation Biology*:

> We summarize the documented and potential impacts of salvage logging—a form of logging that removes trees and other biological material from sites after natural disturbance. Such operations may reduce or eliminate biological legacies, modify rare postdisturbance habitats, influence populations, alter community composition, impair natural vegetation recovery, facilitate the colonization of invasive species, alter soil properties and nutrient levels, increase erosion, modify hydrological regimes and aquatic ecosystems, and alter patterns of landscape heterogeneity. These impacts can be assigned to three broad and interrelated effects: (1) altered stand structural complexity; (2) altered ecosystem processes and functions; and (3) altered populations of species and community composition. Some impacts may be different from or additional to the effects of traditional logging that is not preceded by a large natural disturbance because the conditions before, during, and after salvage logging may differ from those that characterize traditional timber harvesting. The potential impacts of salvage logging often have been overlooked, partly because the processes of ecosystem recovery after natural disturbance are still poorly understood and partly because potential cumulative effects of natural and human disturbance have not been well documented. Ecologically informed policies regarding salvage logging are needed prior to major natural disturbances so that when they occur ad hoc and crisis-mode decision

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[129] Hutto, R. L. (2006) *Toward Meaningful Snag-Management Guidelines for Postfire Salvage Logging in North American Conifer Forest*. Conservation Biology 20, 984-993.
[130] Kotliar, N.B., S.J. Hejl, R.L. Hutto, V.A. Saab, C.P. Melcher, and M.E. McFadzen (2002) *Effects of fire and post-fire salvage logging on avian communities in conifer-dominated forests of the western United States*. Studies in Avian Biology 25: 49-64.
[131] DellaSala DA, Karr JR, Schoennagel T, Perry D, Noss RF, Lindenmayer D, Beschta R, Hutto RL, Swanson ME, Evans J. (2006) *Post-fire logging debate ignores many issues*. Science. 2006 Oct 6;314(5796):51-2. doi: 10.1126/science.314.5796.51b.

> making can be avoided. These policies should lead to salvage-exemption zones and limits on the amounts of disturbance-derived biological legacies (e.g., burned trees, logs) that are removed where salvage logging takes place. Finally, we believe new terminology is needed. The word salvage implies that something is being saved or recovered, whereas from an ecological perspective this is rarely the case.[132]

Importantly, neither the EIS nor the HCP must assume fire has rendered spotted owl habitat unsuitable.[133] Monica Bond (2016) reports changing evidence about the effects of fire on the three subspecies of spotted owls.

> As spotted owls are associated with dense, late-successional forests, biologists typically assumed that fires that burned at high intensity were similar to clearcut logging and had a negative impact on long-term survival of the species. Many land managers now believe that high-severity fires pose the greatest natural risk to owl habitat (Davis et al. 2016). Fire, however, is a different type of disturbance than logging. Before data were collected from spotted owls in burned forests, it was not unreasonable to assume that high-severity fire might eliminate habitat because it reduces canopy cover, kills trees, and consumes coarse woody debris—all of which comprise important structure for owls and their prey—but current research is revealing that a surprising number of spotted owl sites continue to be occupied and reproductively successful after experiencing fires of all intensities and that populations are quite resilient to fire. Further, spotted owls utilize complex early seral forests for foraging, providing evidence that severely burned forests can benefit spotted owls depending upon its extent and configuration (Bond et al., 2009; Comfort et al., 2016). Spotted owls evolved in landscapes where severe fire was an important component historically (Baker, 2015) …
>
> One reason why spotted owls remain in burned territories is that fire enhances habitat for some of their primary prey species. … Many small mammal species are more abundant in shrub- and herb-dominated habitats, vegetation typical of recently burned complex early seral forests. . . .
>
> **Conclusions: An Emerging New Paradigm About Spotted Owls and Severe Wildfire**
>
> • Most spotted owl pairs generally survive and continue to reproduce in breeding sites that experienced severe fire across the range of the three owl subspecies.
>
> • Lower-quality sites (often vacant and nonreproductive) have lower occupancy with increasing amounts of severe fire, whereas higher-quality sites (occupied and

[132] Lindenmayer and Noss 2006.
[133] Hanson, C.T., Lee, D.E., Bond, M.L. (2021) *Disentangling Post-Fire Logging and High-Severity Fire Effects for Spotted Owls*. Birds 2021, *2*, 147–157. https://doi.org/10.3390/birds2020011.

reproductive before fire) remain occupied at similar rates as long-unburned forests, regardless of amount of severe fire.

• Spotted owls nest and roost in forested stands with high canopy cover (unburned/low burned) even in burned landscapes.

• Spotted owls forage in severely burned stands.

• Home-range sizes are similar in burned and unburned landscapes.

• Postfire logging is correlated with site abandonment and reduces survival.

• Studies of spotted owls in burned forests not subjected to postfire logging are necessary in order to separate and understand the relative influence of each disturbance.

Contrary to current perceptions and recovery efforts for the spotted owl (USFWS, 2011, 2012), high-severity fire does not appear to be an immediate, dire threat to owl populations that requires massive landscape-level fuel-reduction treatments to mitigate fire effects (see, eg, Hanson et al., 2009). Empirical studies conducted from 1 to 15 years after fires demonstrate that most burned sites occupied by spotted owl pairs remain occupied and reproductive at the same rates as long-unburned sites, regardless of the amount of high-severity fire in core areas. Burned sites where owls are not detected immediately after fire are often recolonized later, demonstrating the folly of concluding those sites permanently "lost" to spotted owls. . . .

Harvesting timber to lower risk of fire has adverse effects on spotted owls (eg, Tempel et al., 2014), whereas fire itself has both costs and benefits depending on many factors. It is important to critically weigh these costs and benefits, especially since spotted owls evolved in landscapes shaped by wildfires (Baker, 2015). Odion et al. (2014) simulated changes in northern spotted owl habitat over a 40-year period following fire and the type of thinning typically proposed by federal land managers. The simulation showed that thinning over large landscapes would remove 3.4–6.0 times more late-successional forest over time in the Klamath and dry Cascades than forest fires would, even given a future increase in the amount of high-severity fire.[134]

"Fire creates suitable foraging habitat for Spotted Owl prey like gophers and deer mice. Spotted Owls feast on these rodents and this helps the Spotted Owl population, but only as long as the standing dead trees remain for them to perch and pounce on their prey."[135]

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[134] Bond, M.L. 2016. *The Heat Is On: Spotted Owls and Wildfire*. Reference Module in Earth Systems and Environmental Sciences http://dx.doi.org/10.1016/B978-0-12-409548-9.10014-4; Maya Khosla (2017) *Heating Up: California Spotted Owls and Wildfire large wildfire brings all manner of surprises, and a few tough questions*. Boom California. October 20, 2017.

[135] Derek Lee, Monica Bond, & Dominick DellaSala (2020) PRESS RELEASE: *Logging hurts Spotted Owls, forest fires benefit Spotted Owls*. 14 December 2020. California, USA.

"The Timbered Rock Study presented evidence that the northern spotted owl has locations in areas with high severity burns. See AR 341-369. Additionally, there was evidence presented by Jerry Franklin, Professor of Ecosystem Analysis at the University of Washington, that '[r]etention of large snags and logs are specifically relevant to Northern Spotted Owl since these structures provide the habitat that sustain most of the owl's forest-based prey species.'"[136]

Also, page 6 of the BE for the Rogue River National Forest's Ashland Forest Resiliency DEIS has a very interesting paragraph that references the Timbered Rock Fire telemetry findings AND habitat analysis conducted at Biscuit:

> There have been recent large fires in SW Oregon, in particular the Biscuit and the Timbered Rock fires, which have significantly reduced NRF within the province. However, **analysis conducted on the effects of the Biscuit Fire** using recent work by Zabel et al (2003) **showed that of the 49 owl pairs affected by the fire, it was likely that only seven were no longer extant**. In addition, of the 15 spotted owl pairs affected by the Timbered Rock Fire, 11 of those pairs continue to occupy their historic activity centers even thought (sic) they were subject to varying degrees of fire severity. There is uncertainty as to how spotted owls respond to fire in SW Oregon and research is currently being conducted in an attempt to answer that question.

Zabel et al. 2003 suggests that "suitable" habitat within 0.5 miles of the nest site is the best indicator of continued NSO presence, and contends that if more than 20% of "suitable" habitat remains within 0.5 miles of the activity center that the NSOs will stick around post-fire.[137]

The HCP should include clear provisions to the post-disturbance landscape for owl and their prey by retaining all large snags. The Final Draft Spotted Owl Recovery Plan requirements for post-fire salvage say "management to provide the maximum likely benefits for owls and their prey is an appropriate strategy."[138] Probably the most important things that the agencies can do after fire are:

1. Make sure that current owl habitat (both suitable and marginal) is protected from disturbance. The adverse effects of wildfire are often over-estimated. Courtney et al 2004. Fires cause incomplete loss of spotted owl habitat elements, so the remaining habitat elements such as surviving green trees and large snags may still provide current habitat for spotted owls.

2. Manage for abundant populations of owl prey species. Where owl prey base is diverse and abundant spotted owl home ranges tend to be smaller which is energetically

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[136] *FSEEE and EPIC v. US Forest Service*, Civ. No. C 05-2220 SI & C 05-2227 SI (N.D. Cal.) June 27, 2005.
[137] Cynthia J. Zabel, Jeffrey R. Dunk, Howard B. Stauffer, Lynn M. Roberts, Barry S. Mulder, and Adrienne Wright (2003) *Northern Spotted Owl habitat models for research and management application in California (USA)*. Ecological Applications 13:1027-1040.
[138] USDI/USFWS, Recovery Plan for the Northern Spotted Owl (1992) p. 71.

advantageous and enhances owl survival rates. (Carey 2004). "Numerous patches of low foraging quality can have negative impacts on owl demography and behavior (Carey et al 1992)." (Carey 2004). and this is precisely what salvage logging will do to current and future spotted owl home ranges. A large number of owl prey species have some association with snags and down wood either as sites for denning or as a source of fungal food supplies. Removing large amounts of dead trees and down wood after a fire dramatically simplifies the forest structure for many decades and will have adverse effects on the development and recovery of populations of owl prey species. Retaining all large snags is called for in the spotted owl recovery plan and the Northwest Forest Plan.

3. Protect all large snags. Snags and down wood are integral parts of spotted owl suitable habitat, in fact, snags and down wood are included in the official definition of owl habitat. Removal of snags will directly eliminate primary constituent elements of spotted owl habitat.

4. Allow for slow and natural successional development. The diverse plant communities and complex structures that develop after fire provide excellent habitat for spotted owl prey species. Do not rush to plant conifers at high density which will truncate successional development.[139]

USFWS' June 28, 2011 Response-to-Comments on the Revised Recovery Plan says "Whether a burned area could support nesting spotted owls is not relevant to our recommending focusing on spotted owl habitat restoration and conservation of legacy habitat elements in areas where pre-fire management focused on developing spotted owl habitat. This recovery action is designed to provide for legacy habitat elements remaining after high-intensity fires which will contribute to future habitat development."[140] The EIS must fully consider fire risk, model fire potential, and incorporate the available science regarding wildlife use of burned areas and protection of post-fire forests from salvage logging.

III. Conservation Alternative

We request that the EIS consider an alternative that focuses on conservation values, and provide suggestions below for potential parameters.

- A shorter permit term: 30 or 50 years.
- No issuance of take permits for species for which the Services determine there is not sufficient habitat/population modeling, or other research deficiencies exist.

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[139] See USDI/USFWS, Revised Recovery Plan for the Northern Spotted Owl (2011); USDI 1996.

[140] http://web.archive.org/web/20130315193800/http://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/Comments.Responses.pdf

- A larger proportion of ODF-managed lands in HCAs than currently proposed in the draft HCP.
- An expanded "purpose" for HCAs, to include climate mitigation.
- Expanded HCA protections: *e.g.*, stricter sideboards on allowable management activities within HCAs as compared to current guidelines proposed by the draft HCP; an alternative that does not include regeneration harvest, heavy or moderate thinning, or any form of clearcutting withing the HCAs, and furthermore, that prohibits commercial benefit from management activities in the HCAs.
- Expanded RCA protections as discussed above in the coho section; *e.g.*, buffers for landslide initiations sites above the areas identified by ODF as likely to deliver to fish bearing streams (see supra, p. 14), and/or buffers in line with federal practice.
- More stringent guidelines on non-HCA forest management practices; *i.e.*, more stringent than the bare minimum required by the Oregon Forest Practices Act, in regards to both management "prescriptions" and pesticide use outside the HCAs, and perhaps other management direction.

IV. Conclusion

We thank the Services for their thoughtful consideration of these scoping comments, and look forward to participating as stakeholders in the further development and implementation planning of this HCP.

Sincerely,

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UNITED STATES DISTRICT COURT

DISTRICT OF OREGON

PORTLAND DIVISION

CENTER FOR BIOLOGICAL DIVERSITY, ET AL, Plaintiffs, v. DAUGHERTY, ET AL, Defendants, and OREGON FOREST INDUSTRIES COUNCIL, ET AL, Defendant-Intervenors.	Case No: 18-CV-1035 (MO) **EXPERT REPORT OF MARWAN A. HASSAN, PH.D.**

I. INTRODUCTION

I, Dr. Marwan A. Hassan, Ph.D., state and declare as follows:

1. I am a fluvial geomorphologist and professor in the Geography Department at the University of British Columbia. My *curriculum vitae* is attached to this report as Exhibit A. I have been retained by Plaintiffs to provide expert testimony in the above-captioned matter. In

particular, I am providing an expert opinion evaluating the impacts of timber sales and roads within the Tillamook and Clatsop State Forests in the North Oregon Coast Range on Oregon coast coho salmon and their freshwater habitats.

2. I have been requested by Plaintiffs to provide background on the impacts of increases in sediment delivery to streams associated with forestry operations through both episodic landslides and chronic bleeding of sediments associated with maintenance and use of hydrologically connected roads, as well as other impacts of logging and roads on the hydrology, landform and sediment processes of the streams relied upon by Oregon Coast coho salmon. It is well-established that the ability of fish and rivers and streams to recover from anthropogenic disturbance, including increased sediment loading related to logging and roads, depends on the hydrological and geomorphological characteristics of the affected stream channels. These characteristics include a stream's channel morphology, the composition of its sediment (including size, texture, and structure of sediment particles), the degree to which that sediment is mobile, and its streamflow properties. Accordingly, I have evaluated the impacts of the Oregon Department of Forestry's timber sales and roads in the context of the landforms and sediment processes of the Oregon Coast Range.

3. In my professional opinion, forestry practices authorized by state forestry officials through timber sales, and use and maintenance of roads for the purpose of hauling timber on the Tillamook and Clatsop State Forests, causes the death and injury of coho salmon and results in significant impairments to their freshwater stream habitats and disruption of their reproduction.

4. My opinions are based on my personal knowledge, review of the extensive literature on the effects of forestry operations on sediment loading and hydrology, field visits to the Tillamook State Forest and my extensive research on erosional processes and stream

sediment transport in British Columbia, the lab and elsewhere. I have considered the following in reaching my conclusions:

(i) Maps and models, using Geographic Information Systems datasets, that show relevant attributes, topography, terrain, stream and river networks, basins, geographic markers, and boundaries of the State Forests, surrounding environments, timber sales, and roads;

(ii) Photographs and other audio-visual representations of the State Forests and surrounding environments;

(iii) Visual observations of active logging during three visits to the Tillamook State Forest on May 6-7, 2013; October 31-November 2, 2016; and September 4-5, 2019;

(iv) Scientific literature, as outlined in this report;

(v) Notices about coho salmon published in the Federal Register by the U.S. National Marine Fisheries Service;

(vi) Descriptions of timber sales from maps, models, plans, notices, reports, and other materials prepared by state forestry officials;

(vii) My own research, observations, study, and knowledge of geomorphological processes in forested landscapes of the Pacific Northwest, of coho salmon, and of other fish and aquatic species; and

(viii) Scientific literature regarding the habitat needs of coho salmon and the kinds of impacts at issue.

5. I am being compensated by Plaintiffs at a rate of $700 per day spent testifying in depositions or in trial and $50 per hour for all other time spent on this matter. I have not testified as an expert at trial or by deposition in any case in the past 20 years.

6. This report and its attachments summarize and support my professional opinions. My opinions are made to a reasonable degree of scientific certainty and are based on the evidence and my understanding of the biology of salmonid species including coho salmon.

II. SUMMARY OF QUALIFICATIONS

7. Geomorphology is the study of the physical, chemical, and biological processes that shape the Earth's topography. Through field observations, experiments and modeling, and

working within disciplines such as physical geography, geology, hydrology and climatology, geomorphologists study landscapes (and seascapes) to understand why they look the way they do, and to understand how they formed and how they are likely to change in the future. Fluvial geomorphology focuses specifically on rivers and streams, and how they interact with the surrounding landscapes, how they transport sediment, migrate across the landscape, cut into bedrock, respond to environmental and tectonic changes, and interact with aquatic species. Anthropogenic disturbance refers to human-caused changes in environmental conditions that profoundly change ecosystems.

8. My research covers a wide range of topics in fluvial geomorphology, including the interaction between hill-slopes and stream channels, stream channel stability, stream channel morphology, river sediment transport, sediment yield, stream ecology, and in-channel wood dynamics. My research has included field, laboratory experiments and modeling focused on sediment transport in the stream environment. I have modeled fundamental processes involving stream flow and sediment transport. My work has contributed to the advancement of the science and knowledge about rivers, from sediment grains to river basins, as well as other academic fields including forestry impacts on streams, urban hydrology, hyporheic flow, desert floods, water quality, and water resources.

9. I received an M.S. and Ph.D. in geomorphology from the Hebrew University of Jerusalem in 1984 and 1989, respectively. My dissertation was entitled *The Movement of Bedload Particles in a Gravel Bed Stream and Its Relationship to the Transport Mechanism of the Scour Layer.*

10. I am currently a full professor of geography at the University of British Columbia (UBC) and have been since 2009. I began my career at UBC as a postdoctoral fellow in 1989

and have since held a variety of positions, including research and teaching fellow, adjunct professor and lecturer, assistant professor, associate professor and my current position of full professor. I have served as a visiting lecturer, professor or researcher at multiple universities around the world, including in China, Norway, the United States, the United Kingdom and elsewhere.

11. I am the recipient of dozens of research grants from government agencies in Canada, Israel and Germany, as well as a number of private funders. My research has covered a diversity of topics, including, for example, research on stream response to changes in flow and sediment supply, funded by the Natural Sciences and Engineering Research Council of Canada, and study of sediment inputs to streams from logging roads, movement of suspended sediments through streams and the dynamics of large woody-debris in mountain streams, which were all funded by the British Columbia Ministry of Forests and Lands.

12. Finally, I have published dozens of manuscripts in peer-reviewed journals and edited books. Following are a few representative examples:

Marwan A. Hassan et al., *Simulated wood budgets in two mountain streams,* 259 Geomorphology, 119–133 (2016).

David A. Reid, Marwan A. Hassan & William Floyd, *Reach-scale contributions of road-surface sediment to the Honna River, Haida Gwaii, BC,* 30 Hydrological Processes, 3450–3465 (2016).

Marwan A. Hassan et al., *Does small-bodied salmon spawning activity enhance streambed mobility?*, 51 Water Resources Res., 7467–7484 (2015).

H. Andres Araujo, Ashley Page, Andrew B. Cooper, Jeremy Venditti, Erland MacIsaac, Marwan A. Hassan & Duncan Knowler, *Modelling changes in suspended sediment from forest road surfaces in a coastal watershed of British Columbia,* 28 Hydrological Processes, 4914–4927 (2013).

Erik K. Schiefer, Marwan A. Hassan, Brian Menounos, Channa P. Pelpola & Olav Slaymaker, *Inter-decadal patterns of total sediment yield from a montane catchment, south Coast Mountains, Canada*, 118 Geomorphology, 207–212 (2010).

Marwan A. Hassan et al., *Salmon-driven bedload transport and bed morphology in mountain streams,* 35 Geophysical Res. Letters, L04405 (2008).

III. THE EFFECTS OF FORESTRY OPERATIONS ON STREAM FLOW, MORPHOLOGY, SEDIMENT LOADING AND COHO SALMON HABITAT

13. Fish require a specific combination of channel characteristics to successfully migrate, spawn and forage, and to find refuge from predators and adverse environmental conditions (Bjornn & Reiser, 1991; Beecher et al., 2002; Hafs et al., 2014; Naman et al., 2018). These stream channel characteristics are controlled, in turn, by biophysical conditions at a larger scale, including the natural history of a watershed's landscape, its topography and vegetation cover (Brardinoni et al., 2007; Mueller & Pitlick, 2013; Hassan et al., 2018), and the quantity and timing of the supply of water, sediment, and wood from the surrounding landscape to the stream network (Church, 2002; Buffington et al., 2003; Parker et al., 2007; Hassan et al., 2016; Hassan et al., 2018; Reid et al., 2019). Different combinations of these factors are present in different areas of a watershed (*e.g.,* Rice et al., 2018); this spatial heterogeneity results in distinct types of stream channels with varying sensitivities to natural and anthropogenic disturbances and pressures (Montgomery & Buffington, 1997; Moore & Wondzell, 2005). Accordingly, the effects on fish habitat from anthropomorphic disturbances such as land use – including forestry operations – are best understood by analyzing how they modify the stream channel's supply of water, sediment, and wood and how these changes, in turn, alter relevant channel characteristics and stream networks.

A. Effects of Forestry Operations on Supply of Water, Sediment, and Wood to the Channel Network

1. Hydrological Effects of Forest Operations

14. The harvest of trees from the landscape through clearcutting has profound impacts on stream habitat, with one of the most important being hydrological changes that result in

increased peak flows in winter, when coho salmon embryo and alevin are vulnerable in the spawning gravels, and reduced base flows in summer, when habitat is most limiting for rearing fry (Moore & Wondzell; Winkler et al., 2010; Perry & Jones, 2017). Research from the past several decades indicates that three dominant mechanisms are responsible for changes to the timing and magnitude of water delivered to stream channel networks resulting from forest harvesting.

15. First, the removal or reduction of forest cover increases delivery of water to the soil surface, because less precipitation is intercepted by and evaporated off foliage (Grant et al., 2008). The removal or reduction of forest cover results in reduced transpiration (Jassal et al., 2009; Winkler et al., 2010). Decreased forest cover may also promote higher snow accumulation and snowmelt rates (Berris & Harr, 1987; Winkler et al., 2005; Varhola et al., 2010; Lundquist et al., 2013).

16. Second, forestry operations influence movement of water towards the channel network over the land surface and within the soil. In particular, forest roads are known to intercept shallow subsurface flow and convey it to the stream network rapidly through the system of roadside ditches and culverts that feed to gullies (*e.g.,* Wemple & Jones, 2003). In some cases, roads intercept nearly all subsurface flow (Hutchinson & Moore, 2000), leading to increases in peak flows (La Marche & Lettenmeier, 2000), and expansion of drainage networks (Wemple et al., 2018). Soil compaction by heavy equipment causes local overland flow, which reaches channels faster than flow through soil matrix (Johnston & Beschta, 1980; Simmons & Anderson, 2016). Where burning of forest debris takes place, soils which typically have high infiltration capacities may become hydrophobic, leading to the potential of overland flow (*e.g.,* Moore & Wondzell).

17. Third, the spatial organization and timing of forestry operations within a watershed has bearing on the particular hydrological response within each stream channel. The overall effects of forest harvest on streamflow at the watershed scale depend on the proportion of watershed logged (Grant et al.), but depend also on whether water supply to streams from various parts of the watershed is synchronized or desynchronized by the aforementioned changes (Moore and Wondzell; Lin & Wei 2008). The streamflow response will also vary over time as forests regrow following harvesting. Most watershed-scale studies have observed increases in both peak flows (Jones, 2000; Lewis et al., 2001; Moore & Wondzell; Grant et al.) and increases in base flows (Moore & Wondzell), as less water is intercepted and transpirated. At the same time, some studies indicate that forest recovery leads to a rapid shift from increased to decreased base flows relative to pre-disturbance conditions (Hicks et al., 1991; Perry & Jones; Gronsdahl et al., 2019) while rapid vegetation growth leads to elevated transpiration. Following peak flows, hydrological recovery of harvested watersheds reported in past studies took a minimum of 10 to 20 years (Moore & Wondzell), while baseflows may continue to show impacts from timber harvesting for longer (Gronsdahl et al.).

B. Effects of Forestry on Supply of Sediment and Wood Recruitment to the Channel

18. Forestry operations have been observed to substantially alter sediment and wood input to streams from the surrounding landscape (Hogan et al., 1998; Jordan et al., 2009; Moore & Richardson, 2012). Major potential sources of sediment include upstream channel areas, tributaries, banks and riparian zones, unpaved roads, and adjacent hillslopes (Reid & Dunne 1984; Gomi et al., 2005; Goetz et al., 2015). Sediment delivery and mobilization to and within stream networks can be described as a product of:

(i) Chronic erosion, which usually involves fine sediment and is related to road networks and soil disturbance; and

(ii) Episodic erosion events that usually result from localized slope and bank failures which produce mixtures of sediment of various sizes, and are associated with decreased slope stability after timber harvesting has taken place

19. Chronic sediment delivery occurs as a product of reduced infiltration capacities from compaction of the soil surface (Ziegler & Giambelluca, 1997)—i.e., from skid tracks, road networks, and other areas of disturbed soil—leading to increased runoff and an abundance of fine sediment available for transport (van Meerveld et al., 2014). Stream crossings and roadside ditches coupled to channels allow this eroded material to easily enter streams, often in large quantities relative to natural inputs (Croke et al., 1999; Thomaz et al., 2013; Reid et al., 2016). In most cases, this sediment will be transported through channel networks without settling, but may accumulate on streambeds during low flow conditions with negative implications for fish habitat (Lane & Sheridan, 2002). Relatively recent landslide scars and debris flow tracks may also constitute a chronic source of fine sediment to channels (Bovis & Pellerin, 1999).

20. The frequency of episodic sediment delivery to streams often increases following forestry operations, especially in mountainous landscapes (*e.g.,* Jakob et al., 2000). Previous studies in the Pacific Northwest and similar landscapes illustrate that slope failures increased in frequency from a factor of three (*e.g.,* Montgomery et al., 2000) to more than a factor of 20 (Lyons & Beschta, 1983; Rood, 1984; Guthrie, 2002), with associated increases in volume of sediment delivered (*e.g.,* Hartman et al., 1996; May et al., 2002; Imaizumi et al., 2008; Marden & Rowan 2015). Importantly, Guthrie observed not only the increased occurrence of slope failures but also that mobilized sediment reached stream networks two to 12 times more frequently than in non-logged areas.

21. The effects of forest harvest on episodic sediment production may diminish over time as forest regeneration occurs and slope stability is restored. However, Ziemer (1981) observed that between 15 to more than 25 years were needed to restore 50 percent of forest root strength, while Schmidt et al., (2001) proposed that the legacy of forestry operations manifested in reduced root cohesion may persist for as long as 100 years. Surface erosion and the associated fine sediment production from disturbed soil also continues for a prolonged period of time. For example, Bovis and Pellerin reported that even 15 years following a slope failure, the landslide scar was 15 percent barren and was still generating large quantities of sediment.

22. The impact of increased sediment production on streams and fish habitat within a watershed will depend in part on the ability of sediment generated on the landscape to enter a channel. In mountainous areas such as the Oregon Coast Range, streams adjacent to steep slopes are often coupled with hillslope processes (Nakamura & Swanson, 1993). For example, steep slopes and narrow valleys typical of headwater streams facilitate sediment and wood transfer from upslope areas to channels, as few opportunities exist for material to deposit above the channel (Nakamura & Swanson; Bracken et al., 2015; Hassan et al., 2018). In such cases, slope failures stemming from forestry operations generated on steep slopes above a channel are likely to reach it. Swanson et al. (1987) reported that as many as 70 percent of slope failures reached the stream network in an area of Oregon characterized by steep, narrow valleys. However, as the valley floor becomes wider in the downstream part of the watershed, floodplains or low-gradient areas adjacent to channels may buffer them from mass failure deposits, which are instead stored along the valley slopes away from the channel (Whiting & Bradley, 1993; Hassan et al., 2018).

23. Riparian areas can also be important sediment sources due to their proximity to stream channels. Removal of riparian forest can result in a loss of bank strength and lead to

extensive bank erosion (Sweeney et al., 2004), which contributes large quantities of sediment to the channel (Hartman et al.; Richardson & Beyraud, 2014). However, even when riparian buffers are created, increased windthrow (Steinblums, 1984) may still result in elevated sediment inputs to streams (Beaudry, 2003). Moreover, even though riparian buffers are designed to reduce sediment delivery to streams, roadside ditches may transit buffer zones, and supply fine sediment to channels from upslope areas (Bilby & Ward, 1989; Reid et al., 2016).

24. In addition to altered sediment supply, forestry operations have been observed to lead to changes in large wood abundance in the channel network. While instances of increases in in-stream wood from logging slash have been reported (Nakamoto, 1998), removal of wood from riparian zones and hillslopes is more often associated with a reduction in in-stream wood (Murphy & Koski, 1989; Hassan et al., 2016). Even if riparian buffers are retained in order to provide wood recruited by chronic processes (*e.g.,* mortality, bank erosion), the upslope sources may be limited. Working in the Cummins Creek watershed in Oregon, Reeves et al. (2003) observed that 65 percent of in-stream wood by number and 45 percent by volume originated in the upslope areas, over 90 meters (about 295 feet) away from the channel. Similarly, several studies (Benda et al., 2003; Benda et al., 2005; Rigon et al., 2012; Hassan et al., 2016) suggest that up to 80 percent of wood found in channel networks may be delivered from the adjacent hillslopes. Wood input may remain persistently low for substantial periods following harvesting, either in the riparian zone or on hillslopes coupled to channels. Several studies modeling wood budgets in streams suggest reduced input of wood and resulting in-stream wood loads for up to and beyond the century scale (Murphy & Koski; Bragg et al., 2000; Reeves et al., 2003; Stout et al., 2018).

C. Effects of Altered Supply of Water, Sediment, and Wood on Channel Characteristics and Processes

25. One of the most profound forestry-related impacts to stream channels and aquatic habitat is alterations in sediment supply, especially when the volume of such material is large relative to in-channel storage. For example, deposits related to episodic mass movement (*e.g.,* landslides or debris flows) may completely bury headwater channels and form a new floodplain. The thickness of these deposits may be as much as 1-2 meters (Roberts & Church, 1986; Sullivan et al., 1987; Miller & Benda, 2000; Hoffman & Gabet, 2007), and, in extreme cases the new floodplain levels have been reported to be 4 meters above the pre-disturbance levels (Lisle, 1982). In some cases, mass movement deposits may fill the valley (Miller & Benda) and create a "natural dam" which temporarily impounds the stream or river until it is breached (Sutherland et al., 2002; Anderson et al., 2017). If deposits consist of a wide range of particle sizes, then armoring of the deposit may allow it to persist for many years (Brummer & Montgomery, 2006; Hassan et al., 2018). The mass movement deposit may lower the slope of the channel upstream of it, thus leading to reduction in flow forces and entrapment of sediment transported from upstream (Hoffman & Gabet), and in some cases will impact the longitudinal profile of the stream channel (Walsh et al., 2012).

26. Sediment delivered to the channel by mass movement may also overwhelm the transport capacity of the channel immediately downstream of the entry location. These streams often transform into a braided morphology with erodible banks and wider, laterally unstable channels (Roberts & Church; Miller & Benda; Hoffman & Gabet). As the fresh deposits are mobilized by subsequent floods, the sediment removed and transported downstream typically forms "sediment waves" (also termed "pulses" or "slugs"), which may propagate downstream (Lisle et al., 2001).

27. Several studies (Miller & Benda; Sutherland et al.; Major et al., 2017; Reid et al., 2019) observed that such sediment waves can affect channels several kilometres downstream from the location where sediment input reached the stream network, but the impact of the sediment diminishes with distance from the input source (Lisle et al., 2001). In some cases, existing or newly formed large wood jams may interfere with passage of sediment waves downstream by trapping the material and creating "sediment wedges" (Roberts & Church; Hogan et al., 2000; Wohl & Scott, 2017; Reid et al., 2019). Major sediment inputs have been observed to lead to channel widening and filling of pools in Oregon and Northwestern California in channels as large as the Middle Fork Willamette River (Lyons & Beschta) and Redwood Creek (Madej & Ozaki, 1996), which drain areas in excess of 600 square kilometers.

28. Bank erosion due to riparian forest removal may produce similar episodic inputs as those generated by slope failures (although presumably of lower volume) and can affect stream channels irrespective of whether it is coupled with the hillslopes. Overall, the effect of episodic sediment inputs and sediment wave passage is simplification of channel morphology and loss of complexity created by features such as riffles and pools (*e.g.,* Lisle, 1982; Hogan et al., 2000; Madej 1999). Both Madej and Ozaki (2009) and Reid et al. (2019) found that the effects of sediment waves on channel morphology may persist for over 30 years.

29. In addition to morphological changes, streams affected by large sediment inputs tend to have a greater proportion of fine sediments (*e.g.,* Hoffman & Gabet; Hassan et al., 2008; Mueller & Pitlick; Pfeiffer et al., 2017) because of copious amounts of material within the size range which, under normal conditions, would be quickly evacuated from the channel bed surface by flowing water. Fine sediment infiltrates the channel subsurface and accumulates in the interstitial spaces between larger gravel and cobbles, both in riffles and pools (*e.g.,* Lisle, 1989;

Cover et al., 2008; Dudill et al., 2017). Fine sediment thus tends to fill pools (Lisle & Hilton, 1992) and substantial deposits may be trapped in backwater or recirculating eddies, which can lead to long-term storage and prolonged release (Rathburn & Wohl, 2003). Fine-grained texture and smooth, simplified bed topography leads to loss of hydraulic complexity and reduction in flow resistance (Schneider et al., 2015). This effect may be further exacerbated if volume of in-stream wood also declines.

30. Generally, recently supplied sediment particles are loosely arranged, often in contrast to the nature of material typically found in undisturbed montane streams and rivers in the Pacific Northwest. Under conditions of lower sediment supply, sediment lining the channel is tightly packed and frequently forms structures of interlocking grains that restrict their movement (*e.g.,* Church et al., 1998; Hassan et al., 2008; Venditti et al., 2017). The abundance of finer, loosely arranged sediment, supplied directly by mass movement or by a sediment wave, is much more mobile, and the simplified channel morphology and smooth streambed lead to reduced flow resistance and energy dissipation. Moreover, fine sediment increases mobility of the larger particles (Curran & Wilcock, 2005; Venditti et al., 2010). All of these factors contribute to substantial increases in sediment transport rates following increased bedload sediment input, which can be higher by an order of magnitude (Roberts & Church), and this effect may be even further amplified if combined with elevated peak flows. The increased sediment transport rate in such transient deposits is due to the larger area of the channel over which sediment is mobilized (*e.g.,* Dietrich et al., 1989; Deitrich et al., 2006; Venditti et al., 2012) and by mobilization of a thicker layer of the sediment (deeper scour).

31. Chronic supply of sediment tends to affect channel morphology to a lesser degree than episodic inputs. First, the volume of sediment per unit area is usually smaller and fine

sediment typically delivered by this mechanism tends to have less potential to alter bulk channel form (Bilby et al., 1989). Nevertheless, continued supply of fine sediment may lead to finer bed surface texture, accumulation in hydraulically sheltered areas (Lane & Sheridan), and infiltration of this fine material into the subsurface (*e.g.,* Soulsby et al., 2001). Increased abundance of fine size fractions, may also mobilize larger particles, as outlined above, and result in higher sediment transport rates.

32. The watershed-scale effects of episodic sediment inputs depend on the channel network structure, basin shape and drainage density (Benda et al., 2004; Gran & Czuba, 2017) as well as locations and spatial configuration (Czuba & Foufoula-Georgiou, 2015) and timing (Mueller & Hassan, 2018) of mass movement inputs, with most mass movement events occurring during large storms that result in slope failures in multiple locations within a watershed.

33. In-stream wood is an important determinant of channel dynamics, especially in smaller streams (*e.g.,* Hogan et al., 2000; Ryan et al., 2014; Hassan et al., 2018). Reduced recruitment and thus volume of wood in channels due to forest harvest reduces sediment storage capacity (Smith et al., 1993; Hassan et al., 2008; Wohl & Scott). In addition, reduced volume of large wood in streams leads to substantial reduction in flow resistance (*e.g.,* Manga & Kirchner, 2000; Wohl, 2014) and reduced flow (Hicks et al.) and channel (Sear et al., 2010) complexity. Finally, wood strongly interacts with flow and the deformable alluvial boundary, which constitutes a primary mechanism for pool formation in small to intermediate channels (Buffington et al., 2002).

D. Effects of Altered Channel Characteristics and Processes on Stream Habitat and Fish

34. Each of the aforementioned changes in channel characteristics influences habitat

availability, quality and distribution. For example, simplified channel morphology and pool in-filling have been found to negatively influence the ability of juvenile and adult fish to find refuge from predators and adverse conditions such as extreme floods (Murphy, 1995). Research has shown that shallow and simple habitats are associated with higher predation and reduced shelter for fish (*e.g.,* Power, 1987; Beecher et al.; Gende et al., 2004). Limited availability of low-velocity areas such as pools ("flow refuge") is also known to negatively affect fish fitness because of the increased energetic cost of swimming (Hafs et al.). For example, Rosenfeld and Boss (2001) showed that adult trout consistently lose weight when constrained to riffles and could only sustain growth by feeding in pools, while Naman et al. also demonstrated the benefit of a balance of pool and riffle habitat for optimal fish growth. The negative effects of increased energy expenditure by fish may be amplified by the increase in flow velocity that results from lower flow resistance in simplified channels with less topographic variability.

35. Filling of pools by sediment can also impair spawning and incubation habitat because bed undulations at the transition between pools and riffles induce downwelling of hyporheic flow, which provides inter-gravel velocities and oxygen concentrations suitable for incubating embryos (Buffington & Tonina, 2009). Spawning fish show a strong preference for such habitat features (Baxter & Hauer, 2000) and the influence of oxygenated surface water on the incubation environment has been shown to be fundamental for in-stream redd survival (Malcolm et al., 2004). The aforementioned impacts of morphological channel alteration would be further exacerbated if combined with decline in abundance of in-stream wood, which plays similar roles in providing channel structure (Sullivan et al.; Hicks et al.), inducing hyporheic exchange (Wondzell, 2006), influencing water velocities (Buffington et al., 2002; Gurnell, 2013), and providing structural cover for fish (Benke & Wallace, 2003; Pess et al., 2012).

36. At broader scales, the morphological changes induced by variation in the supply of wood and sediment caused by forest operations also has implications for spatial and temporal variability of fish habitat. Abrupt transitions in channel morphology imposed by inputs of sediment from debris flows or tributaries were found to be of ecological significance for many aquatic organisms (Rice et al., 2001; Rice, 2017), while temporal variability in habitat has also been noted as a function of sediment supply changes (Benda, 2004; Reid et al., 2019). The infiltration of channel bed sediment with fine material has a negative impact on buried embryos. Finer material infiltrates and accumulates in the subsurface of the streambed, thus altering the incubation environment (Sear et al., 2008).

37. First, fine sediment infiltration leads to reductions in inter-gravel flow velocities and the oxygen supply rate to embryos, which leads to increased in-redd mortality (*e.g.,* Greig et al., 2005; Sear et al., 2008). This is often exacerbated by infiltration of fine organic matter, oxidation of which creates oxygen demand that further depletes oxygen available to embryos (Greig et al.; Schindler-Wildhaber et al., 2014). Fine sediment can also “entomb” (trap and suffocate) hatched fish (alevin), preventing their emergence on the surface and resulting in elevated mortality (Franssen et al., 2012; Sear et al., 2016). Moreover, accumulation of fine sediment prevents use of filled interstitial spaces of larger particles by small fish as a refuge, thus impairing their growth (Finstad et al., 2007). Fine sediment has been also found to affect reproduction: if bed texture becomes too fine, fish may display avoidance behaviour (Kemp et al., 2011). In addition to direct effects, fine sediment also affects resources on which fish rely, specifically, lower trophic levels of their food webs (Kemp et al.). For example, research has shown that elevated levels of fine material typically lead to reduced abundance of benthic macroinvertebrates, on which fish feed (Angradi, 1999; Blettler et al., 2014). Moreover, textural

changes also result in a shift to burrowing taxa, which is harder for fish to feed on, leading to reductions in fish growth rates (Suttle et al., 2004).

38. Higher bed mobility and increased rates of sediment redistribution may have mixed effects on fish. For example, deposition of gravel delivered by slope failures or a sediment wave may provide spawning gravels in channel reaches which otherwise would be too coarse for fish to excavate redds. However, because such deposits associated with transient supply tend to be unstable they are more prone to deep scour, which may result in increased fish mortality (*e.g.,* Tripp & Poulin, 1986; Shellberg et al., 2010). Increased storage of sediment in the channel may also offset the gain from increased low flow, because a larger portion of streamflow occurs as subsurface flow (May & Lee, 2004). Consequently, during baseflow conditions fish become crowded in disconnected pools and supply of food is often reduced, thus negatively affecting fish energetics (May & Lee). Conversely, the loss of wood in streams impacted by harvesting can lead to a reduction in fine gravel deposits suitable for spawning (Smith et al.,; Montgomery et al., 2003).

39. Aquatic organisms are also negatively impacted by streamflow properties affected by forestry operations. In addition to infilling stream beds and potentially reducing downstream abundance of aquatic organisms (Wipfli & Gregovich, 2002; Wipfli et al., 2007), fine sediment in suspension can impact fish feeding efficiency and cause physiological stress (Kemp et al.; Kjelland et al., 2015), especially if angular sediment is delivered to the channel (*e.g.,* Lake & Hinch, 1999). Higher concentrations of suspended sediment have also been found to induce macroinvertebrate drift (Doeg & Milledge, 1991), leading to a redistribution of resources for fish.

40. In addition to changes in morphological, sedimentological, and hydraulic

properties of streams, road networks associated with forest operations often have stream crossings which are impassible to many organisms. For example, culverts frequently become blocked by debris accumulation, and flow in them is often too shallow or too swift for passage of organisms (Foster & Keller, 2011). As a result of scour at the downstream end, culvert outlets often rise several meters above the channel, often too high above the stream for fish to access them (*e.g.,* Furniss et al., 1991; Poplar-Jeffers et al., 2009). Several studies and surveys in Pacific Northwest and elsewhere have shown that fish movement is hampered by such obstructions (*e.g.,* Beechie et al., 1994; Robinson et al., 1999; Park et al., 2008). Conroy (1997) reported that more than 75 percent of surveyed culverts were impassable to fish.

IV. <u>CONCLUSION</u>

41. Based on my own extensive research, review of the literature and visits to the Tillamook and Clatsop State Forests, I can state with a reasonable degree of certainty that the Oregon Department of Forestry's operations, including logging and use, construction and maintenance of roads for the purpose of hauling timber, are resulting in damage to streams occupied by coho salmon by depositing sediment into their habitat. It is my expert opinion that such activities are therefore reasonably certain to cause myriad adverse impacts to the salmon themselves, including actual harm, injury and death.

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V. LITERATURE CITED

Scott W. Anderson et al., *Geomorphic Response of the North Fork Stillaguamish River to the State Route 530 Landslide Near Oso, Washington* (U.S. Geological Surv. Sci. Investigations Rep. No. 2017–5055, 2017).

Ted R. Angradi, *Fine Sediment and Macroinvertebrate Assemblages in Appalachian Streams: A Field Experiment with Biomonitoring Applications*, 18 J. N. Am. Benthological Society, 49–66 (1999).

Colden V. Baxter & F. Richard Hauer, *Geomorphology, Hyporheic Exchange, and Selection of Spawning Habitat by Bull Trout*, 57 Can J. Fish. Aquat. Sci., 1470–1481 (2000).

Pierre G. Beaudry, *Effects of Riparian Management Strategies on the Hydrology of Small Streams in the Takla Region of British Columbia – Fourth Year Results, in* Forestry Impacts on Fish Habitat in the Northern Interior of British Columbia: A Compendium of Research from the Stuart-Takla Fish-Forestry Interaction Study (Can. Tech. Rep. Fisheries & Aquatic Sci. No. 2509, E.A. MacIsaac ed., 2003).

Hal A. Beecher, Brad A. Caldwell & S. Brett Demond, *Evaluation of Depth and Velocity Preferences of Juvenile Coho Salmon in Washington Streams*, 22 N. Am. J. Fisheries Mgmt., 785–795 (2002).

T. Beechie et al., *Estimating Coho Salmon Rearing Habitat and Smolt Production Losses in a Large River Basin, and Implications for Habitat Restoration*, 14 N. Am. J. Fisheries Mgmt., 797–811 (1994).

Steven N. Berris & R. Dennis Harr, *Comparative Snow Accumulation and Melt During Rainfall in Forested and Clear-Cut Plots in the Western Cascades of Oregon*, 23 Water Resources Res., 135–142 (1987).

Lee Benda et al., *Recruitment of Wood to Streams in Old-Growth and Second-Growth Redwood forests, Northern California, U.S.A.*, 32 Can. J. Forest Res. 1460–1477 (2002).

Lee Benda et al., *Debris Flows as Agents of Morphological Heterogeneity at Low-Order Confluences, Olympic Mountains, Washington*, 115 GSA Bull., 1110–1121 (2003).

Lee Benda et al., *Confluence Effects in Rivers: Interactions of Basin Scale, Network Geometry, and Disturbance Regimes*, 40 Water Resources Res., W05402 (2004).

Lee Benda et al., *The Network Dynamics Hypothesis: How Channel Networks Structure Riverine Habitats*, 54 BioScience, 413–427 (2004).

Arthur C. Benke & J. Bruce Wallace, *Influence of Wood on Invertebrate Communities in Streams and Rivers*, 37 American Fisheries Soc'y Symp., 149–177 (2003).

Robert E. Bilby et al., *The Generation and Fate of Road-Surface Sediment in Forested Watersheds in Southwestern Washington*, 35 Forest Science 453–468 (1989).

T. C. Bjornn and D. W. Reiser, *Habitat Requirements of Salmonids in Streams*, 19 Am. Fisheries Soc'y Special Publ'n, 83–138 (1991).

Martín C. M. Blettler et al., *The Impact of Significant Input of Fine Sediment on Benthic Fauna at Tributary Junctions: A Case Study of the Bermejo-Paraguay River confluence, Argentina*, 8 Ecohydrology, 340–352 (2015).

M. Bovis & D. Pellerin, *Rates of Revegetation of Gullies in Coastal British Columbia: Implications for Sediment Production*, *Final Report to Science Council of British Columbia Forest Renewal Research Program* (June 7, 1999) (unpublished report) (on file with B.C. Ministry of Forests, Lands, Nat. Resource Operations and Rural Dev.)

Louise J. Bracken et al., *Sediment Connectivity: A Framework for Understanding Sediment Transfer at Multiple Scales*, 40 Earth Surface Processes and Landforms, 177–188 (2015).

Don Bragg, *Simulating Catastrophic and Individualistic Large Woody Debris Recruitment for a Small Riparian System*, 81 Ecology, 1383–1394 (2000).

Francesco Brardinoni & Marwan A. Hassan, *Glacially Induced Organization of Channel-Reach Morphology in Mountain Streams*, 112 J. Geophysical Res., F03013 (2007).

Chris J. Brummer & David R. Montgomery, *Influence of Coarse Lag Formation on the Mechanics of Sediment Pulse Dispersion in a Mountain Stream, Squire Creek, North Cascades, Washington, United States*, 42 Water Resources Res., W07412 (2006).

John M. Buffington et al., *Fluvial Processes in Puget Sound Rivers and the Pacific Northwest, in* Restoration of Puget Sound Rivers, 46–78 (D.R. Montogmery, S. Bolton, D.B. Booth, & L. Wall eds., 2003).

John M. Buffington & Daniele Tonina, *Hyporheic Exchange in Mountain Rivers II: Effects of Channel Morphology on Mechanics, Scales, and Rates of Exchange*, 3 Geography Compass, 1038–1062 (2009).

Michael Church et al., *Stabilizing Self-Organized Structures in Gravel-Bed Stream Channels: Field and Experimental Observations*, 34 Water Resources Res., 3169–3179 (1998)

Michael Church, *Geomorphic Thresholds in Riverine Landscapes*, 47 Freshwater Biology, 541–557 (2002).

Stephen C. Conroy, *Habitat Lost & Found: Part Two*, 7 Washington Trout Report, 1–8 (1997).

Matthew R. Cover et al., *Quantitative Linkages Among Sediment Supply, Streambed Fine*

Sediment, and Benthic Macroinvertebrates in Northern California Streams, 27 J. N. Am. Benthological Society, 135–149 (2008).

Jacky Croke et al., *Sediment Transport, Redistribution and Storage on Logged Forest Hillslopes in South-Eastern Australia*, 13 Hydrological Processes, 2705–2720 (1999).

Joanna C. Curran & Peter R. Wilcock, *Effect of Sand Supply on Transport Rates in a Gravel-Bed Channel,* 131 J. Hydraulic Engineering, 961–967 (2005).

Jonathan A. Czuba & Efi Foufoula-Georgiou, *Dynamic Connectivity in a Fluvial Network for Identifying Hotspots of Geomorphic Change*, 51 Water Resources Res., 1401–1421 (2015).

William E. Dietrich et al., *Sediment Supply and the Development of the Coarse Surface Layer in Gravelbedded Rivers*, 340 Nature, 215–217 (1989).

William E. Dietrich et al., *Sediment Patches, Sediment Supply, and Channel Morphology, in* 1 River, Coastal, and Estuarine Morphodynamics, 79–90 (Gary Parker & Marcelo H. Garcia eds., 1st ed. 2005).

Ashley Dudill et al., *Infiltration of Fine Sediment into a Coarse Mobile Bed: A Phenomenological Study*, 42 Earth Surface Processes and Landforms, 1171–1185 (2017)

A. G. Finstad et al., *Shelter Availability Affects Behaviour, Size-Dependent and Mean Growth of Juvenile Atlantic Salmon*, 52 Freshwater Biology, 1710–1718 (2007).

Hannah R. Foster & Troy A. Keller, *Flow in Culverts as a Potential Mechanism of Stream Fragmentation for Native and Nonindigenous Crayfish Species*, 30 J. N. Am. Benthological Society, 1129–1137 (2011).

Jan Franssen et al., *Asphyxiation and Entombment Mechanisms in Fines Rich Spawning Substrates: Experimental Evidence with Brook Trout (Salvelinus Fontinalis) Embryos*, 69 Can. J. Fisheries and Aquatic Sci., 587–599 (2012).

M.J. Furniss et al., *Road Construction and Maintenance, in* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitat, 297–324 (W.R. Meehan ed., 1991).

Scott M. Gende et al., *Brown Bears Selectively Kill Salmon with Higher Energy Content but Only in Habitats That Facilitate Choice*, 104 Oikos, 518–528 (2004).

J. N. Goetz et al., *Forest Harvesting is Associated with Increased Landslide Activity During an Extreme Rainstorm on Vancouver Island, Canada*, 15 Nat. Hazards and Earth Sys. Sci., 1311–1330 (2015).

Takashi Gomi et al., *Sediment Dynamics in Small Forest Streams of the Pacific Northwest*, 41 JAWRA J. Am. Water Res. Ass'n, 877–898 (2005).

Karen B. Gran & Jonathan A. Czuba, *Sediment Pulse Evolution and the Role of Network Structure*, 277 Geomorphology, 17–30 (2017).

S.M. Greig et al., *The Impact of Fine sediment Accumulation on the Survival of Incubating Salmon Progeny: Implications for Sediment Management*, 344 Sci. Total Env't, 241–258 (2005).

Stefan Gronsdahl et al., *Effects of Forestry on Summertime Low Flows and Physical Fish Habitat in Snowmelt-Dominant Headwater Catchments of the Pacific Northwest*, Hydrological Processes (Can. Geophysical Union Special Issue), 1–17 (2019).

A.M. Gurnell, *Wood in Fluvial Systems,* in Treatise on Geomorphology, 163–188 (J. Schroder & E. Wohl eds., 2013).

Richard H. Guthrie, *The Effects of Logging on Frequency and Distribution of Landslides in Three Watersheds on Vancouver Island, British Columbia*, 43 Geomorphology, 273–292.

Andrew W. Hafs et al., *Quantifying the Role of Woody Debris in Providing Bioenergetically Favorable Habitat for Juvenile Salmon,* 285 Ecological Modelling, 30–38 (2014).

G.F. Hartman et al., *Impacts of Logging in Carnation Creek, a High-Energy Coastal Stream in British Columbia, and Their Implication for Restoring Fish Habitat*, 53 Can. J. Fisheries and Aquatic Sci., 237–251 (1996).

Marwan A. Hassan et al., *Sediment Storage and Transport in Coarse Bed Streams: Scale Considerations, in* Gravel-Bed Rivers VI: From Process Understanding to River Restoration, 473–496 (H. Habersack, H. Piegay & M. Rinaldi eds., 2008.)

Marwan A. Hassan et al., *Simulated Wood Budgets in Two Mountain Streams*, 259 Geomorphology, 119–133 (2016).

Marwan A. Hassan et al., *Variable Hillslope-Channel Coupling and Channel Characteristics of Forested Mountain Streams in Glaciated Landscapes: Hillslope-Channel Coupling and Channel Characteristics*, 44 Earth Surface Processes and Landforms, 736–751 (2019).

Brendan J. Hicks et al., *Long-Term Changes in Streamflow Following Logging in Western Oregon and Associated Fisheries Implications*, 27 Water Resources Bull., 217–226 (1991).

Scott G. Hinch, *Fish and Stream Protection*, in Forestry Handbook for British Columbia, 155–187 (S.B. Watts & L. Tolland eds., 5th ed. 2005).

Dan L. Hogan et al., *Spatial and Temporal Evolution of Small Coastal Gravel-Bed Streams: Influence of Forest Management on Channel Morphology and Fish Habitat*, in Gravel-Bed Rivers in the Environment, 365–392 (P.C. Klingerman, R.L. Beschta & P.D. Komar eds., 1998).

Daniel F. Hoffman & Emmanuel J. Gabet, *Effects of Sediment Pulses on Channel Morphology in a Gravel-Bed River*, 119 GSA Bull., 116–125 (2007).

D.G. Hutchinson & R.D. Moore, *Throughflow Variability on a Forested Hillslope Underlain by Compacted Glacial Till*, 14 Hydrological Processes, 1751–1766 (2000).

Fumitoshi Imaizumi et al., *Effects of Forest Harvesting on the Occurrence of Landslides and Debris Flows in Steep Terrain of Central Japan*, 33 Earth Surface Processes and Landforms, 827–840 (2008).

Matthias Jakob, *The Impacts of Logging on Landslide Activity at Clayoquot Sound, British Columbia*, 38 CATENA, 279–300 (2000).

Rachhpal S. Jassal et al., *Evapotranspiration and Water Use Efficiency in Different-Aged Pacific Northwest Douglas-Fir Stands,* 149 Agricultural and Forest Meteorology, 1168–1178 (2009).

J.A. Jones, *Hydrologic Processes and Peak Discharge Response to Forest Removal, Regrowth, and Roads in 10 Small Experimental Basins, Western Cascades, Oregon*, 36 Water Resources Res., 2621–2642 (2000).

Michael G. Johnson & Robert L. Beschta, *Logging, Infiltration Capacity, and Surface Erodibility in Western Oregon*, 78 J. Forestry, 334–337 (1980).

Peter Jordan et al., *Forest Management Effects on Hillslope Processes, in* 1 Compendium of Forest Hydrology and Geomorphology in British Columbia, 275–329 (R.G. Pike, T.E. Redding, R.D. Moore, R.D. Winker & K.D. Bladon eds., 2010)

Paul Kemp et al., *The Impacts of Fine Sediment on Riverine Fish*, 25 Hydrological Processes, 1800–1821 (2011).

Michael E. Kjelland et al., *A Review of the Potential Effects of Suspended Sediment on Fishes: Potential Dredging-Related Physiological, Behavioral, and Transgenerational Implications*, 35 Env't Sys. and Decisions, 334–350 (2015).

Jonathan L. La Marche & Dennis P. Lettenmaier, *Effects of Forest Roads on Flood Flows in the Deschutes River, Washington*, 26 Earth Surface Processes and Landforms, 115–134 (2001).

Randal G. Lake & Scott G. Hinch, *Acute Effects of Suspended Sediment Angularity on Juvenile Coho Salmon (Oncorhynchus Kisutch)*, 56 Can. J. Fisheries and Aquatic Sci., 862–867 (1999).

Patrick N. J. Lane & Gary J. Sheridan, *Impact of an Unsealed Forest Road Stream Crossing: Water Quality and Sediment Sources*, 16 Hydrological Processes, 2599–2612 (2002).

Jack Lewis et al., *Impacts of Logging on Storm Peak Flows, Flow Volumes and Suspended Sediment Loads in Caspar Creek, California*, 2 Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas, 85–125 (Mark S. Wigmosta & Stephen J. Burges eds., 2001).

Yong Lin & Xiaohua Wei, *The Impact of Large-Scale Forest Harvesting on Hydrology in the Willow Watershed of Central British Columbia,* 359 J. Hydrology, 141–149 (2008).

Thomas E. Lisle, *Sediment Transport and Resulting Deposition in Spawning Gravels, North Coastal California*, 25 Water Resources Res., 1303–1319 (1989).

Thomas E. Lisle & Sue Hilton*, The Volume of Fine Sediment in Pools: An Index of Sediment Supply in Gravel-Bed Streams*, 28 Water Resources Bull., 371–383 (1992).

Thomas E. Lisle & Sue Hilton, *Fine Bed Material in Pools of Natural Gravel Bed Channels*, 35 Water Resources Res., 1291–1304 (1999).

Thomas E. Lisle et al., *The Dominance of Dispersion in the Evolution of Bed Material Waves in Gravel-Bed Rivers*, 26 Earth Surface Processes and Landforms, 1409–1420 (2001).

Jessica D. Lundquist et al., *Lower Forest Density Enhances Snow Retention in Regions with Warmer Winters: A Global Framework Developed from Plot-Scale Observations and Modeling: Forests and Snow Retention*, 49 Water Resources Res., 6356–6370 (2013).

Joseph K. Lyons & Robert L. Beschta, *Land Use, Floods, and Channel Changes: Upper Middle Fork Willamette River, Oregon (1936-1980)*, 19 Water Resources Res., 463–471 (1983).

Mary Ann Madej, *Temporal and Spatial Variability in Thalweg Profiles of a Gravel-bed River*, 24 Earth Surface Processes and Landforms, 1153–1169 (1999).

Mary Ann Madej & Vicki Ozaki, *Channel Response to Sediment Wave Propagation and Movement*, 21 Earth Surface Processes and Landforms, 911–927 (1996).

Mary Ann Madej & *Vicki Ozaki, Persistence of Effects of High Sediment Loading in a Salmon-Bearing River, Northern California,* 451 GSA Special Paper: Management and Restoration of Fluvial Systems with Broad Historical Changes and Human Impacts, 43–55 (2009).

Jon J. Major et al., *Geomorphic Responses to Dam Removal in the United States - A Two-Decade Perspective, in* Gravel-Bed Rivers, 355–383 (D. Tsutsumi & J.B. Laronne eds., 2017).

I.A. Malcolm et al., *Hydrological Influences on Hyporheic Water Quality: Implications for Salmon Egg Survival*, 18 Hydrological Processes,1543–1560 (2004).

Michael Manga & James W. Kirchner, *Stress Partitioning in Streams by Large Woody Debris, 36 Water Resources Res.*, 2373–2379, (2000).

Michael Marden & Donna Rowan, *The Effect of Land Use on Slope Failure and Sediment Generation in the Coromandel Region of New Zealand Following a Major Storm in 1995*, 45 N.Z. J. Forestry Sci., Article No. 10 (2015).

Christine L. May, *Debris Flows Through Different Forest Age Classes in the Central Oregon Coast Range*, 38 JAWRA J. Am. Water Res. Ass'n, 1097–1113 (2002).

Christine L. May & Danny C. Lee, *The Relationships Among In-Channel Sediment Storage, Pool Depth, and Summer Survival of Juvenile Salmonids in Oregon Coast Range Streams*, 24 N. Am. J. Fisheries Mgmt., 761–774 (2004).

Daniel J. Miller & Lee E. Benda, *Effects of Punctuated Sediment Supply on Valley-Floor Landforms and Sediment Transport*, 112 GSA Bull., 1814–1824 (2000).

David R. Montgomery & John M. Buffington, *Channel-Reach Morphology in Mountain Drainage Basins*, 109 GSA Bull., 596–611 (1997).

David R. Montgomery et al., *Forest Clearing and Regional Landsliding*, 28 Geology, 311–314 (2000).

David R. Montgomery et al., *Geomorphic Effects of Wood in Rivers*, in 37 Am. Fisheries Soc'y Symp.: The Ecology and Management of Wood in World Rivers, 1–28 (2003).

R. Dan Moore & S.M. Wondzell, *Physical Hydrology and the Effects of Forest Harvesting in the Pacific Northwest: A Review.*, 41 JAWRA J. Am. Water Res. Ass'n, 763–784.

R. Dan Moore & John S. Richardson, *Natural Disturbance and Forest Management in Riparian Zones: Comparison of Effects at Reach, Catchment, and Landscape Scales*, 31 Freshwater Sci., 239–247 (2012).

Erich R. Mueller & John Pitlick, *Sediment Supply and Channel Morphology in Mountain River Systems: 1. Relative Importance of Lithology, Topography, and Climate*, 118 J. Geophysical Res.: Earth Surface, 2325–2342 (2013).

Tobias Müller & Marwan A. Hassan, *Fluvial Response to Changes in the Magnitude and Frequency of Sediment Supply in a 1-D Model*, 6 Earth Surface Dynamics, 1041–1057 (2018).

Michael L. Murphy, *Forestry Impacts on Freshwater Habitat of Anadromous Salmonids in the Pacific Northwest and Alaska: Requirements for Protection and Restoration* (NOAA Coastal Ocean Program Decision Analysis Series No. 7) (1995).

Michael L. Murphy & K. V. Koski, *Input and Depletion of Woody Debris in Alaska Streams and Implications for Streamside Management*, 9 N. Am. J. Fisheries Management, 427–436 (1989).

F. Nakamura & F.J. Swanson, *Effects of Coarse Woody Debris on Morphology and Sediment Storage of a Mountain Stream System in Western Oregon*, 18 Earth Surface Processes and Landforms, 43–61 (1993).

Rodney J. Nakamoto, *Effects of Timber Harvest on Aquatic Vertebrates and Habitat in the North Fork Caspar Creek, in* Proceedings of the Conference on Coastal Watersheds: The Caspar Creek Story, 87–96 (General Tech. Rep. PSW GTR-168, R. Ziemer ed., 1998).

Sean M. Naman et al., *The Energetic Consequences of Habitat Structure for Forest Stream Salmonids,* 87 J. Animal Ecology, 1383–1394 (2018).

David Park et al., *Landscape-Level Stream Fragmentation Caused by Hanging Culverts Along Roads in Alberta's Boreal Forest*, 38 Can. J. Forest Res., 566–575 (2008).

Gary Parker et al., *Physical Basis for Quasi-Universal Relations Describing Bankfull Hydraulic Geometry of Single-Thread Gravel Bed Rivers*, 112 J. Geophysical Res., F04005 (2007).

Timothy D. Perry & Julia A. Jones, *Summer Streamflow Deficits from Regenerating Douglas-Fir Forest in the Pacific Northwest, USA*, 10 Ecohydrology, e1790 (Special Issue, 2017).

G. R. Pess et al., *Juvenile Salmon Response to the Placement of Engineered Log Jams (ELJs) in the Elwha River, Washington State, USA*, 28 River Res. and Applications, 872–881 (2012).

Allison M. Pfeiffer et al., *Sediment Supply Controls Equilibrium Channel Geometry in Gravel Rivers*, 114 Proc. Nat'l Acad. Sci. USA, 3346–3351 (2017).

Ira O. Poplar-Jeffers et al., *Culvert Replacement and Stream Habitat Restoration: Implications from Brook Trout Management in an Appalachian Watershed, U.S.A.*, 17 Restoration Ecology, 404–413 (2009).

Mary E. Power, *Predator Avoidance by Grazing Fishes in Temperate and Tropical Streams: Importance of Stream Depth and Prey Size, in* Predation: Direct and Indirect Impacts on Aquatic Communities, 333–351 (W.C. Kerfoot & A. Sih eds., 1987).

Sara Rathburn & Ellen Wohl*, Predicting Fine Sediment Dynamics Along a Pool-Riffle Mountain Channel*, 55 Geomorphology, 111–124 (2003).

Gordon H. Reeves et al., *A Disturbance-Based Ecosystem Approach to Maintaining and Restoring Freshwater Habitats of Evolutionarily Significant Units of Anadromous Salmonids in the Pacific Northwest, in* Evolution and The Aquatic Ecosystems: Defining Unique Units in Population Conservation, 334–349 (J. Nielsen ed., 1995).

Gordon H. Reeves et al., *Sources of Large Wood in the Main Stem of a Fourth-Order Watershed in Coastal Oregon*, 33 Can. J. Forest Res., 1363–1370 (2003).

Leslie M. Reid & Thomas Dunne, *Sediment Production from Forest Road Surfaces*, 20 Wter Resources Res., 1753–1761 (1984).

David A. Reid et al., *Spatial and Temporal Patterns of Sediment Storage Over 45 Years in Carnation Creek, BC, a Previously Glaciated Mountain Catchment*, 44 Earth Surface Processes and Landforms, 1584–1601 (2019).

David A. Reid et al., *Does Variable Channel Morphology Lead to Dynamic Salmon Habitat?,* Earth Surface Processes Landforms (accepted article, publication forthcoming, 2019).

David A. Reid et al., *Reach-Scale Contributions of Road-Surface Sediment to the Honna River, Haida Gwaii, BC*, 30 Hydrological Processes, 3450–3465 (2016).

John S. Richardson & Salomé Béraud, *Effects of Riparian Forest Harvest on Streams: A Meta-Analysis*, 51 J. Applied Ecology, 1712–1721 (2014).

Stephen P. Rice et al., *Zoogeomorphological Behaviours in Fish and the Potential Impact of Benthic Feeding on Bed Material Mobility in Fluvial Landscapes*, 44 Earth Surface Processes and Landforms, 54–66 (2019).

Stephen P. Rice et al., *Macroinvertebrate Community Changes at Coarse Sediment Recruitment Points Along Two Gravel Bed Rivers*, 37 Water Resources Res., 2793–2803 (2001).

Stephen P. Rice, *Tributary Connectivity, Confluence Aggradation and Network Biodiversity*, 277 Geomorphology, 6–16 (2017).

Richard G. Roberts & Michael Church, *The Sediment Budget in Severely Disturbed Watershed, Queen Charlotte Ranges, British Columbia*, 16 Can. J. Forest Res., 1092–1106.

E. George Robison et al., *Oregon Road/Stream Crossing Restoration Guide: Spring 1999* (Or. Dep't Fish and Wildlife, 1999).

Kenneth M. Rood, *An Aerial Photograph Inventory of the Frequency and Yield of Mass Wasting on the Queen Charlotte Islands, British Columbia* (B.C. Ministry of Forests, Land Mgmt. Rep. No. 34, 1984).

Jordan S. Rosenfeld & Shelly Boss, *Fitness Consequences of Habitat Use for Juvenile Cutthroat Trout: Energetic Costs and Benefits in Pools and Riffles*, 58 Can. J. Fisheries and Aquatic Sci., 585–593 (2001).

Sandra E. Ryan et al., *Influence of Large Wood on Channel Morphology and Sediment Storage in Headwater Mountain Streams, Fraser Experimental Forest, Colorado,* 217 Geomorphology, 73–88 (2014).

Y. Schindler Wildhaber et al., *Effects of River Morphology, Hydraulic Gradients, and Sediment*

Deposition on Water Exchange and Oxygen Dynamics in Salmonid Redds, 470–471 Sci. Total Env't, 488–500 (2014).

K.M. Schmidt et al., *The Variability of Root Cohesion as an Influence on Shallow Landslide Susceptibility in the Oregon Coast Range*, 38 Can. Geotechnical J., 995–1024 (2001).

Johannes M. Schneider et al., *Self-Adjustment of Stream Bed Roughness and Flow Velocity in a Steep Mountain Channel*, 51 Water Resources Res., 7838–7859 (2015).

David A. Sear et al., *The Significance and Mechanics of Fine-Sediment Infiltration and Accumulation in Gravel Spawning Beds, in* 65 Am. Fisheries Soc'y Symp.: Salmonid Spawning Habitat in Rivers, 149–173 (2008).

David A. Sear et al., *Logjam Controls on Channel: Floodplain Interactions in Wooded Catchments and Their Role in the Formation of Multi-Channel Patterns*, 116 Geomorphology, 305–319 (2010).

David A. Sear et al., *Does Fine Sediment Source as Well as Quantity Affect Salmonid Embryo Mortality and Development?,* 541 Sci. Total Env't, 957–968 (2016).

Jeffrey G. Shellberg et al., *Hydrogeomorphic Effects on Bedload Scour in Bull Char (Salvalinus Confluentus) Spawning Habitat, Western Washington, USA*, 67 Can J. Fisheries and Aquatic Sci., 626–640 (2010).

Roy C. Sidle, *A Theoretical Model of the Effects of Timber Harvesting on Slope Stability*, 28 Water Resources Res., 1897–1910 (1992).

Langston A. Simmons & S.H. Anderson, *Effects of Logging Activities on Selected Soil Physical and Hydraulic Properties for a Claypan Landscape*, 269 Geoderma, 145–152 (2016).

R. D. Smith et al., *Effects on Bedload Transport of Experimental Removal of Woody Debris from a Forest Gravel-Bed Stream*, 18 Earth Surface Processes and Landforms, 455–468 (1993).

C. Soulsby et al., *Fine Sediment Influence on Salmonid Spawning Habitat in a Lowland Agricultural Stream: A Preliminary Assessment*, 265 Sci. Total Env't, 295–307 (2001).

Ivars Steinblums et al., *Designing Stable Buffer Strips for Stream Protection*, 82, J. Forestry 49–52 (1984).

Justin C. Stout et al., *Passive Recovery of Wood Loads in Rivers*, 54 Water Resources Research, 8828–8846 (2018).

Kathleen Sullivan et al., *Stream Channels: The Link Between Forests and Fishes*, *in* Streamside Management: Forestry and Fishery Interactions, 39–97 (E.O. Salo & T.W. Cundy eds., 1986).

Diane G Sutherland et al., *Evolution of a Landslide-Induced Sediment Wave in the Navarro River, California*, GSA Bull., 1036–1048 (2002)

Kenwyn B. Suttle et al., *How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids*, 14 Ecological Applications, 969–974 (2004).

Frederick J. Swanson et al., *Mass Failures and Other Processes of Sediment Production in Pacific Northwest Forest Landscapes*, *in* Streamside Management: Forestry and Fishery Interactions, 9–38 (E.O. Salo & T.W. Cundy eds., 1986).

Bernard W. Sweeney et al., *Riparian Deforestation, Stream Narrowing, and Loss of Stream Ecosystem Services*, 101 Proc. Nat'l Acad. Sci. USA, 14132–14137 (2004).

Edivaldo L. Thomaz et al., *The Effects of Unpaved Roads on Suspended Sediment Concentration at Varying Spatial Scales - A Case Study from Southern Brazil*, 28 Water Env't J., 547–555 (2014).

D.B. Tripp & V.A. Poulin, *The Effects of Logging and Mass Wasting on Salmonid Spawning Habitat in Streams on the Queen Charlotte Islands* (B.C. Ministry of Forests, Land Mgmt. Rep. No. 50, 1986).

Peter J. Tschaplinski, *State of Stream Channels, Fish Habitats, and Adjacent Riparian Areas: Resource Stewardship Monitoring to Evaluate the Effectiveness of Riparian Management, 2005–2008* (B.C. Ministry of Forests, Mines and Land, FREP Extension Note No. 17, 2011).

H.J. van Meerveld et al., *Controls on Sediment Production from an Unpaved Forest Road in a Pacific Maritime Watershed*, 50 Water Resources Research, 4803–4820 (2014).

Andrés Varhola et al., *Forest Canopy Effects on Snow Accumulation and Ablation: An Integrative Review of Empirical Results*, 392 J. Hydrology, 219–233 (2010).

Jeremy G. Venditti et al., *Bedforms, Structures, Patches, and Sediment Supply in Gravel-Bed Rivers*, in Gravel-Bed Rivers, 439–466 (D. Tsutsumi & J.B. Laronne eds., 2017).

Jeremy G. Venditti et al., *Effect of Sediment Pulse Grain Size on Sediment Transport Rates and Bed Mobility in Gravel Bed Rivers*, 115 J. Geophysical Res.: Earth Surface, F03039 (2010).

Jeremy G. Venditti et al., *Alternate Bar Response to Sediment Supply Termination*, 117 J. Geophysical Res, F02039 (2012)

Lisa S. Walsh et al., *Correlations of Fluvial Knickzones With Landslide Dams, Lithologic Contacts, and Faults in the Southwestern Annapurna Range, Central Nepalese Himalaya*, 117 J. of Geophysical Res.: Earth Surface, F01012 (2012).

Beverley C. Wemple et al., *Forest Roads and Geomorphic Process Interactions, Cascade Range, Oregon*, 26 Earth Surface Processes and Landforms, 191–204 (2001).

Beverley C. Wemple & Julia A. Jones, *Runoff Production on Forest Roads in a Steep, Mountain Catchment*, 39 Water Resources Res., No. 8, 1220 (2003).

Beverley C. Wemple et al., *Ecohydrological Disturbances Associated with Roads: Current Knowledge, Research Needs, and Management Concerns with Reference to the Tropics*, 11 Ecohydrology, e1881 (Special Issue, 2018).

Peter J. Whiting & Jeffrey B. Bradley, *A Process-Based Classification System for Headwater Streams, 18 Earth Surface Processes and Landforms*, 603–612 (1993).

Rita D. Winkler et al., *Measured Differences in Snow Accumulation and Melt Among Clear-cut, Juvenile, and Mature forests in Southern British Columbia*, 19 Hydrological Processes, 51–62 (2005).

Rita D. Winkler et al., *Hydrologic Processes and Watershed Response*, *in* 1 Compendium of Forest Hydrology and Geomorphology in British Columbia, 133–177 (R.G. Pike, T.E. Redding, R.D. Moore, R.D. Winker & K.D. Bladon eds., 2010)

Mark S. Wipfli & David P. Gregovich, *Export of Invertebrates and Detritus from Fishless Headwater Streams in Southeastern Alaska: Implications for Downstream Salmonid Production*, 47 Freshwater Biology, 957–969 (2002).

Mark S. Wipfli et al., *Ecological Linkages Between Headwaters and Downstream Ecosystems: Transport of Organic Matter, Invertebrates, and Wood Down Headwater Channels,* 43 JAWRA J. Am. Water Res. Ass'n, 72–85 (2007).

Ellen Wohl & Daniel N. Scott, *Wood and Sediment Storage and Dynamics in River Corridors*, 42 Earth Surface Processes and Landforms, 5–23 (2017).

Ellen Wohl, *A Legacy of Absence: Wood Removal in US Rivers*, 38 Progress in Physical Geography: Earth and Env't, 637–663 (2014).

Steven M. Wondzell, *Effect of Morphology and Discharge on Hyporheic Exchange Flows in Two Small Streams in the Cascade Mountains of Oregon, USA*, 20 Hydrological Processes, 267–287 (2006).

Alan D. Ziegler & Thomas W. Giambelluca, *Importance of Rural Roads as Source Areas for Runoff in Mountainous Areas of Northern Thailand*, 196 J. Hydrology, 204–229 (1997).

Robert R. Ziemer, *Roots and the Stability of Forested Slopes*, in Erosion and Sediment Transport in Pacific Rim Steeplands, 343–361 (Int'l Ass'n Hydrological Sci. Publication No. 132, 1981)

EXHIBIT A

THE UNIVERSITY OF BRITISH COLUMBIA
Curriculum Vitae for Faculty Members

Date: March 31, 2019 **Initials**:

1. **SURNAME**: Hassan **FIRST NAME**: Marwan
MIDDLE NAME(S):

2. **DEPARTMENT/SCHOOL:** Geography

3. **FACULTY**: Arts

4. **PRESENT RANK**: Professor **SINCE**: July 1, 2009

5. **POST-SECONDARY EDUCATION**

University or Institution	Degree	Subject Area	Dates
Institute of Earth Sciences, The Hebrew University of Jerusalem	Ph.D.	Geomorphology	1984-1989
Institute of Earth Sciences, The Hebrew University of Jerusalem	M.S.	Geomorphology	1983-1984
Department of Geography, Ben Gurion University of the Negev	B.A.	Geography	1978-1982

Title of Dissertation and Name of Supervisor

Ph.D. Dissertation: The movement of bedload particles in a gravel bed stream and its relationship to the transport mechanism of the scour layer
***Supervisor*:** A. P. Schick

Special Professional Qualifications

6. **EMPLOYMENT RECORD**

(a) *Prior to coming to UBC*

University, Company or Organization	Rank or Title	Dates
The Hebrew University of Jerusalem	Senior Lecturer	1997-2002
University of Glasgow	Lecturer	1995-1996
The Hebrew University of Jerusalem	Teaching Assistant	1983-1989

(b) *At UBC*

Rank or Title	Dates
Professor	2009
Associate Professor	2006 – 2009
Assistant Professor	2004 – 2006
Adjunct Professor and Sessional Lecturer	2001-2004
Research and Teaching Fellow	1991-1994
Killam Post-doctoral Fellow	1989-1991

(c) *Date of granting of tenure at U.B.C.:* July 1, 2006

7. LEAVES OF ABSENCE

University, Company or Organization at which Leave was taken	Type of Leave	Dates
UBC, Geography	Sabbatical	Jan 1-July 1, 2011

8. TEACHING

(a) *Areas of special interest and accomplishments*

Dr. Hassan is recognized by his students as an enthusiastic and engaging instructor, teaches at both the undergraduate and graduate levels, and employs a wide range of scientific pedagogical methods such as in-class discussions, meetings, and field trips of geomorphic/hydrologic relevance. He encourages students to think critically both inside and outside of the classroom by illustrating how topics on water resources, geomorphology and environmental change are relevant to our daily lives. Students are trained in field methods and apply course concepts in real-world settings. He supervises a team of teaching assistants who conduct laboratories for his courses, is committed to TA mentorship, and works closely with them to ensure that they are both comfortable with the material being taught and with their abilities to convey that material. Dr. Hassan helped establish teaching assistant training in Geography, one of the first of its kind in the Faculty of Arts.

(b) *Courses Taught at UBC*

Session	Course Number	Scheduled Hours	Class Size	Hours Taught			
				Lectures	Tutorials	Labs	Other
2018W	Geob508	3.0	5	39			
2018W	Geob405	3.0	29	39			
2017W	Geob 508/501	3.0	5	39			
2016W	Geob508	3.0	3	39		13	1 day field

2016W	Geob405	3.0	29	39		13	1 day field
2015W	Geob508	3.0	3	39			
2014W	Geob508	3.0	2	39			
2014	Geob405	3.0	25	39			
2013W	Geob508	3.0	4	39			
2012W	Geob508	3.0	8	39			
2012W	Geob405	3.0	18	39			
2011W	Geob103	3.0	225	39			
2011W	Geob508	3.0	5	39			
2010W	Geob508	3.0	7	39			
2010W	Geob405	3.0	27	39			
2009W	Geob 503	3.0	3	39			
2009W	Geob 103-203	3.0	170	39			
2008W	GEOG 103-203	1.5	177*	39			
2008W	GEOG 405-101	3.0	22*	39			Field + 1 day

**Enrollments to date*

Session	Course Number	Scheduled Hours	Class Size	Hours Taught			
				Lectures	Tutorials	Labs	Other
2007W	GEOG 103-101	0.5	218	12			
2007W	GEOG 318-201	3.0	32	39			
2007W	GEOG 503-201	3.0	8	39			
2006W	GEOG 103-101	3.0	218	39			
2006W	GEOG 318-201	3.0	38	39			
2006W	GEOG 405-101	3.0	14	39		5	Field+1 day
2005W	GEOG 103-101	3.0	198	13			
2005W	GEOG 103-204	3.0	193	39			

2005W	GEOG 318-201	3.0	53	39			
2005W	GEOG 503-201	3.0	3	39			
2004W	GEOG 102-101	3.0	195	19.5			5[1]
2004W	GEOG 102-104	3.0	196	19.5			
2004W	GEOG 318-201	3.0	40	39			
2004W	GEOG 503-201	3.0	6	39			
2003W	GEOG 412-201	3.0	20	39			
2003W	GEOG 508A-201	3.0	5	39			
Session	**Course**	**Scheduled**	**Class**	**Hours Taught**			
	Number	**Hours**	**Size**	**Lectures**	**Tutorials**	**Labs**	**Other**
2002W	GEOG 103-203	3.0	183	19.5			5[1]
2002W	GEOG 103-204	3.0	181	19.5			
2002W	GEOG 205-201	3.0	40	39			10[1]
2002W	GEOG 306-101	3.0	30	19.5			
2002W	GEOG 503-101	3.0	8	39			
2001W	GEOG 103-203	3.0	192	19.5			
2001W	GEOG 103-204	3.0	192	19.5			5[1]
2001W	GEOG 405-201	3.0	21	39		12	
2001W	GEOG 508A-101	3.0	3	39			

2000W	GEOG 103-203	3.0	201	19.5			
2000W	GEOG 103-204	3.0	186	19.5			5[1]
1993W	GEOG 103-203	3.0	190	19.5			5[1]
1993W	GEOG 405-201	3.0	11	19.5		12	
1992W	GEOG 306-101	3.0	29	19.5			10[1]
1992W	GEOG 405-201	3.0	15	39		12	
1992W	GEOG 503-202	3.0	3	39			

[1]*Number of contact hours with Teaching Assistant(s)*

(c) Directed Studies Taught at UBC

Session	Course Number	Scheduled Hours	Class Size	Hours Taught			
				Lectures	Tutorials	Labs	Other
2015W	GEOG 447-201	3.0	1	39			
2014W	GEOG 447-201	3.0	1	39			
2013W	GEOG 447-201	3.0	1	39			
2007W	GEOG 507-101	3.0	1	39			
2007W	GEOG 448-101	3.0	1	39			
2006W	GEOG 507C	3.0	1	39			

(d) Courses Taught at The Hebrew University of Jerusalem

***Course codes*:**

40103 = Introduction to Geomorphology
40456 = Fluvial Geomorphology
40455 = Drainage Basins
40559 = Water Resources Management
40948 = Introduction to Hydrology
40955 = Field Methods in Geomorphology
40956 = Mechanics of Sediment Transport

Session	Course Number	Scheduled Hours	Class Size	Hours Taught			
				Lectures	Tutorials	Labs	Other
1999-2000	40948	39	14	26		13	Field = 2 days
1998-1999	40103	39	87	26	T.A.	T.A.	Field = 2 days
1998-1999	40103	39	93	26	T.A.	T.A.	Field = 2 days
1998-1999	40948	39	16	26		13	Field = 2 days
1998-1999	40956	39	8	39			
1998-1999	40995	Field	9	5 days			
1997-1998	40455	39	20	26		13	Field = 2 days
1997-1998	40456	39	22	26		13	Field = 2 days
1997-1998	40948	39	29	26		13	Field = 2 days

1996-1997	40456	39	10	26		13	Field = 2 days
1996-1997	40559	26	8	26			
1996-1997	40948	39	15	26		13	Field = 2 days

(e) Courses Taught at Glasgow University

Session	Course Number	Scheduled Hours	Class Size	Hours Taught			
				Lectures	Tutorials	Labs	Other
1995-1996	3rd Year Field Camp	Field	40	10 days			
1995-1996	Laboratory Methods	20	20			20	
1995-1996	Physical Geography	40	4 groups (10 each)		40		
1995-1996	Introduction to Statistics	30	100	30			
1994-1995	1st Year Field Camp	Field	80	3 days			
1994-1995	2nd Year Field Camp	Field	60	5 days			
1994-1995	Physical Geography	40	4 groups (10 each)		40		

f) Graduate Students Supervised and/or Co-Supervised at UBC

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Michael Turley	MSc (GEOG)	2018		M. Hassan	
Nisreen Al-Ghorani	PhD (GEOG)	2018		M. Hassan	
Alex Mitchel	PhD (GEOG)	2018		M. Hassan	
Conor McDowell	PhD (GEOG)	2017		M. Hassan	
Carina Helm	MSc (GEOG)	2017		M. Hassan	
Kevin Pierce	PhD (GEOG)	2016		M. Hassan	
Alex Mitchel	MSc (GEOG)	2016	2018	M. Hassan	
Yinlue Wang	PhD (GEOG)	2015		M. Hassan	
Emma Buckrell	MSc (GEOG)	2015	2017	M. Hassan	
David Reid	PhD (GEOG)	2014		M. Hassan	
Elli Papangelakis	MSc (GEOG)	2013	2015	M. Hassan	

Eva Crego	MSc (GEOG)	2013	2016	M. Hassan	
Kathryn De Rego	PhD (GEOG)	2013	2018	M. Hassan	B. Eaton
Tobias Muller	PhD (GEOG)	2013		M. Hassan	
Kai Tsuruta	PhD (Forestry)	2012	2017	A. Alila	M. Hassan
Maria Elgueta	PhD (GEOG)	2014	2018	M. Hassan	
David Reid	MSc (GEOG)	2012	2014	M. Hassan	
Ahley Dudill"	PhD (GEOG)	2012	2016	M. Church	M. Hassan
Leonora King	PhD (GEOG)	2012	2018	M. Hassan	
Shawn Chartrand	PhD (GEOG)	2011	2017	M. Hassan	
Mahdi Abalharth	MSc (GEOG)	2011	2013	M. Hassan	B. Klinkenberg
Hal Voepel	PhD(Hydrology)	2008	2013	R. Schumer	M. Hassan
Maria Elgueta	MSc (GEOG)	2011	2013	M. Hassan	
Claudia Alviano von Flotow	MSc (GEOG)	2011	2013	M. Hassan	
Matthew Kinnear	MSc (GEOG)	2010	2012	M. Hassan	
Ilana Klinghoffer	MSc (GEOG)	2010	2015	M. Hassan	
Michael More	MSc (GEOG)	2010	2012	M. Hassan	S. Hermansen
Holly Buehler	MSc (GEOG)	2010	2013	B. Eaton	M. Hassan
Daniel V. Tarrio (Spain)	PhD	2009	2013		M. Hassan
Piotr Cienciala	PhD (GEOG)	2009	2014	M. Hassan	
Natasha Cowie	MSc (GEOG)	2009	2012	R.D. Moore	M. Hassan
Tim Blair	MSc(Forest Resource Management	2007	2010	Y. Alila	M. Hassan
Piotr Cienciala	MSc (GEOG)	2008	2009	M. Hassan	
Amy Nicoll	MSc (GEOG)	2008	2012	M. Hassan	
Leonora King	Earth and Environmental Sciences (UBC-Okanaga)	2009	2012	A. Wei	M. Hassan
Tim Argast	MSc (GEOG)	2007	2012	M. Hassan	
Melissa Ewan	MSc (GEOG)	2007	2010	M. Hassan	
Graham McIntyre	MA (GEOG)	2005	2007	M. Hassan	
Tobiah Perkins	M.Eng (CIVIL)	2003	2005	R. Millar	M. Hassan
Jason Rempel	MSc (GEOG)	2003	2005	M. Hassan	
Drew Brayshaw	PhD (Forest Resources Management)	2005	2012	Y. Alila	M. Hassan
Ruben Santos	PhD (Spain)	2005	2011		M. Hassan
Richard McCleary	PhD (GEOG)	2005	2011	M. Hassan	

Nira Salant	PhD (GEOG)	2005	2009	M. Hassan	
Andre Zimmermann	PhD (GEOG)	2004	2009	M. Hassan	M. Church
Joshua Caulkins	PhD (GEOG)	2004		M. Hassan	
Francesco Brardinoni	PhD (GEOG)	2002	2006	M. Hassan	

Postdoctoral Supervision

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Chenge An	Postdoctoral	2019		M. Hassan	
Niannian Fan	Postdoctoral	2016	2017	M. Hassan	
Matteo Saletti	Postdoctoral	2016	2018	M. Hassan	
William Floyd	Postdoctoral	2013	2014	M. Hassan	
Carles Ferrer-Boix	Postdoctoral	2012	2016	M. Hassan	
Faran Ali	Postdoctoral	2010	2012	M. Hassan	
Erik Schiefer	Postdoctoral	2007	2009	M. Hassan	
Philip Marren	Postdoctoral	2007	2008	A. Alila	M. Hassan
Ramon Batalla	Postdoctoral	1993	1993	M. Church	M. Hassan

Graduate Supervision Committee

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Gillian Fuss	MSc	2015		J. Richardson	
Anna Grau	PhD	2013	2017	M. Jellinek	
Aaron Tamminga	PhD	2012	2016	B. Eaton	
Sarah Davidson	PhD	2011	2016	B. Eaton	
John Richards	MSc (GEOG)	2006	2008	D. Moore	
Sonya Powell	MSc (GEOG)	2003	2006	L. Daniel	
Robert Humphries	PhD (GEOG, SFU)	2007	2009	J. Venditti	
Brett Eaton	PhD (GEOG)	2000	2004	M. Church	

Graduate Students Supervised and/or Co-Supervised at The Hebrew University of Jerusalem

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Ariel Cohen	MSc (ENV SCI)	2001	2004	M. Hassan	Y. Enzel
Dror Shail	MSc (AGRI)	2001	2004	R. Nativ	M. Hassan
Mor Salus	MSc (AGRI)	2000	2001	R. Nativ	M. Hassan

Roey Egozi	MA (GEOG)	2000	2001	M. Hassan	
Armani Limor	MA (GEOG)	1999	2002	M. Hassan	
Michael Malmaeus	MSc	1999	2000	M. Hassan	
Daniel Glikman	MA (GEOG)	1999	2000	M. Hassan	
Lavi Ofer	MA (GEOG)	1998	2000	M. Hassan	
Givati Amir	MA (GEOG)	1998	2000	M. Hassan	
Francesco Brardinoni	Diploma	1997	1999	M. Hassan	
Khaled Shaheen	PhD (GEOG)	2000	2006	M. Hassan	R. Nativ
Lior Asaf	PhD (AGRI)	2000	2005	R. Nativ	M. Hassan

(g) ***Continuing Education Activities***

Hassan, M. A., 1998. Introduction to Geomorphology: Laboratory Manual. Department of Geography, Hebrew University of Jerusalem, Jerusalem, Israel.

Hassan, M.A. 1997. Coastal Geomorphology Field Excursion. Department of Geography, Hebrew University of Jerusalem, Jerusalem, Israel, May 1997.

Hassan, M.A. 1997. Dead Sea Field Excursion. Department of Geography, Hebrew University of Jerusalem, Jerusalem, Israel, May 1997.

Hassan, M.A., 1997. Contribution to A. Gafni, editor, Nahal Lakesh River Restoration Project. Field Excursion, Nahal Lakesh, Israel, May 1997.

(h) ***Visiting Lecturer*** *(indicate university/organization and dates)*

Department of Hydraulic Engineering Tsinghua University, China, May 2017 and Sept. 2017
Bundesanstalt für Gewässerkunde, Koblenz, Germany, November 2016
Ecole polytechnique fédérale de Lausanne (EPFL), November, 2015
Ecole polytechnique fédérale de Lausanne (EPFL), June-August 2014
American National Foundation, Site Visit, Washington DC, November, 2010
Visiting Professor, Norwegian Geological Survey, Norway, April, 2010
Visiting Professor, Universitat de Lleida, Spain, March – April, 2009.
Visiting Professor, Università di Milano-Bicocca, Italy, August -Sept., 2009.
Visiting Professor, Department of Geography, UBC; 2000-2001
Visiting Professor, Department of Geography, UBC; 1996 (2 months)
Visiting Scientist, US Army Corps of Engineers, Vicksburg, Mississippi, USA; 1996 (1 month)
Visiting Professor, Department of Geography, UBC; 1995 (6 months)
Visiting Researcher, Birkbeck College, Department of Geography, University of London, UK; 1988 (3 months)
Visiting Researcher, Department of Geography, St. Andrews University, UK; 1988 (3 months)
Visiting Researcher, US Geological Survey, Denver, Colorado, USA; 1985 (2 months)

(i) ***Other: Undergraduate Students Supervised at The Hebrew University of Jerusalem***

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Yair Kopolovich	BA	1997	2000	M. Hassan	
Michal Tal	BA	1996	1999	M. Hassan	
Roey Egozi	BA	1996	1999	M. Hassan	

Undergraduate Students Supervised at Glasgow University

Student Name	Program Type	Year		Principal Supervisor	Co-Supervisor(s)
		Start	Finish		
Simon W. Roser	BSc		1997	M. Hassan	

9. SCHOLARLY AND PROFESSIONAL ACTIVITIES

(a) Areas of special interest and accomplishments

Dr. Hassan has been active nationally and internationally with water issues for 20 years, exploring topics with broad societal relevance. In addition to research in sediment transport, channel morphology and river dynamics, he has initiated projects addressing global water resource problems. In 1999 he established a joint Palestinian-Israeli-German project examining urban hydrology and water resource issues in the West Bank and Israel, a study that embodied several research challenges of prime importance to regional water supply, pollution treatment, and environmental conservation. He has worked with Chinese researchers on the areal sediment yield of the Yellow River, using extensive long-term data sets. This work has implications for irrigation, water use and downstream. Dr. Hassan has examined the relation between sediment transport and habitat modification by salmon in small streams in BC, which has been noted in science media (ScienceNow, Nature Geosciences, etc.) as innovative and interdisciplinary research.

(b) Research or equivalent grants (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC)) at UBC:

Granting agency code:
CFI–LOF = Canada Foundation for Innovation – Leadership Opportunity Fund
NSERC = Natural Sciences and Engineering Research Council of Canada
NSERC-USRA= NSERC-Undergraduate Student Research Awards
BC FSP = British Columbia Forest Science Program
MPB = Mountain Pine Beatle Initiative, Canadian Forest Service

Granting Agency	Subject	COMP	Total $	Year	Principal Investigator	Co-Investigator(s)
Balance Hydrologics (USA)	Dam removal II	C	13000	2018-2019	M. Hassan	
Balance Hydrologics (USA)	Dam removal I	C	30000	2017-2018	M. Hassan	
NSERC	Mountain stream adjustments to changes in flow and sediment supply regimes	C	195000	2017-2022	M. Hassan	
MITACS	Rapid mapping	C	15000	2018	M. Hassan	
Stantec & MITACS	Channel design	C	15000	2016	M. Hassan	
Balance Hydrologics (CA, USA)	Modelling dam removal	C	33000	2015	M. Hassan	

BC Ministry of Forests Lands & Natural Resource & MITACS	Modelling suspended sediment in streams	C	15000	2015	M. Hassan	
BC Ministry of Forests Lands & Natural Resource & MITACS	Suspended sediment input from roads III	C	15000	2014	M. Hassan	
BC Ministry of Forests Lands & Natural Resource & MITACS	Suspended sediment input from roads II	C	15000	2013	M. Hassan	
BC Ministry of Forests Lands & Natural Resource & MITACS	Russell Creek LiDAR	C	15000	2013	M. Hassan	
BC Ministry of Forests Lands & Natural Resource & MITACS	Suspended sediment input from roads I	C	15000	2012	M. Hassan	
NSERC/UBC	ADV		16300	2013	M. Hassan	
NSERC	Grain kinematics and sediment supply	C	160000	2012-2017	M. Hassan	
Foothill Model Forest	Experiments on sediment supply and channel morphology	C	17500	2012-2013	M. Hassan	
CFI-LOF BGMX	Biogeomorphology Experimental Laboratory (BGMX)	C	993000	2012-2014	M. Hassan	B. Eaton and G. Henry
BC Ministry of Forest	Erosion from logging roads		30000	2012-2014	M.Hassan	
Foothill Model Forest	Sediment supply impact on channels		17500	2011-2012	M.Hassan	
NSERC/UBC Arts	Lab support		10,000	2010-2011	M.Hassan	
CFI-LOF	MCHEL		75,000	2010-2015	M.Hassan	
NSERC-USRA	Sediment transport in gravel bed streams	C	$4,500	2009-2010	M. Hassan	C. Hall

NSERC/UBC General Research Fund	Fluvial laboratory	C	68,000 (2 years)	2009-2010	M. Hassan	
CFI- LOF	Mountain Channel Hydraulics Experimental Laboratory	C	$625,000	2008 - 2009	M. Hassan	
NSERC-USRA	Channel morphology of small streams	C	$4,500	2007 - 2008	M. Hassan	I. Klinghoffer
Foothill Model Forest (AB)	Channel morphology and process domains	C	$10,000	2008 - 2009	M. Hassan	
BC FSP	Channel Adjustment	C	$33,000	2008 - 2009	M. Hassan	
BC FSP	Cotton Creek Phase II	C	$105, 000 (3 year total)	2007 - 2010	Dan Moore	M. Hassan
NSERC-USRA	Sediment Transport in small streams	C	$4,500	2007	M. Hassan	T. Argast

Granting Agency	**Subject**	**COMP**	**Total $**	**Year**	**Principal Investigator**	**Co-Investigator(s)**
NSERC	Channel stability of steep mountain streams	C	$141,500 (5 year total)	2007 - 2012	M. Hassan	
BC FSP	Hydrologic Indicators For Watershed Sensitivity to Peak Flow Changes in Small Watersheds	C	$116,970 (3 year total)	2006 - 2009	M. Hassan	Y. Alila
Foothill Model Forest (AB)	Process domain and landscape evolution	C	$28,000	2006	M. Hassan	
MPB Initiative, Canadian Forest Service	Mountain beetle impacts on channel morphology and woody debris in forested landscape	C	$187,000 (2 year total)	2005 - 2007	M. Hassan	D. Hogan
Foothill Model Forest (AB)	Wood budget and sediment budget approach for evaluating effects of various riparian management strategies	C	$55,000 (2 year total)	2005 - 2007	M. Hassan	
UBC-Start up	Bedload transport in gravel bed rivers	NC	$40,000	2004 - 2006	M.Hassan	

NSERC	Channel stability of mountain streams	C	$124,000 (5 year total)	2002 - 2007	M. Hassan	

Research or equivalent grants (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC)) at The Hebrew University of Jerusalem:

Granting Agency	Subject	COMP	Total $	Year	Principal Investigator	Co-Investigator(s)
German Ministry of Science	The impact of Urbanization on the Israeli coast	C	$330,000 (4 year total)	2000-2004	M. Hassan	R. Nativ
DFG, Germany	Urban hydrology of Ramallah, West Bank	C	$350,000 (5 year total)	1999-2004	M. Hassan	Y. Enzel
Hebrew University (seed money)	Water harvesting in Jordan	C	$15,000 (3 year total)	1999-2002	M. Hassan	
Granting Agency	**Subject**	**COMP**	**Total $**	**Year**	**Principal Investigator**	**Co-Investigator(s)**
Israel Academy of Sciences	Stabilizing Structures in gravel streams	C	$210,000 (3 year total)	1999-2002	M. Hassan	
Israel Ministry of Agriculture	Sediment sources in agricultural areas	C	$45,000 (3 year total)	1999-2002	M. Hassan	
Karen Kayemet, Israel	Sources of sediment in semi-arid watershed	C	$65,000 (3 year total)	1998-2001	M. Hassan	
Hebrew University	Sediment transport laboratory	NC	$227,000	1998-1999	M. Hassan	
BC Ministry of Forests	Sediment transfer in Carnation Creek	NC	$10,000	1997-1999	M. Hassan	
Hebrew University – Start up	Sediment transport in ephemeral streams	NC	$43,500	1996-1997		
Israel Association for Canadian Studies	Channel morphology in forested streams	C	$5,000	1997-1998	M. Hassan	

(c) ***Research or equivalent contracts (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC) at UBC:***

Granting Agency	Subject	COMP	Total $	Year	Principal Investigator	Co-Investigator(s)
Alberta Foothill Model Forest	Sediment budget	NC	$10,000	2008	M. Hassan	
BC Ministry of Forests	Functional large woody debris in small streams: what is it?	NC	$6,000	2004-2005	M. Hassan	
BC Ministry of Forests	Tsitika River sediment budget	NC	$15,500	2004-2005	M. Hassan	
BC Ministry of Forests	Suspended sediment dynamics in Penticton Creek, BC	NC	$5,000	2003-2004	M. Hassan	
BC Ministry of Forests	Operational stream channel monitoring in real time	NC	$49,009	2003-2004	M. Hassan	

Research or equivalent contracts (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC) at The Hebrew University of Jerusalem:

Granting Agency	Subject	COMP	Total $	Year	Principal Investigator	Co-Investigator(s)
Hebrew University Conference support	Drainage Basin Dynamics	C	$5,000	1999	M. Hassan	
US Army Research Office, Europe	Drainage Basin Dynamics	C	$4,500	1999	M. Hassan	
Israel Ministry of Science	Drainage Basin Dynamics	C	$4,500	1999	M. Hassan	
The Halbert Centre for Canadian Studies	Drainage Basin Dynamics	NC	$3,000	1999	M. Hassan	

Research or equivalent contracts (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC) at Glasgow University:

Granting Agency	Subject	COMP	Total $	Year	Principal Investigator	Co-Investigator(s)
Carnegie Trust for Universities Scotland	Interaction between hillslopes and river channels in QC Islands, BC	C	$3,500	1995	M. Hassan	

(d) ***Invited Presentations***

Hassan, M.A., 2018, Variable hillslope-channel coupling and channel characteristics of forested mountain streams in glaciated landscapes, Dept. of Hydraulic Engineering, Tsinghua University, China, June 7, 2018.

Hassan, M.A., 2017, Channel adjustment to changes in sediment supply and flow regimes in mountain streams, Dept. of Hydraulic Engineering, Tsinghua University, China, May 2017.

Hassan, M.A., 2017, The footprint of salmonids on river morphology, Dept. of Hydraulic Engineering, Tsinghua University, China, June 2017.

Hassan, M.A., 2017, Channel adjustment to changes in sediment supply and flow regimes, Department of Civil Engineering, Sichuan University, China, September 2017.

Hassan, M.A., 2016, Channel adjustment to changes in sediment supply and flow regimes in mountain streams, Dept. of Geography, University of Bonn, Germany, November 2016.

Hassan, M.A., 2016, Patterns of sediment dynamics in the landscape: Yellow and Yangtze Rivers, Bundesanstalt für Gewässerkunde, Koblenz, Germany, November 2016.

Hassan, M.A., 2015, Geomorphic controls on tracer particle dispersion in gravel bed rivers, Gravel-Bed Rivers 8, Kyoto University, Japan, September 2015. Keynote speaker.

Hassan, M.A., 2015, Channel adjustment to changes in sediment supply and flow regimes, Dept. of Civil Engineering, EPFL, Lausanne, November 2015.

Hassan, M.A., 2015, Stories of sand: channel response to changes in sediment supply and flow regimes, Oregon State University, Corvallis, Oregon, April 2015.

Hassan, M.A., 2014, Grain Kinematics, Chinese Academy of Sciences, Beijing, China, April 2014.

Hassan, M.A., 2014, Move over floods, here come the salmon, Chinese Academy of Sciences, Beijing, China, April 2014.

Hassan, M.A., 2014, Sediment dynamics along the Yangtze, Yellow and Mississippi rivers, Dept. of Civil Engineering, ETH, Zurich, June 2014.

Hassan M.A., and Piotr Cienciala, 2013, Beyond a single life stage: investigating the effects of hydro-geomorphic processes on complementary types of fish habitat, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Hassan, M.A., 2013, Patterns of sediment transport in large rivers, National Taiwan Normal University, Taiwan, June 2013.

Hassan, M.A., 2013, modelling suspended sediment dynamics, Chinese Academy of Sciences, Beijing, China, August 2013.

Hassan, M.A., 2013, sediment dynamics in the landscape, National University of Singapore, Singapore, January.

Hassan, M.A., and D. Tonina, 2011. Salmon as Geomorphic Agents in Gravel-Bed Rivers, American Fisheries Society 141ST Annual meeting, Seattle, Washington, September 4-8, 2011.

Hassan, M.A., Stories of sand: the role of floods, fish and flocks in landscape evolution, Washington, Philosophical Society of Washington, Washington DC, February 2012.

Hassan, M.A., Water Issues on the Palestinian Territories and the Nile Valley, Middle East Dialogue, Washington DC, February 2012.

Hassan, M.A. Salmon as biogeomorphic agents in gravel-bed rivers, American Geophysical Union, Annual Meeting, San Francesco, December 2010.

Hassan, M.A. Does sediment supply control sediment transport in streams? Geological Survey of Norway, Trondheim, Norway, April 2010.

Hassan, M.A. Channel morphology and sediment transport in small streams. Paper presented at Università di Milano-Bicocca, Department of Geological Sciences and Geotechnologies**,** Milano, Italy, August 2009.

Hassan, M.A., 2009. Sediment transport in steep channels. Paper presented at the Universitat de Lleida and Centre Tecnològic Forestal de Catalunya Pujada del Seminari s/n25280 Solsona, Spain March 2009.

Hassan, M.A., 2007. Sediment transport in gravel bed rivers: observations and modeling. Department of Civil Engineering, University of Iowa; April 2007.

Hassan, M.A., J. Rempel, R.J. Enkin, and M. Church, 2007. Calibration of a magnetic bedload movement detector. Paper presented at the International Bedload Surrogate Monitoring Workshop, University of Minnesota; April 11-14, 2007.

Hassan, M.A., 2007. Sediment transport in Harris Creek. Department of Environmental Sciences, The University of British Columbia (Okanagan); February 2007.

Hassan, M. A., 2006. Sediment supply and hydrograph control channel bed state. Paper presented at the Department of Geography, University of Illinois – Urbana; November 2006.

Hassan, M.A., 2006. Grain Kinematic. Paper presented at the Department of Civil Engineering, University of Illinois-Urbana; November 2006.

Parker, G., M. A. Hassan and P. Wilcock, 2005. Adjustment of the Bed Surface Size Distribution of Gravel-bed Rivers in Response to Cycled Hydrographs. Paper presented at 6th International Workshop on Gravel-bed Rivers, Lienz, Austria; September 5-9, 2005.

Hassan, M.A., B. Smith, D. Hogan, D. Luzi, and B. Eaton, 2005. Sediment storage and transport in coarse bed streams: scale considerations. Paper presented at 6th International Workshop on Gravel-bed Rivers, Lienz, Austria; September 5-9, 2005 (revised text published).

Hassan, M.A., 2003. Sediment transport in small forest streams. United States of America Forest Services, RedWood Laboratory, Arcata, California; December 2003.

Hassan, M.A., 2003. Sediment transport and bed surface structures. Department of Civil Engineering, St. Anthony Fall Laboratory, University of Minnesota, Minnesota; December 2003.

Hassan, M.A., 2003. Bed structures in gravel bed streams. United States of America Geological Survey, Boulder, Colorado; May 2003.

Hassan, M. A., 2003. Bed structures and entrainment in gravel-bed rivers. Paper presented at the Canadian Geophysical Union, Annual Meeting, Banff, Alberta; May 10-14, 2003.

Hassan, M. A., 1996. Tracers in fluvial geomorphology. Department of Geography, University of Cambridge, Cambridge, UK; May 1996.

Hassan, M.A., 1996. Tracers in fluvial geomorphology. Department of Geography, University of Southampton, Southampton, UK; May 1996.

Hassan, M. A., 1995. Dispersion of fluvial sediment and contaminants in gravel-bed rivers. Paper presented at International Workshop on Sustainable Land-use in the Near East, Sponsored by the BMFT/Bonn, University of Bielefeld, Germany; November 28-30, 1995.

Hassan, M. A. and M. Church, 1992. The texture and dynamics of bedload in a gravel bed channel. Paper presented at IAHS/IGU-COMTAG Workshop on the Dynamics and Geomorphology of Mountain Rivers, Benediktbeuern, Bavaria, Germany; June 8-15, 1992.

Hassan, M.A. and M. Church, 1990. The movement of individual grains in gravel-bed rivers. Paper presented at 3rd International Workshop on Gravel-bed Rivers, Florence, Italy; September 25-29, 1990.

Schick, A.P., M.A. Hassan and J. Lekach, 1986. A vertical exchange model for coarse bedload movement: numerical consideration. Paper presented at IGU-COMTAG International Workshop on Theoretical Geomorphological Model, Aachen, Germany; April, 1986.

(e) ***Other Presentations***

Department of Civil and Environmental Engineering, Northwestern University; February 2008
Department of Hydraulic Engineering, Tsinghua University, China; May 2007
Institute of Geography and Natural Resources, Chinese Academy of Sciences; May 2007
US Department of Agriculture, National Sedimentation Laboratory, Oxford, Mississippi; February 2005
Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences, Beijing; October 2003
Department of Geography, UBC, Colloquium; October 1997; January 2001
Department of Geography, The Hebrew University of Jerusalem, Jerusalem, Israel; November 1998; February 1999
Department of Geography, University of Jordan, Amman, Jordan; January 1996
Department of Geography and Topographic Sciences, University of Glasgow; January 1996
Geographisches Institut, FU Berlin, Berlin, Germany; September 1995
Department of Geography, Ben-Gurion University of the Negev, Beer-Sheva, Israel; June 1993
Department of Geography, The University of Haifa, Haifa, Israel; June 1993
Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem, Israel; June 1993
Department of Geology, UBC; March 1991
Department of Geography, St. Andrews University, St. Andrews, UK; May 1988
US Geological Survey, Denver, Colorado; September 1985

(f) Conference Presentations

Wang, Y., and Hassan, M.A., 2018, The formation and evolution of transverse ribs, AGU Fall Meeting, December 2018, Washington DC 2018.

Saletti, M. and Hassan, M.A., 2018, Width variability controls formation and stability of step-pool sequences in steep streams, AGU Fall Meeting, December 2018, Washington DC 2018.

Saletti, M. and Hassan, M.A., 2018, The effect of width variations on the formation and evolution of step-pool morphology: insight from new flume experiments, - EGU 2018 - April 2018, Vienna, Austria.

Hassan, M.A., Saletti, M., Ferrer-Boix, C. and Muller, T. 2018, Creation and destruction of grain clusters in an experimental channel subject to episodic sediment supply: implications for particle mobility and channel adjustment, EGU 2018 - April 2018, Vienna, Austria.

Saletti, M., Molnar, P., Hassan, M.A., 2017. The role of particle jamming on the formation and stability of step-pool morphology: insight from a reduced-complexity model, AGU Fall Meeting, December 2017, New Orleans (USA).

Hempel, L. A., Grant, G., Eaton, B.C., Hassan, M.A., and Lewis, S., 2017. The role of varying flow on channel morphology: a flume experiment, AGU Fall Meeting, December 2017, New Orleans (USA).

Tobias M., and Hassan, M.A., 2016. Fluvial response to magnitude and frequency of episodic sediment supply within a 1D sediment transport model of a steep channel, AGU Fall Meeting, December 2016, San Francisco (USA).

Ferrer-Boix, C., Alejandra Elgueta, M., Hassan, M.A., 2016. River adjustments under varying flow and sediment supply regimes: The role of hydrograph shape, AGU Fall Meeting, December 2016, San Francisco (USA).

Chartrand, S.M., Hassan, M.A., and Jellinek, M., 2016. Topography Battles Surface Texture: An Experimental Study of Pool-riffle Formation, AGU Fall Meeting, December 2016, San Francisco (USA).

Emma Buckrell, E., and Hassan, M.A., 2016. Channel Bed Adjustment Along Pool-Riffle Sequences in Gravel Bed Streams, AGU Fall Meeting, December 2016, San Francisco (USA).

Hempel, L. A., Grant, G., Hassan, M.A., and Eaton, B.C., 2016, Hydrograph Shape Controls Channel Morphology and Organization in a Sand-Gravel Flume, AGU Fall Meeting, December 2016, San Francisco (USA).

Cienciala, P., and Hassan, M.A., 2015. Channel Morphology and Hydraulics as Controls on Spatial Patterns of Invertebrate Drift in a Mountain, AGU Fall Meeting, December 2015, San Francisco (USA).

Cienciala, P., and Hassan, M.A., Modeling the influence of channel morphology on spatial patterns in energetic profitability of foraging habitat for drift-feeding trout, ISE2016: International Symposium on Ecohydraulics, Melbourne, Australia. 7-12 February 2016, 3 pp.

Saletti, M. Molnar, P., Zimmermann, A., Hassan, M.A., Church, M., and Burlando, P., 2015.Temporal pattern and memory in sediment transport in an experimental step-pool channel, EGU General Assembly, April 2015 - Vienna (Austria).

Saletti, M. Molnar, P., Hassan, M.A., and Burlando, P., 2015. "A Reduced-Complexity Model for Sediment Transport and Step Morphology, AGU Fall Meeting, December 2015, San Francisco (USA).

Dudill, A., Frey, P., Church, M. and Hassan, M.A., 2014, How Grain Size Ratio and Fine Sediment Feed Concentration Influence Channel Slope Evolution Due to Grain Size Sorting in Bimodal Mixtures, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Chartrand, S., and Hassan, M.A., 2014, Pool-Riffle Formation in Mountain Streams, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

De Rego, K., Eaton, B., Hassan, M.A., and Lauer, J., 2014, Progress of a sediment wave along the Lillooet River, British Columbia following a large debris flow, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Papangelakis, E., and Hassan, M.A., 2014, Bed Morphology and Sediment Dispersion: A Particle Tracing Study in the Field and Flume, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Ferrer-Boix, C., and Hassan, M.A., 2014, Bed surface bed profile adjustments to a series of water pulses in gravel bed rivers, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Altinakar, M., Franca, M., Hassan, M.A., Qu, Z., 2014, Gravel Particles Entrainment and Deposition under Unsteady Flow Conditions, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Cienciala, P., and Hassan, M.A., 2014, Relationship between channel morphology and foraging habitat for stream salmonids: Effects of body size, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Buxton, T.H., Buffington, J.M., Fremier, A.K., Hassan, M.A., and Yager, E., 2014, Salmon Spawning Effects on Streambed Stability, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

Saletti, M., Molnar, P., Hassan, M. A., Zimmermann, A. E., and Church, M., 2014, Temporal pattern and memory in sediment transport in a step-pool channel: an experimental study. 13th Swiss Geoscience Meeting, Fribourg, 2014.

Piotr Cienciala and Marwan A. Hassan*,* 2013, Exploring geomorphic controls on fish bioenergetics in mountain streams: linkages between channel morphology and rearing habitat for cutthroat trout, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Matteo Saletti, Peter Molnar, Marwan A. Hassan, Andre E. Zimmermann, and Luigi Fraccarollo*, 2013,* Modeling step-pool systems in steep streams by a cellular automaton sandpile model, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

John M. Buffington, Todd Buxton, Alexander K. Fremier, Marwan A. Hassan, and Elowyn Yager*, 2013,* Persistence of Salmonid Redds, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Marwan A. Hassan, Daniele Tonina, Roger D. Beckie, and Matthew Kinnear, 2013, Hyporheic fluxes in steep headwater streams with step-pool morphologies, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Carles Ferrer-Boix and Marwan A. Hassan, 2013, Temporal bed adjustments to a series of water pulses in gravel bed rivers, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Todd Buxton, Elowyn Yager, John M. Buffington, Marwan A. Hassan, and Alexander K. Fremier, 2013, Grain packing resistance to particle mobility, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Hal Voepel, Rina Schumer, and Marwan A. Hassan, 2013, Influence of flow regime, particle characteristics and channel morphology on streamwise travel distances of coarse sediment in gravel-bed rivers, American Geophysical Union Annual Meeting, San Francesco, December 9-13, 2013.

Eaton, B.C. and M.A. Hassan, 2012. How Does the Geomorphic Influence of Large Wood Vary With Channel Size? Results from a Stochastic Reach Scale Channel Simulator, the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

Bradley, D., L. Olinde and M.A. Hassan, Tracers, Transport, and Topography: Theory and Technology for Tractive Tracking, Organizers**,** the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

Hassan, M.A. and D. Tonina, 2012. The footprint of salmonids on river morphology, , the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

Elgueta M.A., and M.A. Hassan, 2012. Spatial adjustments of mountain channels to changes in the sediment supply regime, the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

Bradley, D.N., and M.A. Hassan, 2012. The effects of flood sequencing and channel morphology on the mobility of coarse gravel in an alpine stream, the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

Chartrand, S.M., M.A. Hassan, M. Strudley, B.K. Hastings, J. Owens, and B. Hecht, 2012. Textural adjustments of a riffle-pool stream to multiple sediment mobilizing floods, the American Geophysical Union, San Francisco, CA, December 5-9, 2012.

von Flotow, C., and M.A. Hassan, 2012. Temporal adjustments of bed surface texture and sediment mobility to a variable sediment supply regime, the American Geophysical Union, San Francisco, December 3-7, 2012.

Cienciala, P., and M.A. Hassan, 2012. Effect of heterogeneity and sample size on estimates of hydraulic roughness in coarse-bedded channels, the American Geophysical Union, San Francisco, December 3-8, 2012.

Voepel, H., R. Schumer, and M.A. Hassan, 2012, Inuence of ow regime, particle characteristics and channel morphology on vertical mixing of coarse sediment in gravel-bed rivers, the American Geophysical Union, San Francisco, December 3-7, 2012.

Cienciala, P., and M.A. Hassan, 2011. Coupling channel hydro-morphodynamics and fish spawning habitat in a forested montane stream, the American Geophysical Union, San Francisco, December 5-9, 2011.

Voepel, H., R. Schumer, and M.A. Hassan, 2011. Controls on vertical mixing of sediment in gravel bed rivers, the American Geophysical Union, San Francisco, December 5-9, 2011.

Hassan, M. A., A.I. Packman, J. Wilson, and M. Sivapalan, Predicting Behavior of Freshwater Systems in a Changing Environment I (Posters), Session Organizers, the American Geophysical Union, San Francisco, December 13-17, 2010.

Hassan, M. A., A.I. Packman, J. Wilson, and M. Sivapalan, Predicting Behavior of Freshwater Systems in a Changing Environment II (Presenations), Session Organizers, the American Geophysical Union, San Francisco, December 13-17, 2010.

Hassan, M. A., A.I. Packman, J. Wilson, and M. Sivapalan, Predicting Behavior of Freshwater Systems in a Changing Environment III (Presentations), Session Organizers, the American Geophysical Union, San Francisco, December 13-17, 2010.

Cullis, J.D., C. Gillis, M. Bothwell, C. Kilroy, A. I. Packman, and M.A. Hassan, A conceptual model for the growth, persistence, and blooming behavior of the benthic mat-forming diatom *Didymosphenia geminata* Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010 (invited).

Ran, L., T. Garcia, S. Ye, C.J. Harman, M.A. Hassan, and A. Simon, Reach Scale Sediment Balance of Goodwin Creek Watershed, Mississippi, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Xu, X., G. Wynn, M.A. Hassan, S.D. Donner, and M. Sivapalan Environmental change in the Mississippi River Basin, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Patil, S., S. Ye, X. Xu, C.J. Harman, M. Sivapalan and M.A. Hassan, A network model for simulating sediment dynamics within a small watershed, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Ali, F.K., J.D. Cullis, X. Xu, M. More, M.A. Hassan, A. Simon, S. D. Donner, and M. Sivapalan, Suspended sediment dynamics in the Mississippi River basin, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Hassan, M.A., J.D., Cullis, and A. Simon, Historic trends in the suspended sediment dynamics along the Missouri River, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010 (invited).

Cullis, J. D., C. Gillis, J.D. Drummond, T. Garcia, C. Kilroy, S. Larned, and M.A. Hassan, Factors affecting the growth of *Didymosphenia geminata* in New Zealand rivers: Flow, bed disturbance, nutrients, light, and seasonal dynamics, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Gillis, C., R.S. Gabor, J.D. Cullis, L. Ran, and M.A. Hassan, The role of water chemistry and geomorphic control in the presence of Didymosphenia geminata in Quebec, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Cienciala, P, M.A. Hassan, L. Fraccarollo, and H.E. Voepel, Statistical charactersitics of fluvial displacements of individual particles, Paper presented at the American Geophysical Union, San Francisco, December 13-17, 2010.

Rao, P. C., M. Sivapalan, N.B. Basu, M.A. Hassan, A.I. Pakman, and D.S. McGrath, Exploring Emergent Hydrologic and Biogeochemical Patterns in Catchments at Multiple Scales, Paper presented at the American Geophysical Union, San Francisco; December 14-18, 2009 (invited).

Aubeneau, A. F., S.E. Thompson, M.A. Hassan and A.I. Packman, A simple linear catchment-response model for investigating sediment efflux associated with climate and land use change in Goodwin Creek, MS, Paper presented at the American Geophysical Union, San Francisco; December 14-18, 2009 (invited).

Aubeneau, A. F., S.E. Thompson, P.C. Rao, N.B. Basu, M.A. Hassan, A.I. Packman, G. S. McGrath, and L. Fraccarollo, A Parsimonious Model for Transport of Fine Sediments and Sediment-Bound Contaminants in Rivers, Paper presented at the American Geophysical Union, San Francisco; December 14-18, 2009 (invited).

Basu, N. and M.A. Hassan, Hydrologic Predictions in a Changing Environment II. Session Organizers, American Geophysical Union, San Francisco; December 14-18, 2009.

Ruddell, B.L., M.A. Hassan, and N. Basu, 2009. Hydrologic Predictions in a Changing Environment III, Poster Organizers, American Geophysical Union, San Francisco; December 14-18, 2009.

Zimmermann, A.E., M. Church, and M.A. Hassan, 2008. Step-pool stability experiments, Flow resistance and channel stability observations from mountain stream experiments. Paper presented at British Society for Geomorphology (BSG) Annual Conference, University of Exeter; July 2-4, 2008.

Zimmermann, A.E., M. Church, and M.A. Hassan, 2008. Step-pool stability experiments. Paper presented at Canadian Geophysical Union, Banff; May 11-14, 2008.

McCleary, R.J., and M.A. Hassan, 2008. Refining a large woody debris budget by comparing measured and modeled wood storage in three headwater catchments. Poster presented at Canadian Geophysical Union, Banff; May 11-14, 2008.

McCleary, R.J., M.A. Hassan, and R.D. Moore, 2008. Partial sediment budget from two headwater catchments in the Rocky Mountain Foothill. Paper presented at Canadian Geophysical Union, Banff; May 11-14, 2008.

Salant, N. and M.A. Hassan, 2007. Physical effects of streambed periphyton on particle deposition and flow hydraulics. Poster presented at American Geophysical Union, San Francisco; December 10-14, 2007.

Caulkins, J. and M.A. Hassan, 2007. Spatial and temporal patterns of sediment transport in a small stream. Poster presented at American Geophysical Union, San Francisco; December 10-14, 2007.

Hassan, M.A., J. Rempel, R. Enkin, and M. Church, 2007. Calibrating and testing a magnetic bedload movement detector. Paper presented at International Bedload Surrogate Monitoring Workshop, St. Anthony Falls Laboratory, University of Minnesota, Minneapolis, Minnesota; April 11-14, 2007 (text in preparation).

Zimmermann, A., M.A. Hassan, and M. Church, 2007. Video tracking of bed load with a light table. Paper presented at International Bedload Surrogate Monitoring Workshop, St. Anthony Falls Laboratory, University of Minnesota, Minneapolis, Minnesota; April 11-14, 2007 (text published).

Hassan, M.A., and F. Brardinoni, 2006. Channel-reach morphology in formerly glaciated, mountain streams: controls and prediction. Poster presented at American Geophysical Union, San Francisco; December 11-15, 2006 (text published).

McCleary, R.J. and M.A. Hassan, 2006. Predictive modeling and mapping of fish distributions in small streams of the Canadian Rocky Mountain Foothills. Poster presented at American Geophysical Union, San Francisco; December 11-15, 2006 (text published).

Salant, N.L., M.A. Hassan, and C.V. Alonso, 2006. Suspended sediment dynamics at high and low flows in an agricultural watershed. Poster presented at American Geophysical Union, San Francisco; December 11-15, 2006.

Nistor, C., M.A. Hassan, and M. Wellman, 2006. Managing geomorphic impacts in Brunette River Watershed. Paper presented at the Canada Water Resources Association, Water under pressure: balancing values, demands, and extreme, Vancouver, BC; October 25-27, 2006.

Zimmermann, A., M.A. Hassan and M. Church, 2006. Investigating the stability of mountain streams with a scaled model. Paper presented at the Canada Water Resources Association, Water under pressure: balancing values, demands, and extreme, Vancouver, BC; October 25-27, 2006 (text published).

Hassan, M.A., G. Parker, and R. Egozi, 2005. Effect of hydrograph characteristics on vertical grain sorting in gravel bed rivers. Paper presented at American Geophysical Union, San Francisco; December 5-9, 2005.

Brardinoni, F and M.A. Hassan, 2005. Evolution of river long-profiles, organization of process domains and downstream hydraulic geometry in glaciated, mountain drainage basins of coastal British Columbia. Paper presented at Geological Society of America / Geological Association of Canada Conference on Earth System Processes 2, Calgary, Alberta; August 8-11, 2005.

McCleary, R. and M.A. Hassan, 2005. Sediment and large woody debris budgets for small Rocky Mountain Foothills streams following fire. Poster presented at Canadian Geophysical Union, Annual Meeting, Banff, Alberta; May 8-11, 2005.

Rempel, J. and M.A. Hassan, 2004. Calibrating and measuring bedload transport using magnetic detection system. American Geophysical Union, San Francisco; December 13-17, 2004.

Bird, S.A., A. Zimmerman, D.L. Blocka, M.A. Hassan and D.L Hogan, 2004. Comparison of three measurements techniques for estimation of sediment transport using channel morphology. Poster presented at American Geophysical Union Fall Meeting, San Francisco; December 13-17, 2004.

Venditti, J.G., R. Egozi and M.A Hassan, 2004. Turbulent flow over an evolving gravel bed. Poster presented at American Geophysical Union Fall Meeting, San Francisco; December 13-17, 2004.

Brardinoni, F and M.A. Hassan, 2004. The Quaternary legacy in the organization of contemporary geomorphic processes in forested mountain environments of British Columbia. Poster presented at American Geophysical Union, Fall Meeting, San Francisco; December 13-17, 2004.

Woodsmith, R. and M.A. Hassan, 2004. Maintenance of an obstruction-forced pool in a gravel-bed channel: streamflow, channel morphology, and sediment transport. Paper presented at International Conference on River/Catchment Dynamics: Natural Processes and Human Impacts, Solsona, Spain; May 15-20, 2004 (revised text published).

Church, M. and M.A. Hassan, 2004. Sediment transport at low rate in gravel-bed rivers. Paper presented at International Conference on River/Catchment Dynamics: Natural Processes and Human Impacts, Solsona, Spain; May 15-20, 2004 (revised text published).

Hassan, M.A., A.S. Gottesfeld and J.F. Tunnicliffe, 2002. Sediment mobility in fish bearing streams: the influence of floods and spawning salmon. Poster presented at American Geophysical Union, Fall Meeting, San Francisco; December 6-10, 2002 (revised text published).

Lange, J., Ch., Leibundgut, M.A. Hassan, S. Husary, R. Nativ and A.P. Schick, 2001. A field-based hydrological model to study the impacts of urbanization on regional water resources. Paper presented at the IAHS Conference held during the 6th IAHS Scientific Assembly, Maastricht, Netherlands; July 18-27, 2001 (revised text published).

Lange J., Ch. Leibundgut, S. Husary, M.A. Hassan and A.P. Schick, 2000. Non-calibrated models for the dry hydrologic regime - from the arid to the Mediterranean zone. Proceedings of the International Workshop on Runoff Generation and Implications for River Basin Modelling, Freiburg, Germany; October 9-13, 2000.

Givati, A. and M.A. Hassan, 2000. Sediment sources in semi-arid watershed. Paper presented at IGU-GERTEC Conference on Geomorphic Responses to Landuse Changes, Institute of Geography, Slovak Academy of Sciences, Bratislava, Slovakia; May 4-9, 2000.

Egozi, R., M.A. Hassan and G. Parker, 2000. Effect of hydrologic regime on vertical sorting in gravel-bed rivers: humid versus arid environments. Poster presented at American Geophysical Union, Spring Meeting, Washington, DC; May 30 - June 3, 2000.

Shahin, Kh., M.A. Hassan and A. Tamimi, 2000. Hydrological and hydrochemical assessment of the impact of urbanisation in Ramallah, Palestinian Territories. Paper presented at Israeli Group of Geomorphologists, Annual Meeting, Jerusalem, Israel; June 21, 2000.

Hassan, M.A. and R. Egozi, 2000. The effect of hydraulic regime on vertical sorting in gravel-bed rivers. Paper presented at Israeli Group of Geomorphologists, Annual Meeting, Jerusalem, Israel; June 21, 2000.

Hassan, M.A. and M. Church, 2000. Suspended sediment and pollutant transport along the Fraser River. Paper presented at Canadian Studies Bi-Annual Conference at Halperin Centre, Hebrew University of Jerusalem, Jerusalem, Israel; June 24-27, 2000.

Hassan, M.A. and M. Church, 1999. Experiments on surface structure and sediment transport in gravel bed rivers. Paper presented at American Geophysical Union, Fall Meeting, San Francisco; December 13-17, 1999 (revised text published).

Shaw, P., M.A. Hassan and A.P. Schick, 1998. The movement of gravels in a sandbed river. Paper presented at the British Geomorphology Research Group, Annual Conference, Tracers in Geomorphology, Coventry University, Coventry; September 18-20, 1998.

Hassan, M.A. and S.M. Berkowicz, 1998. Environmental and social impacts of forest harvesting, Queen Charlotte Islands, British Columbia. Paper presented at Canadian Studies Bi-Annual Conference at Halperin Centre, Hebrew University of Jerusalem, Jerusalem, Israel; June 29 - July 2, 1998.

Hassan, M.A., 1998. River restoration. Paper presented at Conference on River Restoration in Israel, Israel Ministry of Environmental Quality, Tel-Aviv; May 1998.

Hogan, D.L., S.A. Bird and M.A Hassan, 1995. Spatial and temporal evolution of small coastal gravel-bed streams: the influence of forest management on channel morphology and fish habitats. Paper presented at the 4th International Workshop on Gravel-bed Rivers, Gold Bar, Washington; August 20-26, 1995 (revised text published).

Hassan, M.A., A.P. Schick and P. Shaw, 1994. Movement of pebbles on sand bed river, Botswana. Paper presented at IAHS Conference on Application of Tracers in Arid Zone Hydrology, Vienna, Austria; August 1994.

Hassan, M.A. and M. Church, 1993. Vertical mixing of coarse particles in gravel bed rivers: a kinematic model. Paper presented at 3rd International Geomorphology Conference, Hamilton, Canada; August 24-28, 1993.

Schick, A.P., P. Shaw, M.A. Hassan, E. Hahn and T. Grodek, 1992. Tracing pebbles in an ephemeral sand river. Paper presented at IAHS/IGU-COMTAG Workshop on the Dynamics and Geomorphology of Mountain Rivers, Benediktbeuern, Bavaria, Germany; June 8-15, 1992 (revised text published).

Schick, A.P., M.A. Hassan and S. Sharoni, 1989. Fluvial processes in low -and medium- order stream channels in loess terrains—examples from Southern Israel, Lanzhou (China/IGU/COMTAG) Workshop on Loess Geomorphological Processes and Hazards; May-June 1989.

Schick, A.P., P. Shaw, and M.A. Hassan, 1989. Floods in ephemeral streams: evaluations based on bed material tracing, IGU COMTAG, Rohdenburg Memorial Symposium, 2nd International Conference on Geomorphology; September 1989.

Hassan, M.A., 1989. Bed material and bed load movement in two ephemeral streams. Paper presented at 4th International Conference on Fluvial Sedimentology, Barcelona, Spain; October 2-4, 1989. (revised text published).

Reid I. and M.A. Hassan, 1989. Bed roughness elements and uncertainty in hydraulic prediction of sediment transport in gravel bed rivers. Paper presented at 4th International Conference on Fluvial Sedimentology, Barcelona, Spain; October 2-4, 1989 (revised text published).

Schick, A.P., P. Shaw, T. Grodek and M.A. Hassan, 1988. Floods in ephemeral streams - evaluation based on geomorphology. Paper presented at 4th Benelux Colloquium on Geomorphological Processes and Soils, April-May 1988.

Laronne, J.B., M.J. Duncan and M.A. Hassan, 1987. Scour/fill and stratigraphy in braided, gravel bedded channels: Nahal Hemar, Israel and N. Branch Ashburton River, New Zealand. Paper presented at

IAHS and IGU Workshop on Erosion, Transport and Deposition Processes in Semi-Arid and Arid Areas, The Hebrew University of Jerusalem, Jerusalem, Israel; March 29 - April 4, 1987.

Hassan, M.A. and A.P. Schick, 1987. Bedload transport in gravel bed rivers. Paper presented at IAHS and IGU Workshop on Erosion, Transport and Deposition Processes in Semi-Arid and Arid Areas, The Hebrew University of Jerusalem, Jerusalem, Israel; March 29 - April 4, 1987.

Schick, A.P., J. Lekach and M.A. Hassan, 1986. Vertical exchange of coarse bedload in desert streams. Paper presented at Special Scientific Meeting of the Geological Society of London on Desert Sediments: Ancient and Modern, London, UK; May 1986 (revised text published).

Laronne, J.B., M.A. Hassan and A.P. Schick, 1986. Transport and burial of coarse bedload in the ephemeral Hebron channel, Israel. Paper presented at Australian and New Zealand Geomorphology Group, Third Conference, Napier; February 17-19, 1986 and Mt. Ruapheu; February 20-22, 1986.

Schick, A.P., J. Lekach, and M.A. Hassan, 1985. Bedload transport in desert floods — observations in the Negev. Paper presented at International Workshop on Problems of Sediment Transport in Gravel-bed rivers, Pingree Park, Colorado; August 12-16, 1985 (revised text published).

Hassan, M.A., 1984. Coarse bed material movement in desert streams. Paper presented at Israel Association of Geographers, Annual Meeting, Bar-Ilan University; December 1984.

Hassan, M.A., A.P. Schick and J.B. Laronne, 1983. Transport and dispersion of coarse bed material, Nahal Hebron, Israel. Paper presented at IGU Symposium on the role of Geomorphological Field Experiments in Land and Water Management, Bucharest, Romania; August 25 – September 3, 1983 (revised text published).

(g) ***Other***

Hassan, M.A., 2006. Minerals and Rocks, Grade 6, Bayview Community School, Vancouver, British Columbia, November 2006.

Hassan, M.A., 2007. Salmon, Grade 1, Bayview Community School, Vancouver British Columbia, February 2007.

(h) ***Conference Participation (Organizer, Keynote Speaker, etc.)***

Hassan, M.A., Schumer, R., and Chen D., 2014, Particle Tracing in Geomorphology, Session Organizer, American Geophysical Union Meeting, San Francesco, 15-19 December, 2014.

International Conference on River/Catchment Dynamics: Natural Processes and Human Impacts, Solsona, Spain, May 15-20, 2004. Member of the International Organizing Committee: reviewed abstracts and papers.

Annual Conference of the Israeli Group of Geomorphologists (IGRG), Jerusalem, Israel, June 21, 2000. Conference Organizer (with H. Lavee, P. Sarah, and J. Lekach): Conference Editor.

International Conference on Drainage Basin Dynamics and Morphology, Jerusalem, Israel, May 22-29, 1999. Conference Organizer and Chairperson.

10. SERVICE TO THE UNIVERSITY

(a) Memberships on committees, including offices held and dates

UBC, Department of Geography:
Head, Department of Geography, 2012
Chair, Graduate Committee, 2007 -2012
Chair, Search Committee, Quaternary Geomorphology position, 2006
Member, Graduate Committee, 2005 - 2007
Member, Building, Equipment and Safety Committee, 2004-2005

The Hebrew University of Jerusalem, Department of Geography:
Colloquium Organizer, 1999
Member, Library Committee, 1998-1999
Advisor, Physical Geography, 1997-2001

(b) ***Other service, including dates***

11. SERVICE TO THE COMMUNITY

(a) Memberships on scholarly societies, including offices held and dates

Member, American Geophysical Union (1999 -)
Member, Canadian Geophysical Union (2002 - 2008)
Member, International Association of Hydrological Sciences (1998 -)

(b) Memberships on other societies, including offices held and dates

(c) Memberships on scholarly committees, including offices held and dates

(d) Memberships on other committees, including offices held and dates

(e) Editorships (list journal and dates)

Member, Editorial Board, *Geography Compass* (2006-2010)
Member, Editorial Board, International Journal of Sediment Research (2008-present)

(f) Reviewer (journal, agency, etc. including dates)

Journals:
Arab Geography (2002-)
Canadian Journal of Fisheries and Aquatic Sciences (2002-)
Journal of Geophysical Research (2003-)
Geophysical Research Letters (2005-)
Catena (1996-)
Coastal Research (2005)
Earth Surface Processes and Landforms (1992 -)
Geology (2006 -)
Geomorphology (2000 -)
Hydrological Processes (2000 -)
Israel Journal of Earth Sciences (2001-)
Journal of Environmental Management (2004)
Journal of Hydraulic Engineering (2000 -)
Mathematical Geology (2005)
Nature Geosciences (2008 -)
Sedimentology (2003-)
Water Resources Management (2005)
Water Resources Research (1993 -)

Grant Proposals:
Israel Academy of Sciences
National Science Foundation, USA (regularly)
Natural Sciences and Engineering Research Council of Canada (regularly)
Natural Environment Research Council, UK (regularly)
Swiss National Science Foundation

(g) ***External examiner (indicate universities and dates)***

(h) ***Consultant (indicate organization and dates)***

(i) ***Other service to the community***

12. <u>AWARDS AND DISTINCTIONS</u>

(a) ***Awards for Teaching (indicate name of award, awarding organizations, date)***

(b) ***Awards for Scholarship (indicate name of award, awarding organizations, date)***

Distinguished Visiting Professor, Dept. of Hydraulic Engineering, Tsinghua University, China—2017-2020

Senior Early Career Scholar, Peter Wall Institute for Advanced Studies, The University of British Columbia, 2007-2008.

Three-year Fellowship from the Israel Council of Higher Education (within the framework of a national competition between young scientists applying for university appointments in Israel), 1997-1999.

Izaak Walton Killam Memorial Post-doctoral Fellowship, University of British Columbia, 1989-1991.

Rothschild Post-doctoral Fellowship, Hebrew University of Jerusalem, 1988-1989.

British Council Fellowship, University of St. Andrews, St. Andrews, UK, 1988.

British Council Fellowship, University of London, London, 1988.

The Israeli Prime Minister's Award for Outstanding Students, 1985.

The Goldschmidt Annual Award for Young Researchers in Hydrology, Israel Hydrological Association, 1984.

(c) ***Awards for Service (indicate name of award, awarding organizations, date)***

(d) ***Other Awards***

13. OTHER RELEVANT INFORMATION (Maximum 0ne Page)

I was solely responsible for the design, development, and construction of a laboratory to study sediment transport at the Geography Department (The Hebrew University). The flume is 10 m long, 60 cm wide, and 50 cm deep and is designed to simulate both flashfloods and steady flows. State-of-the-art equipment was acquired for the intended research.

In June 2008, I have been awarded the CFI Leadership Opportunity Fund to establish and equip a state-of-the-art laboratory for the experimental study of channel stability and sediment transport in steep mountain streams, as well as the effects these processes have on stream channel ecology. This proposed laboratory will be unique in the world, because it will be one of only a few facilities to simulate steep channels. Such a facility has yet to be built in Canada. It will be a boon to the University of British Columbia, as it will enhance the prestige of the Geography Department both within Canada and internationally.

THE UNIVERSITY OF BRITISH COLUMBIA
Publications Record

SURNAME: Hassan **FIRST NAME**: Marwan **Initials**:
MIDDLE NAME(S): **Date**: September 16, 2008

1. REFEREED PUBLICATIONS

Notes: [1] Research Supervisor
[2] Graduate Student
[3] Technical Assistant
[4] Collaboration

Authorship Convention: In the natural and environmental sciences, scholarly activity is inherently collaborative. All listed authors are assumed to be capable of defending the research publicly. Lead authors are assumed to be the principal creative driving force behind the research and to have drafted the majority of the text. Those that follow are generally in order of decreasing contribution.
For each multi-authored article below the contribution of Marwan Hassan is given as: [% overall contribution, nature of contribution]

(a) Books (Edited)

Church, M. and M.A. **Hassan**, 2002. *Drainage Dynamics and Morphology*. *Geomorphology*, 45, 1-163. (9 contributions)

Church, M. and M.A. **Hassan**, 2001. *Sediment Transport Dynamics. Earth Surface Processes and Landforms*, 26, 1367-1459. (6 contributions)

Hassan, M.A., O. Slaymaker, and S.M. Berkowicz, 2000. *The Hydrology-Geomorphology Interface: Rainfall, Floods, Sedimentation, Land Use. International Association of Hydrological Sciences*, Publication No. 261. Wallingford, UK, 326 pp. (21 contributions)

(b) Journals

R Matos, J. P., **Hassan**, M. A., Lu, X. X., and Franca, M. J. (2018). Probabilistic prediction and forecast of daily suspended sediment concentration on the Upper Yangtze River. Journal of Geophysical Research: Earth Surface, 123, 1982–2003. https://doi.org/10.1029/ 2017JF004240.

R Juez, C., **Hassan**, M. A., and Franca, M. J. (2018). The origin of fine sediment determines the observations of suspended sediment fluxes under unsteady flow conditions. Water Resources Research, 54, 5654–5669. https://doi.org/10.1029/2018WR022982.

R Muller, T., and **Hassan**, M.A. (2018) Fluvial response to changes in the magnitude and frequency of sediment supply in a 1-D model. Earth Surf. Dynam., 6, 1041–1057, https://doi.org/10.5194/esurf-6-1041-2018.

R An, C., Parker, G., **Hassan**, M.A., and Fu, X. (2018) Can magic sand cause massive degradation of a gravel-bed river at the decadal scale? Shi-ting River, China. Geomorphology, 327, 147-158.

R Chartrand, S. M., Jellinek, A. M., **Hassan**, M. A., and Ferrer-Boix, C. (2018), Morphodynamics of a width-variable gravel bed stream: New insights on pool-riffle formation from physical experiments. *Journal of Geophysical Research: Earth Surface*, *123*. https://doi.org/10.1029/2017JF004533.

R Fan, N., Chu, Z., Jiang, L., **Hassan**, M.A., Lamb, M.P., and Liu, X. (2018). Abrupt drainage basin reorganization following a Pleistocene river capture, Nature Communications: https//doi DOI: 10.1038/s41467-018-06238-6.

R Zhang C., Xu, M., **Hassan**, M.A., Chartrand, S.M., and Wang, Z. (2018). Experimental study on the stability and failure of individual step-pool, Geomorphology, 311, 51-62.

R Elgueta-Astaburuaga, M., **Hassan**, M. A., Saletti, M., and Clarke, G. K. C. (2018). The effect of episodic sediment supply on bedload variability and sediment mobility. Water Resources Research, 54, 6319–6335.

R Tsuruta, K., **Hassan**, M. A., Donner, S. D., and Alila, Y. (2018). Development and application of a large-scale, physically based, distributed suspended sediment transport model on the Fraser River Basin, British Columbia, Canada. Journal of Geophysical Research: Earth Surface, 123, 2481–2508. https://doi.org/10.1029/2017JF004578.

R **Hassan**, M.A., Bird, S., Reid, D., Ferrer-Boix, C., Hogan, D., Brardinoni, F., and Chartrand, S. (2018). Variable hillslope-channel coupling and channel characteristics of forested mountain streams in glaciated landscapes. Earth Surface Processes and Landforms, DOI: 10.1002/esp.4527.

R Tsuruta, K., **Hassan**, M. A., Donner, S. D., and Alila, Y. (in press). Modeling the effects of climatic and hydrological regime changes on the sediment dynamics of the Fraser River Basin, British Columbia, Canada. Hydrological Processes. https://doi.org/10.1002/hyp.13321.

R Cienciala, P., and **Hassan**, M.A. (2018). Spatial linkages between geomorphic and hydraulic conditions and invertebrate drift characteristics in a small mountain stream. Can. J. Fish. Aquat. Sci. 1–13 dx.doi.org/10.1139/cjfas-2017-0170.

R Plumb, B. D., Annable, W. K., Thompson, P. J., and **Hassan**, M. A. (2017). The impact of urbanization on temporal changes in sediment transport in a gravel bed channel in Southern Ontario, Canada. Water Resources Research, 53, 8443–8458.

R **Hassan**, M. A., L. Roberge, M. Church, M. More, S. D. Donner, J. Leach, and K. F. Ali (2017), What are the contemporary sources of sediment in the Mississippi River?, Geophys. Res. Lett., 44, doi:10.1002/2017GL074046.

R Maniatis, G., Hoey, T.B., **Hassan**, M.A., Sventek, J., Hodge, R., Drysdale, T., Valyrakis, M., in press, Calculating the Explicit Probability of Entrainment Based on Inertial Acceleration Measurements, Journal of Hydraulic Engineering, 104, http://dx.doi.org/10.1061/(ASCE)HY.1943-7900.0001262.

R **Hassan**, M.A., Bird, S., Reid, D., and Hogan, D., 2016. Simulated wood budgets in two mountain streams, Geomorphology, 259, 119–133.

R Cienciala, P., and **Hassan**, M.A., 2016, Sampling variability in estimates of flow characteristics in coarse-bed channels: Effects of sample size, Water Resources Research, 52, 1899-1922.

R Juez, C., Ferrer-Boix, C., Murillo, J., Hassan, M.A., and García-Navarro, P., 2016. A model based on Hirano-Exner equations for two-dimensional transient flows over heterogeneous erodible beds, Advances in Water Resources, 87, 1-18.

R Elgueta-Astaburuaga, M. A., and **Hassan**, M.A.,2017. Experiment on temporal variation of bed load transport in response to changes in sediment supply in streams, Water Resources Research, 53, 763–778.

R Papangelakis, E., and **Hassan**, M.A., 2016. The role of channel morphology on the mobility and dispersion of bed sediment in a small gravelbed stream, Earth Surface Processes and Landforms, 41, 2191–2206.

R Reid, D.A., **Hassan**, M. A., and Floyd, W., 2016. Reach-scale contributions of road-surface sediment to the Honna River, Haida Gwaii, BC, Hydrological Processes, 30, 3450–3465.

R Saletti, M., Molnar, P., **Hassan**, M. A., and Burlando, P., 2016. A reduced-complexity model for sediment transport and step-pool morphology, Earth Surf. Dynam., 4, 549–566.

R King, L., **Hassan**, M. A., Yang, K., and Flowers, G., 2016. Flow Routing for Delineating Supraglacial Meltwater Channel Networks, Remote Sensing, 8, 988; doi:10.3390/rs8120988, 21 pp.

R **Hassan, M.A**., Bird, S., Reid, D., and Hogan, D., in press. Simulated wood budgets in two mountain streams, Geomorphology.

R Cienciala, P., and **Hassan, M.A**., in press, Sampling variability in estimates of flow characteristics in coarse-bed channels: Effects of sample size, Water Resources Research.

R Abalharth, M., **Hassan, M.A**., Klinkenberg, B., Leung, V., and McCleary, R., 2015. Using LiDAR to characterize logjams in lowland rivers, Geomorphology, 246, 531–541.

R **Hassan, M. A**., Tonina, D., and T. H. Buxton, T.H., 2015. Does small-bodied salmon spawning activity enhance streambed mobility? Water Resources Research, 51, 7467–7484, doi:10.1002/2015WR017079.

R Ferrer-Boix, C., **Hassan, M. A**. 2015. Channel adjustments to a succession of water pulses in gravel bed rivers, Water Resources Research, 51, 8773–8790, doi:10.1002/2015WR017664.

R Saletti, M., P. Molnar, P., A. Zimmermann, A., **Hassan, M.A**., and M. Church, M., 2015. Temporal variability and memory in sediment transport in an experimental step-pool channel, Water Resources Research, 51, 9325–9337, doi:10.1002/ 2015WR016929.

R Chartrand, S. M., **Hassan, M.A**., and Radic, V., 2015. Pool-riffle sedimentation and surface texture trends in a gravel bed stream, Water Resources Research, 51, 8704–8728, doi:10.1002/2015WR017840.

R Turcotte, B., Millar, R. G. and **Hassan, M.A**., 2016. Drag forces on large cylinders, River Research and Application, 32, 411–417.

R Buxton, T. H., Buffington, J.M., Yager, E.M., **Hassan, M.A**., and Fremier, A.K., 2015. The relative stability of salmon redds and unspawned streambeds, Water Resources Research, 51, 6074–6092, doi:10.1002/2015WR016908.

R **Hassan, M.A**., D. Tonina, R.D. Beckie, and M. Kinner, 2014. The effect of discharge and slope on hyporheic flow in step-pool morphologies, Hydrological Processes, 29, 419-433.

R Ferrer-Boix, C. and **M.A. Hassan**, 2014. Influence of the sediment supply texture on morphological adjustments in gravel, Water Resources Research, 50, doi: 10.1002/2013WR015117, 8868-8890.

R Leong, D.N.S., Donner S.D., **Hassan M.A**., Gabor R, Drummond JD. (2014). Sensitivity of stoichiometric ratios in the Mississippi River to hydrologic variability. Journal of Geophysical Research: Biogeosciences. 119, 1049–1062.

R **Hassan, M. A**., D. Brayshaw, Y. Alila, and E. Andrews, 2014. Effective discharge in small formerly glaciated mountain streams of British Columbia: Limitations and implications, Water Resources Research, 50, 4440–4458, doi:10.1002/2013WR014529.

R **Hassan, M.A**., S. V.J. Robinson, H. Voepel, J. Lewis, T. E. Lisle, 2014. Modeling temporal trends in bedload transport in gravel-bed streams using hierarchical mixed-effects models, Geomorphology, 219, 260–269.

R **Hassan, M.A**., D. Tonina, R.D. Beckie, and *M. Kinner*, in press. The effect of discharge and slope on hyporheic flow in step-pool morphologies, Hydrological Processes.

R Araujo, H.A., A. Page, A.B. Cooper, J. Venditti, E. MacIsaac, **M.A. Hassan** and D. Knowler, inpress, Modelling changes in suspended sediment from forest road surfaces in a coastal watershed of British Columbia, Hydrological Processes, 28, 4914-4927.

R Schiefer E., E. L. Petticrew, R. Immell, **M. A. Hassan**, D. L. Sonderegger, in press, Land use and climate change impacts on lake sedimentation rates in western Canada, Anthropocene, 3, 61-71.

R *Cowie, N.M.*, R.D. Moore, and **M.A. Hassan**, 2014, Effects of glacial retreat on proglacial streams and riparian zones in the Coast and North Cascade Mountains, Earth Surface Processes and Landforms, 39, 351-365.

R *Voepel*, H., R.Schumer, and **M.A. Hassan**, 2013. Sediment residence time distributions: theory and application from bed elevation measurements, J. Geophys. Res. Earth Surf., 118, 2557-2567.

R *Cienciala*, P. and **M.A. Hassan**, 2013. Linking of spatial patterns of bed surface texture, bed mobility, and channel hydraulic in a mountain stream to potential spawning substrate for small resident trout, Geomorphology, 197, 96-107.

R Eaton, B.C., and **M.A. Hassan**, 2013. Scale-dependent interactions between wood and channel dynamics: modeling jam formation and sediment storage in gravel-bed streams, J. Geophys. Res. Earth Surf. 118, 2500-2508.

R *King*, L. **M. A. Hassan**, A. Wei, L. Burge, and X. Chen, 2013. Wood dynamics in upland streams under different disturbance regimes, Earth Surface Processes and Landforms, DOI: 10.1002/esp.3356.

R **Hassan, M. A.**, H. Voepel, R. Schumer, G. Parker, and L. Fraccarollo (2013), Displacement characteristics of coarse fluvial bed sediment, J. Geophys. Res. Earth Surf., 118, doi:10.1029/2012JF002374.

R Araujo, H. A. A. B. Cooper, M. A. **Hassan** and J. Venditti, 2012, Estimating Suspended Sediment Concentrations in Areas with Limited Hydrological Data using a Mixed-effects Model, Hydrological Processes, 26, 3678–3688.

R **Hassan, M.A**., G. *McIntyre*, 2012. Palestinian water: resources, use, conservation, climate change, and land use, Digest of Middle East Studies, 21, 313-326.

R Patil, S., M. Sivapalan, **M. A. Hassan**, S. Ye, C. J. Harman, and X. Xu (2012), A network model for prediction and diagnosis of sediment dynamics at the watershed scale, J. Geophys. Res., 117, F00A04, doi:10.1029/2012JF002400.

R Eaton, B. C., **M. A. Hassan**, and S. L. Davidson (2012), Modeling wood dynamics, jam formation, and sediment storage in a gravel-bed stream, J. Geophys. Res., 117, F00A05, doi:10.1029/2012JF002385.

R Cullis, J.D.S., C.-A. Gillis, M.L. Bothwell, C. Kilroy, A. Packman, and M.A. **Hassan,** 2012. A conceptual model for the blooming behavior and persistence of the benthic mat-forming diatom Didymosphenia geminate in oligotrophic streams, Journal of Geophysical Research, 117, G00N03, doi:10.1029/2011JG001891.

R Schiefer, E., R. Gilbert, and M.A., **Hassan**, 2011. A Lake Sediment-Based Proxy of Floods in the Rocky Mountain Front Ranges, Canada**.** Journal of Paleolimnology, 45, 137-149.

R Thompson, S. E., C.J. Harman, R. Schumer, J.S. Wilson, N.B. Basu, P.D., Brooks, S.D. Donner, M.A. **Hassan**, A.I. Packman, P.S.C. Rao, P.A. Troch, and M. Sivapalan, 2011, Patterns, puzzles and people: implementing hydrological synthesis, Hydrological Processes, doi: 10.1002/hyp.8234 (11 pages)

R **Hassan**, M.A. M. Church, Y. Yan, O. Slaymaker and J. Xu, 2011. Suspended sediment balance for the mainstem of Changjiang (Yangtze River) in the period 1964-1985. Hydrological processes, 25, 2339-2353.

R **Hassan**, M.A., M. Church, X. Yan, and O. Slaymaker, 2010. Spatial and temporal variation of in-reach suspended sediment dynamics along the mainstem of Changjiang (Yangtze River), China, Water Resources Research, 46, W11551, doi:10.1029/2010WR009228.

R *McCleary*, R., M. A. **Hassan**, D. Miller, and D.R. Moore, 2011. Predicting the spatial organization of process domains in headwater drainage basins of a glaciated foothills region using mixed-effects models. Water Resources Research. 47, W05505, doi:10.1029/2010WR009800.

R *Rempel*, J., M.A. **Hassan**, and R. Enkin, 2010. Laboratory calibration of a magnetic bed load movement detector. US Geological Survey Scientific Investigation Report 2010-5091, 400-406.

R Schiefer, E., M.A., Hassan, B. Menounos, C.P. Pelpola, and O. Slaymaker, 2010. Inter-decadal patterns of total sediment yield from a montane catchment, south Coast Mountains, Canada, *Geomorphology*,118, 207-212.

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R Zimmermann[2], A.M., M. Church, and M.A. Hassan, 2010. Step-pool stability: testing the jam state hypothesis, *Journal of Geophysical Research*, 115, F02008, doi:10.1029/2009JF001365.

R Hassan, M.A., G. McIntyre[2], B. Klinkenberg,A. Al-R. Tamimi, R. K. Paisely, M. Diabat and K. Shahin[2], 2010, Palestinian Water I: Resources, Allocation and Perception, Geography Compass, Vol. 4, 118–138.

R Hassan, M. A., K. Shahin[2], B. Klinkenberg, G. McIntyre[2], M. Diabat, A. Al-R. Tamimi, and R. Nativ, 2010, Palestinian Water II: Climate Change and Land Use, Geography Compass, Vol. 4, 139–157.

R Hassan, M. A., P. M. Marren, and U. Schwartz, 2010, Bar structure in an arid ephemeral stream, Sedimentary Geology, Vol. 221, 57–70.

R Hassan, M.A., Church, M., Rempel[2], J. and Enkin, R. J., 2009. Promise, performance and current limitations of a Magnetic Bedload Movement Detector, Earth Surface Processes and Landforms, Vol. 34, 1022-1032.

R Brardinoni[2], F., M. A. Hassan, T. Rollerson, and D. Maynard, 2009. Colluvial sediment dynamics in mountain drainage basins, Earth and Planetary Science Letters, Vol. 284, 310-319.

R Brayshaw[2], D., and M.A. Hassan, 2009. Debris flow initiation and sediment recharge in gullies, Geomorphology, Vol. 109, 122-131.

R Zimmermann[2], A., M. Church, and M.A. **Hassan**, 2008. Video-based gravel transport measurements with a flume mounted light table, *Earth Surface Processes and Landforms*, 33, 2285-2296.

R Zimmermann[2], A., M. Church, and M.A. **Hassan**, 2008. Identification of steps and pools from stream longitudinal profile data, Geomorphology, 102, 395-406.

R * **Hassan**, M.A., A.S. Gottesfeld, D.R. Montgomery, J.F. Tunnicliffe, G.K.C. Clarke, G. Wynn, H. Jones-Cox, R. Poirier, E. MacIsaac, H. Herunter, and S.J. Mcdonald, 2008. Salmon-driven bedload transport and bed morphology in mountain streams, *Geophysical Research Letters*, Volume 35, L04405, doi:10.1029/2007GL032997.
Highlighted by the ScienceNow, February 1, 2008 under title "Move Over Beavers, Here come Salmon", Nature Geoscience, April 2008 under title "Muddying the waters", in Natural History Magazine May 2008 under title "Building Their Own Beds", Science & Vie (French) under title "La Femelle Saumon Faconne Les Cours Dean" and websites worldwide.

R * **Hassan**, M.A., M. Church, X. Xu and Y. Yan, 2008. Spatial and temporal variation of sediment yield in the landscape: the example of Huanghe (Yellow River), *Geophysical Research Letters*, 35, L06401, doi:10.1029/2008GL033428.
Highlighted by the American Geophysical Union Editorial Board and a summary of the paper was distributed to the media (EOS (Transaction, American Geophysical Union) Highlights Volume 89, Issue 17, P. 164).

R Salant[2], N.L., M.A. **Hassan**, and C.V. Alonso, 2008. Suspended sediment dynamics at high and low storm flows in two small watersheds, *Hydrological Processes*, 22, 1573-1587.

R McCleary[2], R. and M.A. **Hassan**, 2008. Predictive modeling and spatial mapping of fish distributions in small streams of the Canadian Rocky Mountain Foothill, *Canadian Journal of Fisheries and Aquatic Sciences*, 65, 319-333.

R * Brardinoni[2], F. and M.A. **Hassan**, 2007. Glacially-induced organization of channel-reach morphology in mountain streams, *Journal of Geophysical Research*, 112, F01013, doi:10.1029/2006JF000741.

R * **Hassan**, M.A., R. Egozi[2] and G. Parker, 2006. Effect of hydrograph characteristics on vertical sorting in gravel-bed rivers: humid versus arid environments, *Water Resources Research*, 42, W09408, doi:10.1029/2005WR004707.

R * Brardinoni[2], F. and M.A. **Hassan**, 2006. Glacial erosion, evolution of river long profiles, and the organization of process domains in mountain drainage basins of coastal British Columbia, *Journal of Geophysical Research*, 111, dio:10.1029/2005JF000358, F01013.

R Wang, S., M.A. **Hassan**, and X. Xie, 2006. Relationship between suspended sediment load, channel geometry, and land area increment in the Yellow River Delta, *Catena*, 65, 302-314.

R Gomi, T., R.D. Moore and M.A. **Hassan**, 2005. Suspended sediment dynamics in small streams and the effects of forest harvesting: a review for the Pacific Northwest context, *Journal of the American Water Resources Association*, 41, 877-898. (30%, initial idea, creative writing)

R Benda, L., M. A. **Hassan**, M. Church and C.L. May, 2005. Geomorphology of headwaters: transition from hillslopes to channels, *Journal of the American Water Resources Association,* 41, 835-851.

R **Hassan**, M.A., D.L. Hogan, S.A. Bird, C.L. May, T. Gomi and D. Campbell, 2005. Spatial and temporal dynamics of wood in small streams, *Journal of the American Water Resources Association*, 41, 899-919.

R **Hassan**, M.A., M. Church, T.E. Lisle, F. Brardinoni[2], L., Benda and G.E. Grant, 2005. Sediment transport and channel morphology of small, forested streams, *Journal of the American Water Resources Association*. 41, 853-875.

R de Boer, D.H., M.A. **Hassan**, B. MacVicar and M. Stone, 2005. Recent (1999-2003) Canadian research on contemporary processes of river erosion and sedimentation, and river mechanics, *Hydrological Processes*, 19, 265-283. (Names in alphabetic order, creative writing)

R * Asaf[2], L., R. Nativ, M. A. **Hassan**, D. Shain[2], S. Geyer and B. Ziv, 2005. Influence of small-scale variables on the chemical and isotopic composition of urban rainwater, as illustrated by a case study in Ashdod, Israel, *Journal of Geophysical Research*, 110, D11307, doi:10.1029/2004JD005414.

R * **Hassan**, M.A., 2005. Gravel bar characteristics in arid ephemeral streams, *Journal of Sedimentary Research*, 75, 29-42.

R * Asaf[2], L., R. Nativ, D. Shain[2], M.A. **Hassan** and S. Geyer, 2004. Controls on the chemical and isotopic compositions of urban stormwater in a semiarid zone, *Journal of Hydrology*, 294, 270-293.

R * Gottesfeld, A.S., M.A. **Hassan**, J.F. Tunnicliffe and R.W Poirier, 2004. Sediment dispersion in fish bearing streams: the influence of floods and spawning salmon, *Journal of the American Water Resources Association*, 40, 1071-1086.

R * **Hassan**, M.A. and R. Woodsmith, 2004. Bedload transport in an obstructed-formed pool in a forested gravel-bed stream, *Geomorphology*, 58, 203-221.

R Brardinoni[2], F, O. Slaymaker and M.A. **Hassan**, 2003. Landslide inventory in rugged forested watershed: a comparison between air photo and field survey data, *Geomorphology*, 54, 179-196.

R * Malmaeus[2], M. and M.A. **Hassan**, 2002. Computersimulation of the movement of individual grains on a streambed, *Earth Surface Processes and Landforms*, 27, 81-97.

R Brardinoni[2], F, M.A. **Hassan** and O Slaymaker, 2002. Complex mass wasting response of drainage basins to forest management in coastal British Columbia, *Geomorphology*, 49, 109-124.

R * Church, M. and M.A. **Hassan**, 2002. Sediment mobility in Harris Creek, *Water Resources Research*, 38, 1237, doi: 10.1029/2001WR000753.

R Hassan, M.A. and M. Klein, 2002. Fluvial adjustment of the Lower Jordan River to a drop in the Dead Sea level, *Geomorphology*, 45, 21-35.

R * **Hassan**, M.A. and M. Church, 2001. Sensitivity of bedload transport in Harris Creek: seasonal and spatial variation over a cobble-gravel bar, *Water Resources Research*, 37, 813-825.

R * **Hassan**, M.A. and R. Egozi[2], 2001. Impact of wastewater discharge on channel morphology of ephemeral streams, *Earth Surface Processes and Landforms*, 26, 1285-1302.

R * **Hassan**, M.A. and M. Church, 2000. Experiments on surface structure and partial sediment transport, *Water Resources Research*, 36, 1885-1895.

R * Church, M., D. Ham, M.A. **Hassan** and O. Slaymaker, 1999. Fluvial sediment yield in Canada, *Canadian Journal of Earth Sciences*, 36, 1267-1280.

R * **Hassan**, M.A., A.P. Schick and P.A. Shaw, 1999. The transport of gravel in an ephemeral sandbed river, *Earth Surface Processes and Landforms*, 24, 623-640.

R * Church, M., M.A. **Hassan** and J.F. Wolcott, 1998. Stabilizing self-organised structures in gravel-bed stream channels, *Water Resources Research*, 34, 3169-3179.

R Gintz[2], D., M.A. **Hassan** and K.-H. Schmidt, 1996. Frequency and magnitude of bedload transport in a mountain river, *Earth Surface Processes and Landforms*, 21, 433-445.

R * **Hassan**, M.A. and M. Church, 1994. Vertical mixing of coarse particles in gravel bed rivers: a kinematic model, *Water Resources Research*, 30, 1173-1185.

R **Hassan**, M.A., 1994. Structural controls on the mobility of coarse material, *Israel Journal of Earth Science*, 41, 105-122.

R Reid, I. and M.A. **Hassan**, 1992. The influence of microform bed roughness elements on flow and sediment transport in gravel bed rivers: a reply, *Earth Surface Processes and Landforms*, 17, 535-538.

R * Church, M. and M.A. **Hassan**, 1992. Size and distance of travel of unconstrained clasts on a streambed, *Water Resources Research*, 28, 299-303.

R * **Hassan**, M.A., M. Church and P.J Ashworth, 1992. Virtual rate and mean distance of travel of individual clasts in gravel bed channels, *Earth Surface Processes and Landforms*, 17, 617-627.

R * **Hassan**, M.A., M. Church and A.P. Schick[1], 1991. Distance of movement of coarse particles in a gravel bed stream, *Water Resources Research*, 27, 503-511.

R * **Hassan**, M.A. and I Reid, 1990. The influence of microform bed roughness elements on flow and sediment transport in gravel bed rivers, *Earth Surface Processes and Landforms*, 15, 739-750.

R * **Hassan**, M.A., 1990. Scour, fill and burial depths of coarse bed material in gravel bed streams, *Earth Surface Processes and Landforms*, 15, 341-356.

R **Hassan**, M.A., 1990. Observation on desert bores, *Earth Surface Processes and Landforms*, 15, 481-485.

(c) Chapters

R **Hassan**, M.A., and Bradley N. 2017. Geomorphic controls on tracer particle dispersion in gravel bed rivers, Gravel-Bed Rivers 8, Kyoto University, Japan, September 2015. In Gravel-Bed Rivers: Processes and Disasters, First Edition. Edited by Daizo Tsutsumi and Jonathan B. Laronne., John Wiley & Sons, pp. 159-184 (Invited contribution).

R **Hassan**, M.A., Ferrer-Boix, C., Cienciala, P., and Chartrand, S., 2018, Sediment transport and channel morphology: implications for fish habitat, In Open Channel Hydraulics, River Hydraulic Structures and Fluvial Geomorphology: For Engineers, Geomorphologists and Physical Geographers, Edited by A. Radecki-Pawlik, S. Pagliara, and J. Hradecky, CRC Press, ISBN 9781498730822, 1st Edition, pp. 322-348 (Invited contribution).

R **Hassan**, M.A., and A. Roy, 2016. Tracer in fluvial geomorphology, In Tools in Fluvial Morphology, In G. M. Kondolf and H. Piegay, Editors, Tools in Fluvial Geomorphology, Wiley, 306-323.

R Ferreira, R. M. L., **Hassan, M. A**. and Ferrer-Boix, C., 2015. Principles of bedload transport of non-cohesive sediment in open-channels , In P. Rowinski and A. Radecki-Pawlik (Eds.), Rivers Physical, Fluvial and Environmental Processes, Springer International Publishing AG.

R **Hassan, M.A**., E.L. Petticrew, D.R Montgomery, A.S. Gottesfeld, and J.F. Rex, 2011. Salmon as geomorphic agents and ecosystem engineers in gravel-bed rivers: the effect of fish and floods on sediment mobility and habitat suitability, In A. Simon, S.J. Bennett, and J.M. Castro, Stream Restoration in Dynamic Fluvial System, AGU Monograph 194, 337-352.

R **Hassan**, M.A. and A. *Zimmermann*, 2011. Channel response and recovery to changes in sediment supply, In M. Church, P.A. Biron, and A. Roy, editors, Gravel-bed River: processes, Tools, Environments, 464-473.

R **Hassan,** M.A., and A. Roy, in press. Tracer in fluvial geomorphology, In Tools in Fluvial Morphology, In G. M. Kondolf and H. Piegay, Editors, Tools in Fluvial Geomorphology, 2nd edition, Wiley.

Hassan, M.A., *K.F. Ali*, Y. Yan, and X.X. Lu, 2011. Spatial and temporal suspended sediment dynamics in the Yangtze River basin, China, River, Coastal and Estuarine Morphodynamics: RCEM2011, Tsinghua University Press, Beijing.

R * **Hassan**, M.A., E.L. Petticrew, D.R Montgomery, A.S. Gottesfeld, and J.F. Rex, 2011. Salmon as geomorphic agents and ecosystem engineers in gravel-bed rivers: the effect of fish and floods on sediment mobility and habitat suitability, In A. Simon, S.J. Bennett, and J.M. Castro, Stream Restoration in Dynamic Fluvial System, AGU Monograph 194, 337-352.

R * **Hassan**, M.A., B. Smith, D. Hogan, D. Luzi, A. Zimmermann and B. Eaton, 2008. Sediment storage and transport in coarse bed streams: scale considerations. In H. Habersack, H. Piegay and M. Rinaldi, editors, *Gravel-Bed Rivers VI: From Process Understanding to River Restoration*. Elsevier B.V., 473-496.

R * Parker, G., M.A. **Hassan**, and P. Wilcock, 2008. Adjustment of the bed surface size distribution of gravel-bed rivers in response to cycled hydrographs. In H. Habersack, H. Piegay and M. Rinaldi, editors, *Gravel-Bed Rivers VI: From Process Understanding to River Restoration*. Elsevier B.V., 241-289.

R Gottesfeld, A.S., M.A. **Hassan**, and J.F. Tunnicliffe, 2008. Salmon bioturbation and stream processes. In *Salmon Spawning Habitat in Rivers: Physical Controls, Biological Responses and Approaches to Remediation*, American Fisheries Society.

R * Salant, N.L. and M.A. **Hassan**, 2008. Fine particles in small steepland streams: physical, ecological, and human connections. In *Land Management Impacts on Coastal Watershed Hydrology*, Progress in Water Resources Series.

R Woodsmith, R. and M.A **Hassan**, 2006. Maintenance of an obstruction-forced pool in a gravel-bed channel: streamflow, channel morphology, and sediment transport. In R. Batalla and C. Garcia, editors, *Festschrift Volume for Professor Maria Sala*. Elsevier. Amsterdam, 169-196.

R * Church, M. and M.A. **Hassan**, 2006. Upland gravel bed rivers with low sediment transport. In R. Batalla and C. Garcia, editors, *Festschrift Volume for Professor Maria Sala*. Elsevier. Amsterdam, 141-168.

R **Hassan**, M.A., 2003. Tracers for sediment movement. In G.V. Middleton, editor, *Encyclopedia of Sediments and Sedimentary Rocks*. Kluwer, 752-753 (invited paper).

R * **Hassan**, M.A. and P. Ergenzinger, 2003. Tracers in fluvial geomorphology. In G.M. Kondolf and H. Piegay, editors, *Fluvial Morphology*. Chichester: John Wiley, 397-423 (invited paper).

R Hogan, D.L., S.A. Bird and M.A. **Hassan**, 1998. Spatial and temporal evolution of small coastal gravel-bed streams: the influence of forest management on channel morphology and fish habitats. In P.C. Klingeman, R.L. Beschta, P.D. Komar and J.B. Bradley, editors, *Gravel Bed Rivers and the Environment*, Water Resources Publication. Colorado, 365-392.

R **Hassan**, M.A., 1993. Bed material and bed load movement in two ephemeral Streams. In M. Marzo and C. Puigdefabregas, editors, *Alluvial Sedimentation*, IAS Special Publication 17. Blackwell: Oxford, 37-49.

R * **Hassan**, M.A. and M Church, 1992. The movement of individual grains on the streambed. In P. Billi, R.E. Hey, C.R. Thorne and P. Tacconi, editors, *Dynamics of Gravel Bed Rivers*. John Wiley, 159-175 (invited paper).

R Schick[1], A.P., J. Lekach and M.A. **Hassan**, 1987. Vertical exchange of coarse bedload in desert streams. In L.E. Frostick and I. Reid, editors, Desert *Sediments: Ancient and Modern*, Special Publication No. 35, Geological Society. Blackwell: Oxford, 7-16 (invited paper).

R * Schick[1], A.P., J. Lekach and M.A. **Hassan**, 1987. Bedload transport in desert floods—observations in the Negev. In C.R. Thorne, J.C. Bathurst and R.E. Hey, editors, *Sediment Transport in Gravel Bed Rivers*. John Wiley, 617-641 (invited paper).

R Schick[1], A.P., M.A. **Hassan** and J. Lekach, 1987. A vertical exchange model for coarse bedload movement: numerical consideration. In F. Ahnert, editor, *Geomorphological Models*, Catena Suppl., 10. Catena Verlag: Cremligen, Germany, 73-83 (invited paper).

R **Hassan**, M.A., A.P. Schick[1] and J.B. Laronne[1], 1984. The recovery of flood dispersed coarse sediment particles: A three dimensional magnetic tracing method. In A.P. Schick, editor, *Channel Processes: Water, Sediment, Catchment Controls*, Vol. Catena Suppl., 5. Catena Verlag: Cremligen, Germany, 153-162.

R **Hassan**, M.A., J. Lekach and A.P Schick[1], 1984. Bedload movement in desert floods. *Horizons in Geography*, 11, 13-29.

(d) Conference Proceedings

RCienciala, P., and **Hassan, M.A**., Modeling the influence of channel morphology on spatial patterns in energetic profitability of foraging habitat for drift-feeding trout, ISE2016: International Symposium on Ecohydraulics, Melbourne, Australia. 7-12 February 2016, 3 pp.

Marren, P.M., **M.A. Hassan**, and Y. Alila, 2013, Hydrological impacts of mountain pine beetle infestation: potential for river channel changes. In Cold and Mountain Region Hydrological Systems Under Climate Change: Towards Improved Projections, Proceedings of H02, IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, July 2013, IAHS Publ. 360, pp. 77-82.

R Rempel, J., M.A. **Hassan** and Randy Enkin, in press. Magnetic bed load movement detector, United State Geological Survey Circular.

R Nistor, C., M.A. **Hassan** and M. Wellman, 2006. Managing geomorphic impacts in Brunette River Watershed. Paper presented at the Canada Water Resources Association, Water under pressure: balancing values, demands, and extreme, Vancouver, BC, October 25-27, 2006, 437-449.

R Zimmermann, A., M.A. **Hassan** and M. Church, 2006. Investigating the stability of mountain streams with a scaled model. Paper presented at the Canada Water Resources Association, Water under pressure: balancing values, demands, and extreme, Vancouver, BC, October 25-27, 2006, 340-350.

R Church, M. and M.A. **Hassan**, 2005. Sediment transport at low rate in gravel-bed rivers. International Association of Hydrological Sciences, Publication No. 299. (International Conference on River/Catchment Dynamics: Natural Processes and Human Impacts, Solsona, Spain, May 15-20, 2004. Proceedings volume). Accepted for publication October 26, 2004, 141-153.

R Slaymaker, O., M.A. **Hassan** and S.M. Berkowicz, 2001. Hydrology-geomorphology interface: rainfall, floods, sedimentation, land use. International Hydrological Association of Hydrological Sciences, Publ. No. 261, I-III.

R Shaw, P.A., A.P. Schick and M.A **Hassan**, 1994. Bedload sediment transport in the sand rivers of Botswana. In Botswana Notes and Records, Vol. 26, 1-20.

R Schick[1], A.P., and M.A. **Hassan**, 1987. Nahal Hebron: a study of bedload movement. In A. Yair and A.P. Schick, editors, *Erosion, Transport and Deposition Processes in Semi-arid and Arid Area*. The Hebrew University of Jerusalem, 1-15.

(e) Other

2. NON-REFEREED PUBLICATIONS

(a) Journals

Hassan, M.A., 2008. Salmon-driven bedload transport in small streams. *Island Geoscience*, 5 (02), 4 pages.

Church, M. and M.A. **Hassan**, 2002. Drainage dynamics and morphology (introduction to special issue). *Geomorphology*, 45, 1-2. (50%, writing)

Church, M. and M.A. **Hassan**, 2001. Sediment transport dynamics (introduction to special issue). *Earth Surface Processes and Landforms*, 26, 1367-1368. (50%, writing)

(b) Conference Proceedings

Hassan, M.A., (1999) Abstracts, Proceedings of the International Conference on Drainage Basin Dynamics and Morphology, Jerusalem, May 22-29, 1999, 69 pp.

Lekach, J. and M.A. **Hassan**, (1999) Conference Excursion -- Proceedings of the International Conference on Drainage Basin Dynamics and Morphology, Jerusalem, May 22-29, 1999, 201 pp.

(c) Other

Hassan, M.A. and D.L. Hogan, 2007. Mountain Pine Beetle impacts on channel morphology and woody debris in forested landscapes. Natural Resources Canada. March 31, 2007, 37 pp.

Hassan, M.A. and D.L. Hogan, 2006. Mountain Pine Beetle impacts on channel morphology and woody debris in forested landscapes. Natural Resources Canada. February 7, 2006, 21 pp.

Hassan, M.A., 2004. Tsitika River Sediment Budget. British Columbia Ministry of Forest, Report, CD.

Zimmerman, A., S. Tsang, S. Bird, M.A. **Hassan**, 2004. Operational stream channel monitoring in real time. British Columbia Ministry of Forests, Report, 93.

Hassan, M.A., 2003. Suspended sediment dynamics in Penticton Creek, British Columbia. British Columbia Ministry of Forests, Report, 30 pp.

Nativ, R., M.A. **Hassan**, L. Assaf, D. Shain, S. Geyer and T.G. Schmitt, 2003. The impact of enhanced urbanization in the coastal area on quantity and quality of the Coastal Plain Aquifer's groundwater. Bundesministerium fur Bildung Wissenschaft, Forschung und Technologie, Germany, Report, 80 pp.

Hassan, M.A., 2001. Stabilizing bed surface structures in gravel bed rivers. Israel Academy of Sciences, Report, 76 pp.

Hassan, M.A. (with others), 2000. The Impact of urbanization on integrated drainage basin hydrology, channel dynamics, and water resources, West Bank and Israel. Deutsche Forschungsgemeinschaft (DFG), Germany – 1999-2000 (phase I), Report.

Hassan, M.A. and A. Givati, 2000. Sediment sources in small semi-arid basins: Nahal Hanun and Ruhama. Israel Ministry of Agriculture, Report, 103.

Hassan, M.A. and D. Glikman, 1999. Channel Morphology and Sediment Transfer in Carnation Creek, British Columbia. British Columbia Ministry of Forests, Report, 93 pp.

Hassan, M.A., 1996. Interaction between hillslopes and river channel in the Queen Charlotte Islands, BC. The Carnegie Trust for the Universities of Scotland, Report, 8 pp.

3. PATENTS

4. SPECIAL COPYRIGHTS

5. ARTISTIC WORKS, PERFORMANCES, DESIGNS

6. OTHER WORKS

7. WORK SUBMITTED (including publisher and date of submission)

8. <u>WORK IN PROGRESS</u> (including degree of completion)

CERTIFICATE OF SERVICE

I hereby certify that on December 3, 2019, I caused the foregoing Expert Report of Marwan A. Hassan, Ph.D. and sources cited therein to be served on counsel of record for the State Defendants and Defendant-Intervenors.

Dated this 3rd day of December, 2019.

<u>/s Amy R. Atwood</u>
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DISTRICT OF OREGON

PORTLAND DIVISION

CENTER FOR BIOLOGICAL DIVERSITY, ET AL, Plaintiffs, v. DAUGHERTY, ET AL, Defendants, and OREGON FOREST INDUSTRIES COUNCIL, ET AL, Defendant-Intervenors.	Case No: 18-CV-1035 (MO) **<u>EXPERT REPORT OF THOMAS P. QUINN, PH.D.</u>**

I. INTRODUCTION

I, Thomas P. Quinn, Ph.D., state and declare as follows:

1. I have been retained by Plaintiffs in the above-captioned case to provide expert testimony about the behavior, ecology, and habitat requirements of coho salmon with particular attention to their needs in the freshwater environment. Specifically, I have been asked by

plaintiffs to provide expert background on the well-studied impacts of logging and roads, and the sediment those activities produce, on coho salmon habitat across their range, including the Oregon Coast Range. Although I have visited the Tillamook State Forest to observe coho salmon habitats and the Oregon Department of Forestry's logging practices and this informs my views, my primary role is to provide an overview of the science on the needs of coho salmon and the harmful impacts of logging and roads on their survival.

2. My conclusions are based on review of the extensive literature and my own research on the life cycle, behavior, habitat requirements, and ultimately survival and reproductive success of Pacific salmonids, including coho salmon—topics I have immersed myself in for close to four decades. As discussed in more detail below, coho salmon spend roughly half their lives in the stream environment, where they depend on gravel beds with adequate flow and dissolved oxygen to support reproduction, and adequate pools and side channels for young salmon, known as fry or parr, to establish territories and feed. These survival needs make coho salmon particularly vulnerable to the impacts of logging and roads, which are predominant land uses along the Pacific Coast including on the Tillamook and Clatsop state forests.

3. This report and its attachments contain any exhibits that may be used to summarize or support my opinions. I am being compensated by Plaintiffs at a rate of $100 per hour for time spent testifying in depositions or in trial, with a maximum of $700 for each day testifying, and at a rate of $50 per hour for all other time spent on this matter. I have not testified as an expert at trial or by deposition in any case in the past four years. Unless otherwise noted, all opinions rendered herein are made to a reasonable degree of scientific certainty, based on the evidence and my understanding of the biology of coho salmon.

II. STATEMENT OF QUALIFICATIONS

4. I am a professor in the School of Aquatic and Fishery Sciences at the University of Washington, and have taught there since 1986. I received a B.A. with distinction in biology from Swarthmore College in 1976, and an M.S. and Ph.D. in fisheries from the University of Washington in 1978 and 1981, respectively.

5. Prior to becoming a professor, I was a post-doctoral fellow at the University of British Columbia and Pacific Biological Station in Nanaimo, B.C., Canada from 1981-1984, and a Research Associate in the Department of Oceanography at the University of British Columbia, Vancouver, B.C. from 1984-1985. My work during this time, as with my doctoral dissertation, concerned the behavior and ecology of Pacific salmon.

6. I have received numerous awards for both teaching and research, including the Distinguished Teaching Award from the University of Washington in 1991, the College of Ocean and Fishery Sciences Distinguished Research Award in 1998, and an Excellence in Fisheries Education award from the American Fisheries Society in 2010 among others. I was elected to the Washington State Academy of Sciences in 2010 and appointed to a National Research Council panel on the status of Pacific Northwest anadromous salmonids in 1992.

7. Over the last 40 years, my research has singularly focused on the ecology, behavior, evolution, and conservation of fishes, particularly Pacific salmon and their relatives. Since 1980, I have published several hundred articles on salmonid ecology in peer-reviewed journals and books, culminating in the publication in 2005 of the seminal textbook on Pacific salmonids titled: The Behavior and Ecology of Pacific Salmon and Trout (University of Washington Press). In preparing the book, I reviewed and synthesized decades of published research and observation of Pacific salmon, including extensive information related to coho

salmon and the impacts of logging and roads on their habitat. I entirely revised this book and the second edition was published in 2018.

8. Much of my research has focused on coho salmon, including their migration, habitat needs, growth, and survival in the freshwater environment. The following are a few of the publications that qualify me as an expert on coho salmon and their habitat needs.

J. Ohlberger, T. W. Buehrens, S. J. Brenkman, P. Crain, T. P. Quinn & R. Hilborn, *Effects of Past and Projected River Discharge Variability on Freshwater Production in an Anadromous Fish*, 63 Freshwater Biology, 331–340 (2018).

G.R. Pess, P. M. Kiffney, M. C. Liermann, T. R. Bennett, J. H. Anderson & T. P. Quinn, *The Influences of Body Size, Habitat Quality, and Competition on the Movement and Survival of Juvenile Coho Salmon, Oncorhynchus kisutch, During the Early Stages of Stream Re-colonization*, 140 Trans. Am. Fisheries Soc'y, 883–897 (2011).

J.H. Anderson, P. M. Kiffney, G. R. Pess & T. P. Quinn, *Summer Distribution and Growth of Juvenile Coho Salmon During Colonization of Newly Accessible Habitat,* 137 Trans. Am. Fisheries Soc'y, 772–781 (2008).

T.H. Kahler, P. Roni & T. P. Quinn, *Summer Movement and Growth of Juvenile Anadromous Salmonids in Small Western Washington Streams*, 58 Can. J. Fisheries and Aquatic Sci., 1947–1956 (2001).

P. Roni & and T. P. Quinn, *Density and Size of Juvenile Salmonids in Response to Placement of Large Woody Debris in Western Oregon and Washington Streams*, 58 Can. J. Fisheries and Aquatic Sci., 282-292 (2001)a.

P. Roni & and T. P. Quinn, *Effects of Wood Placement on Movements of Trout and Juvenile Coho Salmon in Natural and Artificial Stream Channels*, 130 Trans. Am. Fisheries Soc'y, 675–685 (2001)b.

Thomas P. Quinn, *The Behavior and Ecology of Pacific Salmon and Trout* (2nd. ed. 2018)

T.P. Quinn & N. P. Peterson. 1996. *The Influence of Habitat Complexity and Fish Size on Over-winter Survival and Growth of Individually-Marked Juvenile Coho Salmon (Oncorhynchus kisutch) in Big Beef Creek, Washington*, 53 Can. J. Fisheries and Aquatic Sci., 1555–1564 (1996).

J.T. Konecki, C. A. Woody & T. P. Quinn, *Influence of Temperature on Incubation Rates of Coho Salmon (Oncorhynchus kisutch) From Ten Washington Populations*, 69 Northwest Sci., 126–132 (1995).

D.G. Lonzarich & T. P. Quinn, *Experimental Evidence for the Effect of Depth and Structure on the Distribution, Growth and Survival of Stream Fishes*, 72 Can. J. Zoology, 2223–2230 (1995).

T.P. Quinn, A. H. Dittman, N. P. Peterson & E. C. Volk, *Distribution, Survival and Growth of Sibling Groups of Juvenile Coho Salmon, Oncorhynchus kisutch, in an Experimental Stream Channel*, 71 Can. J. Zoology, 2119–2123 (1994).

9. My curriculum vitae (CV) is attached to this report and further details my professional experience and lists my published works including all publications that I have authored or coauthored. Many of these other papers are relevant to the spawning habitat requirements of salmonids in general, and the ways in which habitat conditions affect survival. They are thus pertinent to coho salmon because many aspects of salmon and trout habitat requirements are common to all species.

III. TERMINOLOGY

10. For ease of communication, it is important to have some knowledge of the terminology associated with Pacific salmonids. An egg is an unfertilized ovum, produced by the female, which once fertilized by the male is referred to as an embryo. Embryos are immediately buried by the female in a gravel nest called a redd. The embryos are situated within the redd in several egg pockets, each representing a discrete spawning event by that female. After several months of development (the pace of which depends on ambient water temperature), the embryos hatch and are known as alevins. The alevins remain in the gravel for additional weeks or months (depending, again, on temperature), relying on their yolk sac for nutrition. Once the yolk sac has been consumed, young fish emerge from the gravel into the stream environment to feed on their own and are referred to as fry. Salmon fry of several species remain in the stream and display brown or green vertical stripes known as parr marks and the fry are often referred to as parr. The duration spent in fresh water habitats varies among species and populations but once the fry

begin the physiological changes needed for them to migrate downstream and survive in the ocean, they are referred to as smolts.

11. There are also a number of important terms and concepts related to streams. Streams are categorized by order; first-order streams are the primary channels, joining to form second-order streams, and so on, in an open-ended system, with coho tending to spawn and rear in second and third order streams. An important feature of streams to salmon life history and survival is their flow regime, which is the seasonal pattern in average and variation in discharge. The gradient of a stream is an important determinant of channel characteristics and tends to become more gentle moving down a watershed. Coho salmon tend to occur in areas of moderate gradient characterized by a series of steps, pools, riffles and runs. Large woody debris includes the logs, sticks, branches and other wood that falls into streams and plays an important role in shaping channel morphology in ways that are critical to juvenile coho salmon rearing habitat.

IV. COHO SALMON

12. One of several species of Pacific salmonids, coho salmon (*Oncorhynchus kisutch*), also known as silver salmon, range in North America from just north of Santa Cruz, California to Point Hope, Kotzebue Sound, Alaska. When at sea, coho salmon have blue-to-greenish backs with silver sides and a light belly, and black spots on the back and upper part of the tail. Unlike Chinook, coho salmon have a light gumline in the lower jaw. Spawning coho are dark with red coloration on the sides and a strongly hooked snout in males. Adult coho weigh between about eight and twelve pounds and are 24 to 30 inches long, though considerable variation is observed in size.

13. Coho salmon tend to spawn in small streams of moderate gradient along the coast, where most juveniles live the first one and a half years of their lives (more commonly two and a

half years in northern habitats, and sometimes only a half year in some small coastal streams). Smolts spend little time in estuaries and subadults feed primarily in coastal waters. Most coho salmon return to their natal streams after one full year and a summer in marine waters, but some return after only one summer and others after two years.

14. As with all species of salmon and trout, coho salmon exist as multiple populations, more or less isolated from each other by the homing behavior for which salmon are famous, but experiencing some exchange among breeding populations by the small fraction of salmon that stray to non-natal sites (Quinn, 2018). While fisheries for coho salmon are co-managed by state and tribal entities, the species is also managed by NOAA-Fisheries under the U.S. Endangered Species Act. To administer this law to species with such complex population structure, NOAA has applied the Evolutionarily Significant Unit (ESU) policy (Waples 1991, 1995). According to the NOAA-Fisheries website (https://www.fisheries.noaa.gov/species/coho-salmon, accessed Sept. 7, 2019), one ESU of coho salmon is listed as endangered (central California coast) and three are listed as threatened under the ESA (lower Columbia River, Oregon coast, and southern Oregon & northern California coast). The Oregon coast coho salmon ESU occurs in rivers from south of the Columbia River to the Sixes River, just north of Cape Blanco.

V. <u>COHO SALMON IN THE FRESHWATER ENVIRONMENT</u>

15. Adult coho salmon begin migrating from the ocean to their natal streams in late summer to early fall and typically spawn from November to December (earlier in the northern part of the range and later in the southern part). Each female selects a breeding site based on innate preferences for certain habitat conditions (chiefly water depth, velocity, and substrate) and the range of conditions that are available to her in the natal river. She then commences to dig in

the gravel, preparing the site for spawning and incubation of her offspring, who must survive below the surface of the streambed for many months, long after she has died. This site selection and preparation of the nest are critical because salmon, including coho salmon, experience the greatest proportion of the total lifetime mortality during incubation in the gravel, and much of that mortality is related to features of the site.

16. Coho salmon select sites for spawning and the preparation of redds that are at the transition between pools or runs and riffles, have a higher percentage of gravel-pebble in the substrate, have greater depth and are near to the redds of other females (Mull & Wilzbach, 2007; Clark et al., 2014). These features, as well as the timing of spawning, appear designed to maximize survival of the embryos, which need well-oxygenated water and stable gravels to incubate. The transition of pools into riffles are preferred locations for redds because the rate of flow through the gravel is high, reflecting the increasing velocity as the pool shallows up and becomes a riffle and forces the water down into the gravel.

17. The scientific literature on the spawning site selection process in salmon, trout, and their relatives is very extensive. Some aspects such as gravel size, a key attribute that is related to other features of the stream and watershed, scale to some extent with the size of the fish. That is, larger-bodied females tend to select and prepare redds in somewhat deeper and faster water, with large substrate, than smaller-bodied females (Kondolf & Wolman, 1993; Kondolf et al., 1993; Quinn, 2018). The overall processes of nest digging, mating, egg burial, and incubation are very similar among salmon and trout species, and the differences among species are largely related to the size of the fish and the particular range of conditions available in a given stream. Examples of this range in values, associated with different species, include large-bodied Chinook salmon (e.g., Groves & Chandler, 1999; Cram et al., 2017), and steelhead

(Orcutt et al., 1968; Kammel et al., 2016), multiple species, including coho salmon in Oregon (Smith, 1973), and small-bodied species such as golden trout (Knapp & Vredenburg, 1996; Knapp & Preisler, 1999).

18. The embryos remain in the egg pockets, buried in the gravel for several months, with the duration depending on ambient temperature. During this time, their survival is related to several factors. First, water flow is needed to deliver dissolved oxygen to the developing embryos. In general, the presence of fine sediments (particles < 1.0 or 0.85 mm) in the stream as a whole or in the egg pocket is associated with a pronounced reduction in survival of embryos, relative to sites with a lower proportion of such fine material. This pattern was revealed largely on the basis of studies that were specifically designed to determine whether the increase in fine sediment, so often associated with logging operations (e.g., Brown & Krygier, 1971; Cederholm et al., 1982; Cederholm & Reid, 1987; Platts et al., 1989; Eaglin & Hubert, 1993), could be deleterious to developing salmon. There are several processes by which fine sediments can reduce the survival of embryos, including filling the interstitial spaces of gravels (Peterson & Quinn, *Persistence of Egg Pocket Architecture in Redds of Chum Salmon, Oncorhynchus keta,* 1996). This can reduce the flow of oxygenated water (Peterson & Quinn, *Spatial and Temporal Variation in Dissolved Oxygen in Natural Egg Pockets of Chum Salmon, in Kennedy Creek, Washington,* 1996) though the fine sediment does not itself depress oxygen levels (Quinn & Peterson, 1996) unless it includes organic material (Greig et al., 2007). Reduced oxygen delivery not only decreases survival rate (Coble, 1961; Hamor & Garside, 1976; Sowden & Power, 1985) but also affects the size of the fry that emerge, as reported for coho salmon (Shumway et al., 1964), and delays emergence (Hamor & Garside). Finally, fine sediment can trap or "entomb" embryos, preventing their emergence (Franssen et al., 2012).

19. The subject of fine sediment and salmon embryo survival was reviewed over three decades ago by Chapman (1988), and a wide variety of laboratory and field studies supported the conclusion that increased proportions of fine sediment (e.g., greater than about 10 percent of the substrate by weight) are associated with marked reductions in embryo survival. Many papers have been published since his review, but the conclusion stands. Indeed, according to a meta-analysis of studies, coho salmon appear to be especially sensitive to increases in fine sediments (Jensen et al., 2009). Further details and examples are listed in the next section of this report.

20. Embryos are also vulnerable to high flows that can scour gravels and displace the young fish before they are ready to emerge. The same features that make sites desirable for redds, namely bed characteristics that push water down into the gravel, also make these sites vulnerable to scour during flooding (Holtby & Healey, 1986; Schuett-Hames et al., 2000). There is a particular period during embryonic development when they are especially sensitive to mechanical shock, such as that associated with gravel movement, and very high mortality rates can occur when the embryos are disturbed (Jensen & Alderdice, 1989; Johnson et al., 1989). As with the effects of fine sediments, the effects of mechanical shock affect all salmon species in these ways.

21. After hatching, coho salmon live another several weeks or more in the gravel as alevins, consuming the yolk sac. At this stage, they have some ability to respond to fluctuations in dissolved oxygen by moving to areas of improved flow and using their fins to move water over their gills, but remain vulnerable to being buried in the gravels by landslides or other deposition, or to being displaced by scour.

22. When coho salmon emerge as fry in the spring, they must establish and defend territories or otherwise find sufficient food, and avoid predators. In part because of these

challenges, the quantity of habitat for rearing in the stream environment appears to be the primary limiting factor for coho salmon populations. Studies find that past a certain threshold, reflecting the carrying capacity of a particular stream, increasing the number of spawning adults will not increase smolt production (Marshall & Britton, 1990; Bradford et al., 1997).

23. Immediately after emergence, fry tend to school at the margins of streams likely to avoid predators. As they grow, the fry begin to establish and defend territories centered around pools. For this reason, the number of smolts produced per a given length of stream increases with increased pool area (Sharma & Hilborn, 2001). In most coastal streams, including those on the Tillamook and Clatsop state forests, low flows occur in late summer and hence this is when the area and depth of pools are at their lowest, leading to documented correlations between run abundance and summer low flows in the year the run was reared (Seiler et al., 2002). Indeed, the relationship between summer low flow and coho salmon production was reported decades ago (Mathews & Olson, 1980) and also more recently (Beecher et al., 2010).

24. Streams with more large woody debris tend to have more and larger pools and more overall complexity with more diversity in depth, velocity, substrate, and cover than streams with more limited woody material, making large woody debris a critical component of coho salmon rearing habitat and a primary determinant of smolt production. In addition to creating more habitat for coho salmon, large woody debris also likely helps shelter them from high winter flows that can displace them from suitable habitat. Studies showed that during winter, coho salmon selectively inhabit deep pools with accumulations of large woody debris and are attracted to the low stream velocities in the lee of large woody debris (Quinn & Peterson).

VI. LOGGING AND ROAD IMPACTS TO COHO SALMON

25. The negative impacts of logging and associated roads on coho salmon and their

stream habitat are well studied and generally uncontroversial in the scientific literature, particularly the deleterious effects of increased fine sediments, but also reduced input of large woody debris, channel simplification leading to reduced pools, ponds and off-channel habitat, reductions in prey for coho fry and loss of embryo, alevins, and fry to high winter flows.

26. It is well documented that logging and associated roads substantially increase the amount of fine sediments entering streams, including in the Oregon Coast Range (Brown & Krygier; Beschta, 1978; Gresswell et al., 1979), as well as in many other areas (Cederholm & Salo, 1979; Reid et al., 1981; Reid & Dunne, 1984; Amaranthus et al., 1985; Swanson et al., 1987; Platts et al.; Scrivener & Brownlee, 1989; Eaglin & Hubert; Jones et al., 2000; Ziegler et al., 2001; Wemple et al., 2001; Gomi et al., 2005; Zégre, 2008). Such increases result from land surfaces exposed after removal of trees, the bare surfaces of unpaved roads and, in particular, increased frequency and density of landslides related to both clearcuts and roads (Gresswell et al.; Amaranthus et al.; Swanson et al.; Jones et al., 2000; Wemple et al., 2000; Guthrie, 2002; May, 2002; Whittaker & McShane, 2012; Goetz et al., 2015).

27. Elevated fine sediment levels related to logging and roads have a number of deleterious effects on coho salmon and their habitat, but none is more clearly documented than the negative effects of fine sediments on egg-to-fry survival.

28. Numerous studies have documented a relationship between the percentage of fine sediments in spawning gravels and egg-to-fry survival, specifically for coho (Koski, 1965; Tagart, 1984; Meyer, 2003; Jensen et al.), but also many other salmonid species, including Atlantic salmon (Lapointe et al., 2004), bull trout (Bowerman et al., 2014), chum salmon (Dill & Northcote, 1970; Iida et al., 2017), rainbow trout or steelhead (Witzel & MacCrimmon, 1981), brook trout (Hausle & Goble, 1976), cutthroat trout (Weaver & Fraley, 1993), brown trout

(Rubin & Glimsäter, 1996; Sternecker et al., 2013), and studies on multiple species (Phillips et al., 1975, Reiser & White 1988; Scrivener & Brownlee; Sternecker & Geist, 2010). As noted above, a meta-analysis utilizing 14 previous studies (Jensen et al.) echoed earlier reviews by Chapman and Greig et al., (2005) and determined that once fine sediments exceeded 10 percent of the material in the streambed, egg-to-fry survival declines rapidly, and coho salmon were more sensitive to increased fine sediment compared to Chinook and chum salmon, and steelhead trout. The Ecosystem Diagnosis and Treatment (EDT) model that is commonly used in the Pacific Northwest to assess habitat quality and potential for recovery explicitly used the percent of fine material in the substrate as part of the assessment (Blair et al., 2009). In sum, decades of research, including experiments, field studies, and models, has shown that fine sediments are produced by logging and associated roads, and that this kind of material leads to direct mortality of salmon embryos and alevins.

29. In addition to reducing egg-to-fry survival, elevated fine sediments impact coho salmon by increasing turbidity during rain events, which can cause direct physiological stress and even mortality of coho salmon, as well as reduce the ability of fry to forage by reducing visibility (Newcombe & MacDonald, 1991). Fine sediments also reduce the density of the aquatic invertebrates that serve as food for salmon fry, shifting the community and resulting in lower growth and survival, as shown by Suttle et al., (2004) for juvenile steelhead.

30. Landslides and debris flows impact habitat for fry by simplifying channel morphology, including reducing pool area, side-channels, and diversity of velocities and depths (Benda & Dunne, 1997; Miller & Benda, 2000; Hoffman & Gabet, 2007). As noted above, space and food for rearing are a primary limiting factor for coho salmon, with the number and area of pools being a primary determinant of rearing space. With fewer pools and other features, and

simplified channels, emerging fry are unable to establish territories, are forced to migrate, and may eventually be displaced to inferior habitat in the stream farther downriver, or into the estuary. This reduces fitness, lowering survivability and ultimately leading to mortality of individuals. Simplification of the channel also makes fry more vulnerable to winter flows by providing fewer areas for the young fish to find areas to shelter during flood events, leading to further displacement and mortality.

31. Logging and roads directly impact stream flows with consequences for coho salmon, both by increasing winter flows and reducing summer flows (Cederholm & Reid; Jones & Grant, 1996; Thomas & Megahan, 1998; Beschta et al., 2000; Jones et al., 2000; Lewis et al., 2000; Miller & Benda; Zégre, 2008). Removal of vegetation through clearcutting and construction of road networks both increase peak winter flows during rain events (Lewis et al., 2001; Zégre). Because coho salmon construct redds at the tail-end of pools to maximize down-flow of oxygenated water, they are vulnerable to scour with increased peak flows (Lisle & Lewis, 1992; Montgomery et al., 1996). Following emergence, coho fry are subject to flushing downstream during high winter flows, leading to poor fitness and likely mortality. On the other end of the spectrum, landslides, and debris flows caused by logging and roads can bury streams in so much material, termed aggradation, that during periods of low flow in the summer, streams go subsurface, leading to reductions in pools and other habitat for coho and displacement and mortality of fry (Miller & Benda; May & Lee, 2004).

32. Lastly, logging adversely impacts coho salmon by reducing input of large woody debris—a critical component of their freshwater habitat. Numerous studies have shown that logging practices, variable though they have been over the years and regions, tend to reduce the density and size of large woody debris in stream margins and channels. This reduction in woody

debris results in a loss of stream complexity and especially a reduction in pool size and abundance (e.g., Ralph et al., 1994). Juvenile coho salmon show a particular affinity for the slow, deep water characteristic of pools (Bisson et al., 1988; Healy & Lonzarich, 2000; Quinn, 2018). Indeed, this aspect of their ecology is so well-known that some studies do not even bother to sample riffles but only sample in pools when studying this species (e.g., Pess et al.). Not surprisingly, the density of pools is positively associated with high coho salmon smolt production (Sharma & Hilborn). Habitat with a high density of woody debris tends to have higher densities of coho salmon than more deficient habitat (Hicks et al., 1991), and enhancement of habitat with woody debris additions typically benefits juvenile coho salmon (Solazzi et al., 2000; Roni & Quinn, 2001(a); Peters et al., 2015).

VII. CONCLUSION

33. The habitat alterations associated with logging—such as increases in fine sediment deposition in the streambed, increased winter flows, decreased summer flows or stream depths, reduced woody debris volume, simplified channel form, reduced number of size of pools, reduced variation in velocity, reduced overhead and in-stream cover, etc.—have been studied in great detail throughout the range of Pacific salmon in North America, including multi-decade case studies in Carnation Creek, British Columbia (Chamberlin, 1987; Hartman & Scrivener, 1990; Hartman et al., 1996; Tschaplinski, 2000), the Clearwater River, Washington (Cederholm & Reid), the Alsea River, Oregon (Moring & Lantz, 1975), and numerous other sites, as well as controlled experiments, models, and other forms of scientific inquiry. The overall conclusions regarding the many ways in which logging practices have, and continue to adversely affect salmon, have been abundantly clear for many decades. As a result, it my professional opinion that activities that increase fine sediment, adversely affect winter and summer flows, reduce

woody debris volume, and simplify channel form in coho salmon-bearing streams—such as the logging and road-related activities authorized and undertaken by the Oregon Department of Forestry—are certain to kill, injure, and otherwise negatively impact Oregon Coast coho salmon.

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VIII. <u>LITERATURE CITED</u>

Michael P. Amaranthus et al., *Logging and Forest Roads Related to Increased Debris Slides in Southwestern Oregon*, 83 J. Forestry, 229–233 (1985).

Hal A. Beecher et al., *An Empirical Assessment of PHABISM Using Long-Term Monitoring of Coho Salmon Smolt Production in Bingham Creek, Wa*, 30 N. Am. J. Fisheries Mgmt., 1529-1543 (2010).

Lee Benda & Thomas Dunne, *Stochastic Forcing of Sediment Supply to Channel Networks from Landsliding and Debris Flow*, 33 Water Resources Res., 2849–2863 (1997).

Robert L. Beschta, *Long-Term Patterns of Sediment Production Following Road Construction and Logging in the Oregon Coast Range*, 14 Water Resources Res., 1011–1016 (1978).

Robert L. Beschta et al., *Peak Flow Responses to Forest Practices in the Western Cascades of Oregon*, 233 U.S. J. Hydrology, 102-120 (2000).

Gregory R. Blair et al., *The Ecosystem Diagnosis and Treatment Model: a Tool for Assessing Salmonid Performance Potential Based on Habitat Conditions*, 71 Am. Fisheries Soc'ySymp. 289-309 (2009).

Tracy Bowerman et al., *Effects of Fine Sediment, Hyporheic Flow, and Spawning Site Characteristics on Survival and Development of Bull Trout Embryos*, 71 Can. J. Fisheries and Aquatic Sci., 1059–1071 (2014).

Michael J. Bradford et al., *Empirical Review of Coho Salmon Smolt Abundance and Prediction of Smolt Production at the Regional Level*, 126 Trans. Am. Fisheries Soc'y, 49-64 (1997).

George W. Brown & James T. Krygier, *Clear-Cut Logging and Sediment Production in the Oregon Coast Rang*e, 7 Water Resources Res., 1189–1198 (1971).

C. J. Cederholm & Ernest O. Salo, *The Effects of Logging Road Landslide Siltation on the Salmon and Trout Spawning Gravels of Stequaleho Creek and the Clearwater River Basin, Jefferson County, Washington*, *1972-1978*, (U. Wash. FRI Rep. No. FRI-UW-7915, 1979).

C. J. Cederholm & L. M. Reid, *Impact of Forest Management on Coho Salmon (Oncorhynchus kisutch) Populations of the Clearwater River, Washington: A Project Summary*, *in* Streamside Management: Forestry and Fishery Interactions, 373–398 (E.O. Salo & T.W. Cundy eds., 1986).

C.J. Cederholm et al., *Effects of Forest Road Erosion on Salmonid Spawning Gravel Composition and Populations of the Clearwater River, Washington*, *in* Habitat Disturbance and Recovery, 1-17 (1982).

Proceedings of the Workshop: Applying 15 Years of Carnation Creek Results (prepared by the Carnation Creek Steering Committee, Pacific Biological Station, Nanaimo, B.C.) (T. W. Chamberlin ed., 1987).

Steven M. Clark et al, *Breeding Site Selection by Coho Salmon (Oncorhynchus kisutch) in Relation to Large Wood Additions and Factors that Influence Reproductive Success*, 71 Can. J. Fisheries & Aquatic Sci., 1498-1507 (2014).

D.W. Chapman, *Critical Review of Variables Used to Define Effects of Fines in Redds of Large Salmonids*, 117 Trans Am. Fisheries Soc'y, 1-21 (1988).

Daniel W. Coble, *Influence of Water Exchange and Dissolved Oxygen in Redds on Survival of Steelhead Trout Embryos*, 90 Trans. Am. Fisheries Soc'y, 469-474 (1961).

Jeremy M. Cram et al., *Spatial Variability of Chinook Salmon Spawning Distribution and Habitat Preferences*, 146 Trans. Am. Fisheries Soc'y, (2017).

L.M. Dill & T.G. Northcote, *Effects of Some Environmental Factors on Survival, Condition, and Timing of Emergence of Chum Salmon Fry (Oncorhynchus keta),* 27 J. Fisheries Res. Board Can., 196-201 (1970).

Gregory S. Eaglin & Wayne A. Hubert, *Management Briefs: Effects of Logging and Roads on Substrate and Trout in Streams of the Medicine Bow National Forest, Wyoming*, 13 N. Am. J. Fisheries Mgmt., 844–846 (1993).

Jan Franssen et al., *Asphyxiation and Entombment Mechanisms in Fines Rich Spawning Substrates: Experimental Evidence with Brook Trout (Salvelinus fontinalis) Embryos*, 69 Can. J. Fisheries and Aquatic Sci., 587–599 (2012).

J. N. Goetz et al., *Forest Harvesting is Associated with Increased Landslide Activity During an Extreme Rainstorm on Vancouver Island, Canada*, 15 Nat. Hazards and Earth Sys. Sci., 1311–1330 (2015).

Takashi Gomi et al., *Suspended Sediment Dynamics in Small Forest Streams of the Pacific Northwest*, 41 J. Am. Water Resources Ass'n, 877-898 (2005).

S.M. Greig et al., *The Impact of Fine Sediment Accumulation on the Survival of Incubating Salmon Progeny: Implications for Sediment Management*, 344 Sci. Total Env't, 241–258 (2005).

S.M. Greig et al., *A Review of Factors Influencing the Availability of Dissolved Oxygen to Incubating Salmonid Embryos*, 21 Hydrological Processes, 323-334 (2007).

Stuart Gresswell et al., *Mass Movement Response to Forest Management in the Central Oregon Coast Ranges* (PNW Resource Bull. No. 84, 1979).

Phillip A. Groves & James A. Chandler, *Spawning Habitat Used by Fall Chinook Salmon in the Snake River*, 19 N. Am. J. Fisheries Mgmt, 912-922 (1999).

R.H. Guthrie, *The Effects of Logging on Frequency and Distribution of Landslides in Three Watersheds on Vancouver Island, British Columbia*, 43 Geomorphology, 273–292 (2002).

T. Hamor & E.T. Garside, *Developmental Rates of Embryos of Atlantic Salmon, Salmo salar L., in Response to Various Levels of Temperature, Dissolved Oxygen, and Water Exchange*, 54 Can. J. Zoology, 1912-1916 (1976).

G.F. Hartman & J.C. Scrivener, *Impacts of Forestry Practices on a Coastal Stream Ecosystem, Carnation Creek, British Columbia*, 223 Can. Bull. Fisheries & Aquatic Sci, 1-148 (1990).

G.F. Hartman et al., *Impacts of Logging in Carnation Creek, a High-energy Coastal Stream in British Columbia, and Their Implication for Restoring Fish Habitat*, 53 Can. J. Fisheries and Aquatic Sci., 237-251, (1996).

Donald A. Hausle & Daniel W. Coble, *Influence of Sand in Redds on Survival and Emergence of Brook Trout (Salvelinus fontinalis)*, 105 Trans. Am. Fisheries Soc'y, 57–63 (1976).

Brian D. Healy & David G. Lonzarich, *Microhabitat Use and Behavior of Overwintering Juvenile Coho Salmon in a Lake Superior Tributary*, 129 Trans. Am. Fisheries Soc'y, 866-872 (2000).

B.J. Hicks et al., *Responses of Salmonids to Habitat Changes*, 19 Am. Fisheries Soc'y Special Publication, 483-518 (1991).

Daniel F. Hoffman & Emmanuel J. Gabet, *Effects of Sediment Pulses on Channel Morphology in a Gravel-bed River*, 119 GSA Bull., 116-125 (2007).

L.B. Holtby & M.C. Healey, *Selection for Adult Size in Female Coho Salmon (Oncorhynchus kisutch)*, 43 Can. J. Fisheries and Aquatic Sci., 1946-1959 (1986).

Masaya Iida et al., *Effect of Riverbed Conditions on Survival of Planted Eyed Eggs in Chum Salmon Oncorhynchus keta*, 83 Fisheries Sci., 291-300 (2017).

David W. Jensen et al., *Impact of Fine Sediment on Egg-To-Fry Survival of Pacific Salmon: A Meta-Analysis of Published Studies*, 17 Rev. in Fisheries Sci., 348–359 (2009).

J.O.T. Jensen & D.F. Alderdice, *Comparison of Mechanical Shock Sensitivity of Eggs of Five Pacific Salmon (Oncorhynchus) Species and Steelhead Trout (Salmo gairdneri)*, 78 Aquaculture, 163-181 (1989).

Steven C. Johnson et al., *Relationships between Temperature Units and Sensitivity to Handling for Coho Salmon and Rainbow Trout Embryos*, 51 Progressive Fish-Culturist, 61-68 (1989).

Julia A. Jones et al., *Effects of Roads on Hydrology, Geomorphology, and Disturbance Patches in Stream Networks*, 14 Conservation Biology, 76–85 (2000).

Julia A. Jones & G.E. Grant, *Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon*, 32 Water Resources Res., 959-974 (1996).

Leah E. Kammel et al., *Near-census Ecohydraulics Bioverification of Oncorhynchus mykiss Spawning Microhabitat Preferences*, 1 J. Ecohydrolics, 62-78 (2016).

Peggy Kavanagh et al., *Fish Habitat Assessment in the Oregon Department of Forestry Tillamook Study Area* (ODFW Aquatic Inventories Project, 2005).

Roland A. Knapp & Haiganoush K. Preisler, *Is It Possible to Predict Habitat Use by Spawning Salmonids? A Test Using California Golden Trout (Oncorhynchus mykiss aguabonita),* 56 Can. J. Fisheries and Aquatic Sci., 1576-1584 (1999).

Roland A. Knapp & Vance T. Vredenburg, *Spawning by California Golden Trout: Characteristics of Spawning Fish, Seasonal and Daily Timing, Redd Characteristics, and Microhabitat Preferences*, 125 Trans. Am. Fisheries Soc'y, 519-531 (1996).

G. Mathias Kondolf et al., *Modification of Fluvial Gravel Size by Spawning Salmonids*, 29 Water Resources Res., 2265-2274 (1993).

G. Mathias Kondolf & M. Gordon Wolman, *The Sizes of Salmonid Spawning Gravels*, 29 Water Resources Res., 2275-2285 (1993).

K. Victor Koski, *The Survival of Coho Salmon (Oncorhynchus kisutch) From Egg Deposition to Emergence in Three Oregon Coastal Streams* (unpublished master's thesis, Oregon State University) (1965).

Michel F. Lapointe et al., *Interactive Effects of Substrate Sand and Silt Contents, Redd-scale Hydraulic Gradients, and Interstitial Velocities on Egg-to-emergence Survival of Atlantic Salmon (Salmo Salar)*, 61 Can. J. Fisheries and Aquatic Sci., 2271–2277 (2004).

Jack Lewis et al., *Impacts of Logging on Storm Peak Flows, Flow Volumes and Suspended Sediment Loads in Caspar Creek, California*, *in* 2 Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas, 85-125 (Water Sci. & Applications Ser., 2001).

Thomas E. Lisle & Jack Lewis, *Effects of Sediment Transport on Survival of Salmonid Embryos in a Natural Stream: A Simulation Approach*, 49 Can. J. Fisheries and Aquatic Sci., 2337–2344 (1992).

D.E. Marshall & E.W. Britton, *Carrying Capacity of Coho Salmon Streams*, 2058 Can. Manuscript Rep. Fisheries & Aquatic Sci. (1990).

S.B. Mathews & F.W. Olson, *Factors Affecting Puget Sound Coho Salmon (Oncorhynchus kisutch) Run*s, 37 Can. J. Fisheries & Aquatic Sciences, 1373-1378 (1980).

Christine L. May, *Debris Flows Through Different Forest Age Classes In The Central Oregon Coast Range*, 38 J. Am. Water Resources Ass'n, 1097–1113 (2002).

Christine L. May & Danny C. Lee, *The Relationships Among In-Channel Sediment Storage, Pool Depth, and Summer Survival of Juvenile Salmonids in Oregon Coast Range Streams*, 24 N. Am. J. Fisheries Mgmt., 761–774 (2004).

W.R. Meehan (ed.), *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*, 19 Am. Fisheries Soc'y Special Publication (1991).

C. B. Meyer, *The Importance of Measuring Biotic and Abiotic Factors in the Lower Egg Pocket to Predict Coho Salmon Egg Survival*, 62 J. Fish Biology, 534–548 (2003).

Daniel J. Miller & Lee E. Benda, *Effects of Punctuated Sediment Supply on Valley-Floor Landforms and Sediment Transport*, 112 GSA Bull., 1814–1824 (2000).

David R. Montgomery et al., *Stream-bed Scour, Egg Burial Depths, and the Influence of Salmonid Spawning on Bed Surface Mobility and Embryo Survival*, 53 Can. J. Fisheries and Aquatic Sci., 1061–1070 (1996).

John R. Moring & Richard L. Lantz, *The Alsea River Watershed Study: Effects of Logging on the Aquatic Resources of Three Headwater Streams of the Alsea River, Oregon, Part I: Biological Sciences* (ODFW Fishery Res. Rep. No. 9, 1975)

John R. Moring & Richard L. Lantz, *The Alsea River Watershed Study: Effects of Logging on the Aquatic Resources of Three Headwater Streams of the Alsea River, Oregon, Part II: Changes in Environmental Conditions* (ODFW Fishery Res. Rep. No. 9, 1975).

John R. Moring & Richard L. Lantz, *The Alsea River Watershed Study: Effects of Logging on the Aquatic Resources of Three Headwater Streams of the Alsea River, Oregon Part III: Discussion and Recommendations* (ODFW Fishery Res. Rep. No. 9, 1975).

Kristin E. Mull & Margaret A. Wilzbach, *Selection of Spawning Sites by Coho Salmon in a Northern California Stream*, 27 N. Am. J. Fisheries Mgmt., 1343–1354 (2007).

Michael L. Murphy et al., *Effects of Clear-Cut Logging with and without Buffer Strips on Juvenile Salmonids in Alaskan Streams*, 43 J. Fisheries & Aquatic Sci., 1521-1533.

Watershed Management: Balancing Sustainability and Environmental Change, (Robert J. Naiman ed., 1992).

C.P. Newcombe & D.D. MacDonald, *Effects of Suspended Sediments on Aquatic Ecosystems*, 11 N. Am. J. Fisheries Mgmt., 72-82 (1991).

Donald R. Orcutt et al., *Characteristics of Steelhead Trout Redds in Idaho Streams*, 97 Trans. Am. Fisheries Soc'y, 42-45 (1968).

G. R. Pess et al., *The Influences of Body Size, Habitat Quality, and Competition on the Movement and Survival of Juvenile Coho Salmon during the Early Stages of Stream Recolonization*, 140 Trans. Am. Fisheries Soc'y, 883–897 (2011).

Roger J. Peters et al., *Influence of Wood and Other Habitat Characteristics on the Distribution and Abundance of Coho Salmon in a Relatively Large River*, 89 NW Sci., 336-354 (2015).

N. Phil Peterson & Thomas P. Quinn, *Persistence of Egg Pocket Architecture in Redds of Chum Salmon (Oncorhynchus keta),* 46 Envtl. Biology of Fishes, 243-253 (1996)a.

N. Phil Peterson & Thomas P. Quinn, *Spatial and Temporal Variation in Dissolved Oxygen in Natural Egg Pockets of Chum Salmon, in Kennedy Creek, Washington*, 48 J. Fish Biology, 131-143 (1996)b.

Robert W. Phillips et al., *Some Effects of Gravel Mixtures on Emergence of Coho Salmon and Steelhead Trout Fry*, 104 Trans. Am. Fisheries Soc'y, 461–466 (1975).

William S. Platts et al., *Changes in Salmon Spawning and Rearing Habitat from Increased Delivery of Fine Sediment to the South Fork Salmon River, Idaho*, 118 Trans. Am. Fisheries Soc'y, 274–283 (1989).

Stephen C. Ralph et al., *Stream Channel Morphology and Woody Debris in Logged and Unlogged Basins of Western Washington*, 51 Can. J. Fisheries and Aquatic Sci., 37–51 (1994).

Leslie M. Reid et al., *Application of Sediment Budget Studies to the Evaluation of Logging Road Impact*, 20 J. Hydrology (New Zealand), 49–62 (1981).

Leslie M. Reid & Thomas Dunne, *Sediment Production from Forest Road Surfaces*, 20 Water Resources Res., 1753–1761 (1984).

Dudley W. Reiser & Robert G. White, *Effects of Two Sediment Size-Classes on Survival of Steelhead and Chinook Salmon Eggs*, 8 N. Am. J. Fisheries Mgmt., 432–437 (1988).

Philip Roni & Thomas P. Quinn, *Density and Size of Juvenile Salmonids in Response to Placement of Large Woody Debris in Western Oregon and Washington Streams*, 58 Can J. Fisheries & Aquatic Sci., 282-292 (2001)a.

J.F. Rubin and C. Glimsater, *Egg-to-fry Survival of the Sea Trout in Some Streams of Gotland*, 48 J. Fish Biology, 585–606 (1996).

Streamside Management: Forestry and Fishery Interactions (Inst. Forest Resources, Contribution No. 57, U. Wash., 1987) (E. O. Salo & T. W. Cundy eds., 1987).

Dave E. Schuett-Hames et al., *Patterns of Gravel Scour and Fill After Spawning by Chum Salmon in a Western Washington Stream,* 20 N. Am. J. Fisheries Mgmt., 610-617 (2000).

J. C. Scrivener & M. J. Brownlee, *Effects of Forest Harvesting on Spawning Gravel and Incubation Survival of Chum (Oncorhynchus Keta) and Coho Salmon (O. Kisutch) in Carnation Creek, British Columbia*, 46 Can. J. Fisheries and Aquatic Sci., 681–696 (1989).

Dave Seiler et al., *2002 Wild Coho Forecasts for Puget Sound and Washington Coastal Systems*, Wash. Dep't Fish & Wildlife Sci. Div. (2002).

Rishi Sharma & Ray Hilborn, *Empirical Relationships Between Watershed Characteristics and Coho Salmon (Oncorhynchus kisutch) Smolt Abundance in 14 Western Washington Streams*, 58 Can. J. Fisheries and Aquatic Sci., 1453-1463 (2001).

Dean L. Shumway et al., *Influence of Oxygen Concentration and Water Movement on the Growth of Steelhead Trout and Coho Salmon Embryos*, 93 Trans. Am. Fisheries Soc'y, 342-356 (1964).

Allan K. Smith, *Development and Application of Spawning Velocity and Depth Criteria for Oregon Salmonids*, 102 Trans. Am. Fisheries Soc'y, 312-316 (1973).

M.F. Solazzi et al., *Effects of Increasing Winter Rearing Habitat on Abundance of Salmonids in Two Coastal Oregon Streams*, 57 Can. J. Fisheries and Aquatic Sci., 906-914 (2000).

Terry K. Sowden & G. Power, *Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates*, 114 Trans. Am. Fisheries Soc'y, 804-812 (1985).

Katharina Sternecker & Juergen Geist, *The Effects of Stream Substratum Composition on the Emergence of Salmonid Fry*, 19 Ecology of Freshwater Fish, 637-544 (2010).

Katharina Sternecker et al., *Factors Influencing the Success of Salmonid Egg Development in River Substratum*, 22 Ecology of Freshwater Fish, 322-333 (2013).

Kenwyn B. Suttle et al., *How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids*, 14 Ecological Applications 969-974 (2004).

Frederick J. Swanson et al., *Mass Failures and Other Processes of Sediment Production in Pacific Northwest Forest Landscapes*, *in* Streamside Management: Forestry and Fishery Interactions, 9–38 (E.O. Salo & T.W. Cundy eds., 1986).

J.V. Tagart, *Coho Salmon Survival from Egg Deposition to Fry Emergence*, *in* Proceedings of the Olympic Wild Fish Conference, 173-181 (1984).

Robert B. Thomas & Walter F. Megahan, *Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon: A Second Opinion*, 34 Water Resources Res., 3393-3404 (1998).

P.J. Tschaplinski, *The Effects of Forest Harvesting, Fishing, Climate Variation, and Ocean Conditions on Salmonid Populations of Carnation Creek, Vancouver Island, British Columbia*, *in* Sustainable Fisheries Mgmt.: Pacific Salmon, 297-327 (E. Knudsen & D. McDonald eds., 2000).

Robin S. Waples, *Pacific Salmon, Oncorhynchus Spp., and the Definition of "Species" Under the Endangered Species Act*, 53 Marine Fisheries Rev., 11-22 (1991).

Robin S. Waples, *Evolutionarily Significant Units and the Conservation of Biological Diversity Under the Endangered Species Act*, 17 Am. Fisheries Soc'y Symp., 8-27 (1995).

Thomas M. Weaver & John J. Fraley, *A Method to Measure Emergence Success of Westslope Cutthroat Trout Fry from Varying Substrate Compositions in a Natural Stream Channel*, 13 N. Am. J. Fisheries Mgmt., 817-822 (1993).

Beverly C. Wemple et al., *Channel Network Extension by Logging Roads in Two Basins, Western Cascades, Oregon*, 32 AWRA Water Resources Bull., 1195-1207 (1996).

Beverly C. Wemple et al., *Forest Roads and Geomorphic Process Interactions, Cascade Range, Oregon*, 26 Earth Surface Processes and Landforms, 191-204 (2001).

Kara A. Whittaker & Dan McShane, *Comparison of Slope Instability Screening Tools Following a Large Storm Event and Application to Forest Management and Policy*, 145-146 Geomorphology, 115-122 (2012).

Larry D. Witzel & Hugh R. MacCrimmon, *Role of Gravel Substrate on Ova Survival and Alevin Emergence of Rainbow Trout, Salmo gairdneri,* 59 Can. J. Zoology, 629-636 (1981).

Nicolas P. Zégre, *Local and Downstream Effects of Contemporary Forest Harvesting on Streamflow and Sediment Yield* (unpublished Ph.D. dissertation, Oregon State University) (2008).

Alan D. Ziegler et al., *Interstorm Surface Preparation and Sediment Detachment by Vehicle Traffic on Unpaved Mountain Roads*, 26 Earth Surface Processes and Landforms, 235-250 (2001).

EXHIBIT A

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Employment:

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1990-2000	Associate Professor, School of Fisheries,
1992-1995	Associate Director for Instruction, School of Fisheries
1986-1990	Assistant Professor, School of Fisheries, Univ. of Washington
1984-1985	Research Associate, Department of Oceanography, University of British Columbia, Vancouver, B.C.
1981-1984	Post-doctoral Fellow, University of British Columbia and Pacific Biological Station, Nanaimo, B. C., Canada

Research Interests:

Behavior, ecology, and evolution of fishes, with emphasis on migrations, life history patterns, reproduction, habitat requirements, and conservation of salmon and trout

Honors:

College of Ocean and Fishery Sciences Undergraduate Teaching Award, 1989
Distinguished Teaching Award, University of Washington, 1991
Marsha Landolt Distinguished Graduate Mentor Award, University of Washington, 2008
Excellence in Fisheries Education Award, American Fisheries Society, 2010
National Research Council panel "The Status of Pacific Northwest Anadromous Salmonids"
College of Ocean and Fishery Sciences Distinguished Research Award 1998
Fulbright Fellowship to study in Ireland, 2000
Elected member, Washington State Academy of Sciences, 2010
Carl R. Sullivan Fisheries Conservation Award, 2012, from the American Fisheries Society to the Alaska Salmon Program, of which I have been a member since 1987
National Research Council panel "Ecological Risk Assessment Under FIFRA and ESA"
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Publications

1978

Quinn, T., G.W. Esch, T.C. Hazen and J.W. Gibbons. 1978. Long range movement and homing by largemouth bass (*Micropterus salmoides*) in a thermally altered reservoir. Copeia 1978: 542-545.

Quinn, T.P. 1978. The role of the odors of conspecifics in the locomotor behavior of the blind cave characin, *Astyanax jordani*. Master's thesis, University of Washington.

1980

Quinn, T.P. 1980. Locomotor responses of juvenile blind cave fish, *Astyanax jordani*, to the odors of conspecifics. Behavioral and Neural Biology 29: 123-127.

Quinn, T.P. 1980. Evidence for celestial and magnetic compass orientation in lake migrating sockeye salmon fry. Journal of Comparative Physiology 137: 243-248.

Quinn, T.P., B.S. Miller and R.C. Wingert. 1980. Depth distribution and seasonal and diel movements of ratfish, *Hydrolagus colliei*, in Puget Sound, Washington. Fishery Bulletin 78: 816-821.

1981

Brannon, E.L., T.P. Quinn, G.L. Lucchetti and B.D. Ross. 1981. Compass orientation of sockeye salmon from a complex river system. Canadian Journal of Zoology 59: 1548-1553.

Quinn, T.P. 1981. Compass orientation of juvenile sockeye salmon (*Oncorhynchus nerka*). Doctoral dissertation, University of Washington.

Quinn, T.P., R.T. Merrill and E.L. Brannon. 1981. Magnetic field detection in sockeye salmon. Journal of Experimental Zoology 217: 137-142.

1982

Quinn, T.P. and E.L. Brannon. 1982. The use of celestial and magnetic cues by orienting sockeye salmon smolts. Journal of Comparative Physiology 147: 547-552.

Quinn, T.P. 1982. A model for salmon navigation on the high seas. In: E.L. Brannon and E.O. Salo (editors), Salmon and Trout Migratory Behavior Symposium. School of Fisheries, University of Washington, pp. 229-237.

Quinn, T.P. 1982. Intra-specific differences in sockeye salmon fry compass orientation mechanisms. In: E.L. Brannon and E.O. Salo (editors), Salmon and Trout Migratory Behavior Symposium. School of Fisheries, University of Washington, pp. 79-85.

Whitman, R.P., T.P. Quinn and E.L. Brannon. 1982. The influence of suspended volcanic ash on the homing behavior of adult chinook salmon. Transactions of the American Fisheries Society 111: 63-69.

1983

Quinn, T.P., E.L. Brannon and R.P. Whitman. 1983. Pheromones and the water source preferences of adult coho salmon (*Oncorhynchus kisutch*). Journal of Fish Biology 22: 677-684.

Quinn, T.P. and C. Groot. 1983. Orientation of chum salmon (*Oncorhynchus keta*) after internal and external magnetic field alteration. Canadian Journal of Fisheries and Aquatic Sciences 40: 1598-1606.

1984

Brannon, E.L., R.P. Whitman and T.P. Quinn. 1984. Responses of returning adult coho salmon to home water and population-specific odors. Transactions of the American Fisheries Society 113: 374-377.

Ogden, J.C. and T.P. Quinn. 1984. Migration in coral reef fishes: Ecological significance and orientation mechanisms. In: J.D. McCleave, G.P. Arnold, J.J. Dodson and W.H. Neill (editors), Mechanisms of Migration in Fishes. Plenum Press, New York, pp. 293-308.

Quinn, T.P. 1984. An experimental approach to fish compass and map orientation. In: J.D. McCleave, G.P. Arnold, J.J. Dodson and W.H. Neill (editors), Mechanisms of Migration in Fishes. Plenum Press, New York, pp. 113-123.

Quinn, T.P. 1984. Homing and straying in Pacific salmon. In: J.D. McCleave, G.P. Arnold, J.J. Dodson and W.H. Neill (editors), Mechanisms of Migration in Fishes. Plenum Press, New York, pp. 357-362.

Quinn, T.P. and C. Groot. 1984. The effect of water flow rate on bimodal orientation of juvenile chum salmon, *Oncorhynchus keta*. Animal Behaviour 32: 628-629.

Quinn, T.P. and J.C. Ogden. 1984. Field evidence of compass orientation in migrating juvenile grunts (Haemulidae). Journal of Experimental Marine Biology and Ecology 81: 181-192.

Quinn, T.P. and K. Fresh. 1984. Homing and straying in chinook salmon (*Oncorhynchus tshawytscha*) from Cowlitz River Hatchery, Washington. Canadian Journal of Fisheries and Aquatic Sciences 41: 1078-1082.

Quinn, T.P. and C. Groot. 1984. Pacific salmon (*Oncorhynchus*) migrations: Orientation vs. random movement. Canadian Journal of Fisheries and Aquatic Sciences 41: 1319-1324.

1985

Quinn, T.P. and C.A. Busack. 1985. Chemosensory recognition of siblings in juvenile coho salmon (*Oncorhynchus kisutch*). Animal Behaviour 33: 51-56.

Quinn, T.P. 1985. Salmon homing: Is the puzzle complete? Review of A.D. Hasler and A.T. Scholz, Olfactory Imprinting and Homing in Salmon. Environmental Biology of Fishes 12: 315-317.

Quinn, T.P. 1985. Homing and the evolution of sockeye salmon, *Oncorhynchus nerka*. In: M.A. Rankin (editor), Migrations: Mechanisms and Adaptive Significance. Contributions in Marine Science, Supplement to Vol. 27: 353-366.

1986

Brannon, E.L., T.P. Quinn, R.P. Whitman, A.E. Nevissi, R.E. Nakatani and C. D. McAuliffe. 1986. The homing of adult chinook salmon after brief exposure to whole and dispersed crude oil. Transactions of the American Fisheries Society 115: 823-827.

Groot, C., T.P. Quinn and T.J. Hara. 1986. Responses of migrating adult sockeye salmon (*Oncorhynchus nerka*) to population-specific odors. Canadian Journal of Zoology 64: 926-932.

Quinn, T.P. and G.M Tolson. 1986. Evidence of chemically mediated population recognition in coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Zoology 64: 84-87.

Quinn, T.P. and T.J. Hara. 1986. Sibling recognition and olfactory sensitivity in juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Zoology 64: 921-925.

Quinn, T.P., K.D. Cooke and G. Ellis. 1986. The responses of adult sockeye salmon (*Oncorhynchus nerka*) to a commercial purse seine. Canadian Technical Report of Fisheries and Aquatic Sciences 1511: 13 p.

Quinn, T.P. 1986. Review of McKeown, B.A., Fish Migration, and Smith, R.J.F., The Control of Fish Migration. Copeia 1986: 268-269.

1987

Groot, C. and T.P. Quinn. 1987. The homing migration of sockeye salmon to the Fraser River. Fishery Bulletin 85: 455-469.

Matthews, K.R., B.S. Miller and T.P. Quinn. 1987. Movement studies of nearshore demersal rockfishes in Puget Sound, Washington. Proceedings of the Lowell Wakefield International Rockfish Symposium, Anchorage, Alaska, pp. 63-72.

Quinn, T.P. and R.F. Tallman. 1987. Seasonal environmental predictability and homing in riverine fishes. Environmental Biology of Fishes 18: 155-159.

Quinn, T.P. and W.C. Leggett. 1987. Perspectives on the marine migrations of diadromous fishes. American Fisheries Society Symposium 1: 377-388

Quinn, T.P. and B.A. terHart. 1987. Movements of adult sockeye salmon (*Oncorhynchus nerka*) in British Columbia coastal waters in relation to temperature and salinity stratification: Ultrasonic telemetry results. Canadian Special Publication in Fisheries and Aquatic Sciences 96: 61-77.

Quinn, T.P., C.C. Wood, L. Margolis, B. Riddell and K.D. Hyatt. 1987. Homing in wild sockeye salmon (*Oncorhynchus nerka*) populations as inferred from differences in parasite prevalence and allozyme allele frequencies. Canadian Journal of Fisheries and Aquatic Sciences 44: 1963-1971.

1988

Journal of Experimental Biology 140: 51-63.

McIsaac, D.O. and T.P. Quinn. 1988. Evidence for a hereditary component in homing behavior of chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 45: 2201-2205.

Quinn, T.P., A.F. Olson and J.T. Konecki. 1988. Effects of anaesthesia on the chemosensory behaviour of Pacific salmon. Journal of Fish Biology 33: 637-641.

Quinn, T.P. 1988. Estimated swimming speeds of migrating adult sockeye salmon. Canadian Journal of Zoology 66: 2160-2163.

Walker, M.M., T.P. Quinn, J.L. Kirschvink and C. Groot. 1988. Production of single-domain magnetite throughout life by sockeye salmon, *Oncorhynchus nerka*.

1989

Brannon, E.L. and T.P. Quinn. 1989. Odor cues used by homing coho salmon. In: E.L. Brannon and B. Jonsson (editors), Salmon and Trout Migratory Behavior Symposium. pp. 30-34.

Moser, M.L., A.F. Olson and T.P. Quinn. 1989. Migratory behavior of coho salmon smolts (*Oncorhynchus kisutch*) in Grays Harbor, Washington. Proceedings of the 1988 Chinook and Coho Salmon Workshop. pp. 220-226.

Quinn, T.P. and S. Courtenay. 1989. Intraspecific chemosensory discrimination in salmonid fishes: Alternative explanations. In: E.L. Brannon and B. Jonsson (editors), Salmon and Trout Migratory Behavior Symposium. pp. 35-41.

Quinn, T.P., E.L. Brannon and A.H. Dittman. 1989. Spatial aspects of imprinting and homing by coho salmon (*Oncorhynchus kisutch*). Fishery Bulletin 87: 769-774.

Quinn, T.P. 1989. Review of McDowall, R.M., Diadromy in Fishes. Quarterly Review of Biology 64: 358-359.

Quinn, T.P. and J.T. Light. 1989. Occurrence of threespine sticklebacks (*Gasterosteus aculeatus*) in the open North Pacific Ocean: migration or drift? Canadian Journal of Zoology 67: 2850-2852.

Quinn, T.P. 1989. Current controversies in the study of marine migration. Review of Herrnkind, W.F. and A.B. Thistle (eds.) Signposts in the Sea. Environmental Biology of Fishes 26: 311-313.

Quinn, T.P., B.A. terHart and C. Groot. 1989. Migratory orientation and vertical movements of homing adult sockeye salmon (*Oncorhynchus nerka*) in coastal waters. Animal Behaviour 37: 587-599.

1990

Brannon, E.L. and T.P. Quinn. 1990. A field test of the pheromone hypothesis for homing by Pacific salmon. Journal of Chemical Ecology 16: 603-609.

Matthews, K.R., T.P. Quinn and B.S. Miller. 1990. The application of ultrasonic transmitters to demersal rockfish movement research on shallow rocky reefs in Puget Sound, Washington. American Fisheries Society Symposium 7: 375-379.

Moser, M.L., A.F. Olson and T.P. Quinn. 1990. Effects of dummy ultrasonic transmitters on juvenile coho salmon. American Fisheries Society Symposium 7: 353-356.

Quinn, T.P. 1990. Current controversies in the study of salmon homing. Ethology, Ecology and Evolution 2: 49-63.

Quinn, T.P. and A.H. Dittman. 1990. Pacific salmon migrations and homing: mechanisms and adaptive significance. Trends in Ecology and Evolution 5: 174-177.

Quinn, T. P. 1990. Migratory behavior of Pacific salmon in estuaries: recent results with ultrasonic telemetry. In: C. A. Simenstad (editor), Effects of Dredging on Anadromous Pacific Coast Fishes. Washington Sea Grant, Seattle, Washington, pp. 13-25.

Ruggerone, G.T., T.P. Quinn, I.A. McGregor and T.S. Wilkinson. 1990. Horizontal and vertical movements of adult steelhead trout, *Oncorhynchus mykiss*, in Dean and Fisher channels, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 47: 1963-1969.

1991

Berman, C.H. and T.P. Quinn. 1991. Behavioural thermoregulation and homing by spring chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), in the Yakima River. Journal of Fish Biology 39: 301-312.

Blair, G.R. and T.P. Quinn. 1991. Homing and spawning site selection by sockeye salmon (*Oncorhynchus nerka*) in Iliamna Lake, Alaska. Canadian Journal of Zoology 69: 176-181.

Moser, M.L., A.F. Olson and T.P. Quinn. 1991. Riverine and estuarine migratory behavior of coho salmon (*Oncorhynchus kisutch*) smolts. Canadian Journal of Fisheries and Aquatic Sciences 48: 1670-1678.

Pascual, M. A. and T. P. Quinn. 1991. Evaluation of alternative models of the coastal migration of adult Fraser River sockeye salmon (*Oncorhynchus nerka*). Canadian Journal of Fisheries and Aquatic Sciences 48: 799-810.

Quinn, T.P. 1991. Models of Pacific salmon orientation and navigation on the open ocean. Journal of Theoretical Biology 150: 539-545.

Quinn, T.P. and R.D. Brodeur. 1991. Intra-specific variations in the movement patterns of marine animals. American Zoologist 31: 231-241.

Quinn, T.P., R.S. Nemeth and D. O. McIsaac. 1991. Patterns of homing and straying by fall chinook salmon in the lower Columbia River. Transactions of the American Fisheries Society 120: 150-156.

1992

Bisson, P.A., T.P. Quinn, G.H. Reeves and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. In: Watershed Management. R.J. Naiman (editor). Springer-Verlag, pp.189-232.

Quinn, T.P. 1992. Book Review of Groot, C. and L. Margolis (editors) Pacific Salmon Life Histories. Copeia 1992: 927-928.

Quinn, T.P. and A.H. Dittman. 1992. Fishes. In: Animal Homing. F. Papi (editor). Chapman and Hall, pp.145-211.

Quinn, T. P. and G.R. Blair. 1992. Morphological changes in senescing adult male sockeye salmon (*Oncorhynchus nerka* Walbaum). Journal of Fish Biology 41: 1045-1047.

Quinn, T P. and S. Bloomberg. 1992. Fecundity of chinook salmon (*Oncorhynchus tshawytscha*) from the Waitaki and Rakaia rivers. New Zealand Journal of Marine and Freshwater Research 26: 429-434.

1993

Blair, G.R., D.E. Rogers and T.P. Quinn. 1993. Variation in life history characteristics and morphology of sockeye salmon (*Oncorhynchus nerka*) in the Kvichak River system, Bristol Bay, Alaska. Transactions of the American Fisheries Society 122: 550-559.

Olson, A.F. and T.P. Quinn. 1993. Vertical and horizontal movements of adult chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River estuary. Fishery Bulletin 91: 171-178.

Quinn, T.P. 1993. Review of Pearcy, W.G. Ocean Ecology of North Pacific Salmonids. Transactions of the American Fisheries Society 122: 513-514.

Quinn, T.P. 1993. A review of homing and straying of wild and hatchery-produced salmon. Fisheries Research 18: 29-44.
Quinn, T. P. and M. J. Unwin. 1993. Life history patterns of New Zealand chinook salmon (*Oncorhynchus tshawytscha*) populations. Canadian Journal of Fisheries and Aquatic Sciences 50: 1414-1421.
Unwin, M. J. and T. P. Quinn. 1993. Homing and straying patterns of chinook salmon (*Oncorhynchus tshawytscha*) from a New Zealand hatchery: spatial distribution of strays and effects of release date. Canadian Journal of Fisheries and Aquatic Sciences 50: 1168-1175.

1994

Dittman, A.H. and T.P. Quinn. 1994. Avoidance of a putative pheromone, 17a,20b-dihydroxy-4-pregnene-3-one, by precociously mature chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Zoology 72: 215-219.
Dittman, A.H., T.P. Quinn, W.W. Dickhoff and D.A. Larsen. 1994. Interactions between novel water, thyroxine and olfactory imprinting in underyearling coho salmon (*Oncorhynchus kisutch*, Walbaum). Aquaculture and Fisheries Management 25 (Supplement 2): 157-169.
Nevitt, G.A., A.H. Dittman, T.P. Quinn and W.J. Moody, Jr. 1994. Evidence for a peripheral olfactory memory in imprinted salmon. Proceedings of the National Academy of Science. 91: 4288-4292.
Pascual, M.A. and T.P. Quinn. 1994. Geographical patterns of straying of fall chinook salmon (*Oncorhynchus tshawytscha*) from Columbia River (U.S.A.) hatcheries. Aquaculture and Fisheries Management 25 (Supplement 2): 17-30.
Peterson, N.P., E.F. Prentice and T.P. Quinn. 1994. Comparison of sequential coded-wire and passive integrated transponder tags for assessing overwinter growth and survival of juvenile coho salmon. North American Journal of Fisheries Management 14: 870-873.
Quinn, T.P. 1994. Review of Cloud, J.G. and Thorgaard, G.H., Genetic Conservation of Salmonid Fishes. Animal Behavior 48: 1489-1490.
Quinn, T.P. 1994. How do sharks orient at sea? Trends in Ecology and Evolution 9: 277-278.
Quinn, T.P. 1994. Anthropogenic influences on fish populations of the Georgia Basin. Part I: Salmonids. In: Review of the Marine Environment and Biota of Strait of Georgia, Puget Sound and Juan de Fuca Strait. Canadian Technical Report of Fisheries and Aquatic Sciences 1948: 219-229.
Quinn, T. P. and C. J. Foote. 1994. The effects of body size and sexual dimorphism on the reproductive behaviour of sockeye salmon (*Oncorhynchus nerka*). Animal Behaviour 48: 751-761.
Quinn, T.P., A.H. Dittman, N.P. Peterson and E.C. Volk. 1994. Distribution, survival and growth of sibling groups of juvenile coho salmon, *Oncorhynchus kisutch*, in an experimental stream channel. Canadian Journal of Zoology 72: 2119-2123.
Varnavskaya, N.V., C.C. Wood, R.J. Everett, R.L. Wilmot, V.S. Varnavsky. V.V. Midanaya and T.P. Quinn. 1994. Genetic differentiation of subpopulations of sockeye salmon (*Oncorhynchus nerka*) within lakes of Alaska, British Columbia

and Kamchatka, Russia. Canadian Journal of Fisheries and Aquatic Sciences 51 (Supplement 1): 147-157.

1995

Adkison, M.D., T.P. Quinn and O. Rutten. 1995. An inexpensive, non-disruptive method of in situ dart tagging for visual recognition of fish underwater. North American Journal of Fisheries Management 15: 507-511.

Berg, O.K., C.J. Foote and T.P. Quinn. 1995. Fish age, nematode, *Philonema oncorhynchi*, infection and development of sexual dimorphism by the adult male sockeye salmon, *Oncorhynchus nerka*, in western Alaska. Canadian Journal of Zoology 73: 1999-2004.

Hendry, A.P., F.E. Leonetti and T.P. Quinn. 1995. Spatial and temporal isolating mechanisms: the formation of discrete breeding aggregations of sockeye salmon (*Oncorhynchus nerka*). Canadian Journal of Zoology 73: 339-352.

Konecki, J.T., C.A. Woody and T.P. Quinn. 1995. Influence of temperature on incubation rates of coho salmon (*Oncorhynchus kisutch*) from ten Washington populations. Northwest Science 69: 126-132.

Konecki, J.T., C.A. Woody and T.P. Quinn. 1995. Critical thermal maxima of coho salmon (*Oncorhynchus kisutch*) fry under field and laboratory acclimation regimes. Canadian Journal of Zoology 73: 993-996.

Konecki, J.T., C.A. Woody and T.P. Quinn. 1995. Temperature preference in two populations of juvenile coho salmon (*Oncorhynchus kisutch*). Environmental Biology of Fishes 44: 417-421.

Lonzarich, D.G. and T.P. Quinn. 1995. Experimental evidence for the effect of depth and structure on the distribution, growth and survival of stream fishes. Canadian Journal of Zoology 73: 2223-2230.

Pascual, M.A., T.P. Quinn and H. Fuss. 1995. Factors affecting the homing of Columbia River hatchery-produced fall chinook salmon. Transactions of the American Fisheries Society 124: 308-320.

Quinn, T.P. 1995. Review of Cone, J. A Common Fate: Endangered Salmon and the People of the Pacific Northwest. Illahee, Journal of the Northwest Environment 11: 106-107.

Quinn, T.P., A.P. Hendry and L.A. Wetzel. 1995. The influence of life history trade-offs and the size of incubation gravels on egg size variation in sockeye salmon (*Oncorhynchus nerka*). Oikos 74: 425-438.

Roni, P. and T.P. Quinn. 1995. Geographic variation in size and age of North American chinook salmon (*Oncorhynchus tshawytscha*). North American Journal of Fisheries Management 15: 325-345.

Spalding, S., N.P. Peterson and T.P. Quinn. 1995. Summer distribution, survival and growth of juvenile coho salmon *Oncorhynchus kisutch* under varying experimental conditions of brushy in-stream cover. Transactions of the American Fisheries Society 124: 124-130.

Warner, E.J. and T.P. Quinn. 1995. The horizontal and vertical movements of telemetered rainbow trout (*Oncorhynchus mykiss*) in Lake Washington. Canadian Journal of Zoology 73: 146-153.

1996

Berejekian, B.A., S.B. Mathews and T.P. Quinn. 1996. The effects of hatchery and wild ancestry and rearing environments on the development of agonistic behavior in steelhead trout (*Oncorhynchus mykiss*) fry. Canadian Journal of Fisheries and Aquatic Sciences 53: 2004-2014.

Candy, J.R., E.W. Carter, T.P. Quinn and B.R. Riddell. 1996. Adult chinook salmon behavior and survival after catch and release from purse-seine vessels in Johnstone Strait, British Columbia. North American Journal of Fisheries Management 16: 521-529.

Dittman, A.H. and T.P. Quinn. 1996. Homing in Pacific salmon: mechanisms and ecological basis. Journal of Experimental Biology 199: 83-91.

Dittman, A.H., T.P. Quinn and G.A. Nevitt. 1996. Timing of imprinting to natural and artificial odors by coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 53: 434-442.

Hawkins, D.K. and T.P. Quinn. 1996. Critical swimming velocity and associated morphology of juvenile coastal cutthroat trout (*Oncorhynchus clarki clarki*), steelhead trout (*O. mykiss*) and their hybrids. Canadian Journal of Fisheries and Aquatic Sciences 53: 1487-1496.

Hendry, A.P., T.P. Quinn and F.M. Utter. 1996. Genetic evidence for the persistence and divergence of native and introduced populations of sockeye salmon (*Oncorhynchus nerka*) within Lake Washington, WA. Canadian Journal of Fisheries and Aquatic Sciences 53: 823-832.

Montgomery, D.R., J.M. Buffington, N.P. Peterson, D. Schuett-Hames and T.P. Quinn. 1996. Stream-bed scour, egg burial depths, and the influence of salmonid spawning on bed surface mobility and embryo survival. Canadian Journal of Fisheries and Aquatic Sciences 53: 1061-1070.

Peterson, N.P. and T.P. Quinn. 1996. Persistence of egg pocket architecture in redds of chum salmon (*Oncorhynchus keta*). Environmental Biology of Fishes 46: 243-253.

Peterson, N.P. and T.P. Quinn. 1996. Spatial and temporal variation in dissolved oxygen in natural egg pockets of chum salmon, *Oncorhynchus keta* (Walbaum), in Kennedy Creek, Washington. Journal of Fish Biology 48: 131-143.

Quinn, T.P., M.D. Adkison and M.B. Ward. 1996. Behavioral tactics of male sockeye salmon (*Oncorhynchus nerka*) under varying operational sex ratios. Ethology 102: 304-322.

Quinn, T.P. and D.J. Adams. 1996. Environmental changes affecting the migratory timing of American shad and sockeye salmon. Ecology 77: 1151-1162.

Quinn, T.P., J.L. Nielsen, C. Gan, M.J. Unwin, R. Wilmot, C. Guthrie, and F.M. Utter. 1996. Origin and genetic structure of chinook salmon (*Oncorhynchus tshawytscha*) transplanted from California to New Zealand: Allozyme and mtDNA evidence. Fishery Bulletin 94: 506-521.

Quinn, T.P., N.P. Peterson and S. Spalding. 1996. Effects of instream brush on juvenile coho salmon: Response to comment by C.C. Coutant. Transactions of the American Fisheries Society 125: 151-153.

Quinn, T.P. and N.P. Peterson. 1996. The influence of habitat complexity and fish size on over-winter survival and growth of individually-marked juvenile coho salmon

(*Oncorhynchus kisutch*) in Big Beef Creek, Washington. Canadian Journal of Fisheries and Aquatic Sciences 53: 1555-1564.

1997

Berg, O.K., M.D. Adkison and T.P. Quinn. 1997. Bilateral asymmetry, sexual dimorphism, and nematode parasites in mature male sockeye salmon *Oncorhynchus nerka*. Northwest Science 71: 305-312.

Courtenay, S.C., T.P. Quinn, H.M.C. Dupuis, C. Groot and P.A. Larkin. 1997. Factors affecting the recognition of population-specific odours by juvenile coho salmon (*Oncorhynchus kisutch*). Journal of Fish Biology 50: 1042-1060.

Dittman, A. H., T. P. Quinn, G. A. Nevitt, B. Hacker and D. R. Storm. 1997. Sensitization of olfactory guanylyl cyclase to a specific imprinted odorant in coho salmon. Neuron 19: 381-389.

Hendry, A.P. and T.P. Quinn. 1997. Variation in adult life history and morphology among Lake Washington sockeye salmon (*Oncorhynchus nerka*) populations, in relation to habitat features and ancestral affinities. Canadian Journal of Fisheries and Aquatic Sciences 54: 75-84.

Quinn, T.P. 1997. Review of “Migration: The Biology of Life on the Move” by Hugh Dingle. Quarterly Review of Biology 72: 232.

Quinn, T.P., S. Hodgson and C. Peven. 1997. Temperature, flow and the migration of adult sockeye salmon (*Oncorhynchus nerka*) in the Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 54: 1349-1360.

1998

Dittman, A.H., T.P. Quinn and E.C. Volk. 1998. Is the distribution, growth and survival of juvenile salmonids sex-biased? Negative results for coho salmon in an experimental stream channel. Journal of Fish Biology 53: 1360-1364.

Hansen, L.P. and T.P. Quinn. 1998. The marine phase of the Atlantic salmon (*Salmo salar*) life cycle, with comparisons to Pacific salmon. Canadian Journal of Fisheries and Aquatic Sciences 55 (Supplement 1): 104-118.

Kinnison, M., M. Unwin, N. Boustead and T. Quinn. 1998. Population-specific variation in body dimensions of adult chinook salmon (*Oncorhynchus tshawytscha*) from New Zealand and a related Sacramento River population, 90 years after introduction. Canadian Journal of Fisheries and Aquatic Sciences 55: 554-563.

Kinnison, M.T., M.J. Unwin, W.K. Hershberger and T.P. Quinn. 1998. Egg size, fecundity and early development rate of two New Zealand chinook salmon (*Oncorhynchus tshawytscha*) populations, with a comparison to their ancestral Sacramento River population. Canadian Journal of Fisheries and Aquatic Sciences 55: 1946-1953.

Kinnison, M.T., M.J. Unwin, and T.P. Quinn. 1998. Growth and salinity tolerance of juvenile chinook salmon (*Oncorhynchus tshawytscha*) from two introduced New Zealand populations. Canadian Journal of Zoology 76: 2219-2226.

Marschall, E.A., T.P. Quinn, D.A. Roff, J.A. Hutchings, N.B. Metcalfe, T.A. Bakke, R.L. Saunders and N.L. Poff. 1998. A framework for understanding Atlantic salmon (*Salmo salar*) life history. Canadian Journal of Fisheries and Aquatic Sciences 55 (Supplement 1): 48-58.

McCormick, S.D., L.P. Hansen, T.P. Quinn and R.L. Saunders. 1998. Movement, migration, and smolting of Atlantic salmon. Canadian Journal of Fisheries and Aquatic Sciences 55 (Supplement 1): 77-92.

McPhee, M.V. and T.P. Quinn. 1998. Factors affecting the duration of nest defense and reproductive lifespan of female sockeye salmon, *Oncorhynchus nerka*. Environmental Biology of Fishes 51: 369-375.

Quinn, T.P. and M.V. McPhee. 1998. Effects of senescence and density on the aggression of adult female sockeye salmon. Journal of Fish Biology 52: 1295-1300.

Quinn, T.P., E. Graynoth, C.C. Wood and C.J. Foote. 1998. Genotypic and phenotypic divergence of sockeye salmon in New Zealand from their ancestral British Columbia populations. Transactions of the American Fisheries Society 127: 517-534.

Rhodes, J.S. and T.P. Quinn. 1998. Factors affecting the outcome of territorial contests between hatchery and naturally reared coho salmon parr in the laboratory. Journal of Fish Biology 53: 1220-1230.

Spidle, A.P., T.P. Quinn and P. Bentzen. 1998. Sex-biased marine survival and growth in a population of coho salmon (*Oncorhynchus kisutch*). Journal of Fish Biology 52: 907-915.

1999

Candy, J.R. and T.P. Quinn. 1999. Behavior of adult chinook salmon (*Oncorhynchus tshawytscha*) in British Columbia coastal waters determined from ultrasonic telemetry. Canadian Journal of Zoology 77: 1161-1169.

Griffith, J.N., A.P. Hendry and T.P. Quinn. 1999. Exploratory behavior or straying: adult sockeye salmon (*Oncorhynchus nerka*) entering a non-natal hatchery. Fishery Bulletin 97: 713-716.

Hendry, A.P., O.K. Berg and T.P. Quinn. 1999. Breeding date, life history, and energy allocation in a population of sockeye salmon (*Oncorhynchus nerka*). Oikos 85: 499-514.

Montgomery, D.R., E.M. Beamer, G. Pess and T.P. Quinn. 1999. Channel type and salmon spawning distribution. Canadian Journal of Fisheries and Aquatic Sciences 56: 377-387.

Quinn, T.P. 1999. Variation in Pacific salmon reproductive behaviour associated with species, sex and levels of competition. Behaviour 136: 179-204.

Quinn, T.P., E.C. Volk and A.P. Hendry. 1999. Natural otolith microstructure patterns reveal precise homing to natal incubation sites by sockeye salmon (*Oncorhynchus nerka*). Canadian Journal of Zoology 77: 766-775.

Quinn, T.P. 1999. Revisiting the stock concept in Pacific salmon: insights from Alaska and New Zealand. Northwest Science 73: 312-324

Quinn, T.P. and M.T. Kinnison. 1999. Size-selective and sex-selective predation by brown bears on sockeye salmon. Oecologia 121: 273-282.

Rhodes, J.S. and T.P. Quinn. 1999. Comparative performance of genetically similar hatchery and naturally-reared juvenile coho salmon in streams. North American Journal of Fisheries Management 19: 670-677.

Steen, R.P. and T.P. Quinn. 1999. Egg burial depth by sockeye salmon (*Oncorhynchus nerka*): implications for survival of embryos and natural selection on female body size. Canadian Journal of Zoology 77: 836-841.

Unwin, M.J., M.T. Kinnison and T. P. Quinn. 1999. Exceptions to semelparity: postmaturation survival, morphology and energetics of male chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 56: 1172-1181.

2000

Essington, T.E., T.P. Quinn and V.E. Ewert. 2000. Intra- and interspecific competition and the reproductive success of sympatric Pacific salmon. Canadian Journal of Fisheries and Aquatic Sciences 57: 205-213.

Hendry, A.P., J. K. Wenburg, P. Bentzen, E. C. Volk and T. P. Quinn. 2000. Rapid evolution of reproductive isolation in the wild: evidence from introduced salmon. Science 290: 516-518.

Quinn, T.P. and G.B. Buck. 2000. Scavenging by brown bears, *Ursus arctos*, and glaucous-winged gulls, *Larus glaucescens*, on adult sockeye salmon, *Oncorhynchus nerka.* Canadian Field-Naturalist 114: 217-223.

Quinn, T. P., M. J. Unwin, and M. T. Kinnison. 2000. Evolution of temporal isolation in the wild: genetic divergence in timing of migration and breeding by introduced chinook salmon populations. Evolution 54: 1372-1385.

Scholz, N. L., N. K. Truelove, B. L. French, B. A. Berejekian, T. P. Quinn, E. Casillas and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behavior in chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 57: 1911-1918.

Schuett-Hames, D. E., N. P. Peterson, R. Conrad and T. P. Quinn. 2000. Patterns of gravel scour and fill after spawning by chum salmon in a western Washington stream. North American Journal of Fisheries Management 20: 610-617.

Unwin, M. J., T. P. Quinn, M.T. Kinnison and N.C. Boustead. 2000. Divergence in juvenile growth and life history in two recently colonized and partially isolated chinook salmon populations. Journal of Fish Biology 57: 943-960.

2001

Barry, T. P., M. J. Unwin, J.A. Malison and T. P. Quinn. 2001. Free and total cortisol levels in semelparous and iteroparous chinook salmon. Journal of Fish Biology 59: 1673-1676.

Bentzen, P., J. B Olsen, J. McLean, T. R. Seamons, and T. P Quinn. 2001. Kinship analysis of Pacific salmon: insights into mating, homing and timing of reproduction. Journal of Heredity 92: 127-136.

Courtenay, S. C., T. P. Quinn, H. M. C. Dupuis, C. Groot and P. A. Larkin. 2001. Discrimination of family-specific odours by juvenile coho salmon (*Oncorhynchus kisutch*): roles of learning and odour concentration. Journal of Fish Biology 58: 107-125.

Gende, S. M., T. P. Quinn and M. F. Willson. 2001. Consumption choice by bears feeding on salmon. Oecologia 127: 372-382.

Hendry, A. P., O. K. Berg and T. P. Quinn. 2001. Breeding location choice in salmon: causes (habitat, competition, body size, energy stores) and consequences (life span, energy stores). Oikos 93: 407-418.

Kahler, T. H., P. Roni and T. P. Quinn. 2001. Summer movement and growth of juvenile anadromous salmonids in small western Washington streams. Canadian Journal of Fisheries and Aquatic Sciences 58: 1947-1956.

Kinnison, M. T., M. J. Unwin, A. P. Hendry, and T. P. Quinn. 2001. Migratory costs and the evolution of egg size and number allocation in new and indigenous salmon populations. Evolution 55: 1656-1667.

Mackey, G., J. E. McLean and T. P. Quinn. 2001. Comparisons of run timing, spatial distribution, and length of wild and newly-established hatchery populations of steelhead in Forks Creek, Washington. North American Journal of Fisheries Management 21: 717-724.

Quinn, T. P. and G. B. Buck. 2001. Size and sex selective mortality on adult Pacific salmon: bears, gulls and fish out of water. Transactions of the American Fisheries Society 130: 995-1005.

Quinn, T.P., Hendry, A.P., and Buck, G.B. 2001. Balancing natural and sexual selection in sockeye salmon: interactions between body size, reproductive opportunity and vulnerability to predation by bears. Evolutionary Ecology Research 3: 917-937.

Quinn, T. P., L. Wetzel, S. Bishop, K. Overberg and D. E. Rogers. 2001. Influence of breeding habitat on bear predation, and age at maturity and sexual dimorphism of sockeye salmon populations. Canadian Journal of Zoology 79: 1782-1793.

Quinn, T. P., M. T. Kinnison and M. J. Unwin. 2001. Evolution of chinook salmon (*Oncorhynchus tshawytscha*) populations in New Zealand: pattern, rate, and process. Genetica 112/113: 493-513.

Quinn, T.P. 2001. Review of: Sustainable Fisheries Management: Pacific salmon. Edited by E. E. Knutson, C. R. Steward, D. D. MacDonald, J. E. Williams, and D. W. Reiser. Copeia 2001: 1174-1175.

Roni, P. and T. P. Quinn. 2001. Density and size of juvenile salmonids in response to placement of large woody debris in western Oregon and Washington streams. Canadian Journal of Fisheries and Aquatic Sciences 58: 282-292.

Roni, P. and T. P. Quinn. 2001. Effects of wood placement on movements of trout and juvenile coho salmon in natural and artificial stream channels. Transactions of the American Fisheries Society 130: 675-685.

2002

Dickerson, B. R., M. F. Willson and T. P. Quinn. 2002. Body size, arrival date, and reproductive success of pink salmon, *Oncorhynchus gorbuscha*. Ethology, Ecology and Evolution 14: 29-44.

Hodgson, S. and T. P. Quinn. 2002. The timing of adult sockeye salmon migration into fresh water: adaptations by populations to prevailing thermal regimes. Canadian Journal of Zoology 80: 542-555.

Kinnison, M. T., P. Bentzen, M. J. Unwin and T. P. Quinn. 2002. Reconstructing recent divergence: evaluating non-equilibrium population structure in New Zealand chinook salmon. Molecular Ecology 11: 739-754.

Nowak, G. M. and T. P. Quinn. 2002. Diel and seasonal patterns of horizontal and vertical movements of telemetered cutthroat trout (*Oncorhynchus clarki*) in Lake Washington, Washington. Transactions of the American Fisheries Society 131: 452-462.

Quinn, T. P., J. A. Peterson, V. Gallucci, W. K. Hershberger, and E. L. Brannon. 2002. Artificial selection and environmental change: countervailing factors affecting the timing of spawning by coho and chinook salmon. Transactions of the American Fisheries Society 131: 591-598.

Robards, M. D. and T. P. Quinn. 2002. The migratory timing of adult summer-run steelhead trout (*Oncorhynchus mykiss*) in the Columbia River: Six decades of environmental change. Transactions of the American Fisheries Society 131: 523-536.

2003

Hilborn, R., T. P. Quinn, D. E. Schindler and D. E. Rogers. 2003. Biocomplexity and fisheries sustainability. Proceedings of the National Academy of Science 100: 6564-8568.

Kinnison, M. T., M. J. Unwin and T. P. Quinn. 2003. Migratory costs and contemporary evolution of reproductive allocation in male chinook salmon. Journal of Evolutionary Biology 16: 1257-1269.

McLean, J. E., Bentzen, P., and Quinn, T. P. 2003. Differential reproductive success of sympatric, naturally-spawning hatchery and wild steelhead trout (*Oncorhynchus mykiss*) through the adult stage. Canadian Journal of Fisheries and Aquatic Sciences 60: 433-440.

Quinn, T. P. 2003. Review of Migration of Freshwater Fishes. By: Martyn C. Lucas and Etienne Baras. The Quarterly Review of Biology 78: 490-491.

Quinn, T.P., S. M. Gende, G. T. Ruggerone and D. E. Rogers. 2003. Density dependent predation by brown bears (*Ursus arctos*) on sockeye salmon (*Oncorhynchus nerka*). Canadian Journal of Fisheries and Aquatic Sciences 60: 553-562.

Stewart, I. J., R. Hilborn, and T. P. Quinn. 2003. Coherence of observed adult sockeye salmon abundance within and among spawning habitats in the Kvichak River watershed. Alaska Fishery Research Bulletin 10: 28-41.

Stewart, I. S., T. P. Quinn and P. Bentzen. 2003. Evidence for fine-scale natal homing among island beach spawning sockeye salmon, *Oncorhynchus nerka.* Environmental Biology of Fishes 67: 77-85.

Unwin, M. J., M. T. Kinnison, N. C. Boustead and T. P. Quinn. 2003. Genetic control over survival in Pacific salmon (*Oncorhynchus* spp.): experimental evidence between and within populations of New Zealand chinook salmon (*O. tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 60: 1-11.

Vøllestad, L. A. and T. P. Quinn. 2003. Trade-off between growth rate and aggression in juvenile coho salmon *Oncorhynchus kisutch.* Animal Behaviour 66: 561-568.

2004

Beauchamp, D. A., C. J. Sergeant, M. M. Mazur, J. M. Scheuerell, D. E. Schindler, M. D. Scheuerell, K. L. Fresh, D. E. Seiler, and T. P. Quinn. 2004. Spatial-temporal dynamics of early feeding demand and food supply by sockeye salmon fry in Lake Washington. Transactions of the American Fisheries Society 133: 1014-1032.

Boatright, C., T. Quinn and R. Hilborn. 2004. Timing of adult migration and stock structure of sockeye salmon in Bear Lake, Alaska. Transactions of the American Fisheries Society 133: 911-921.

Brannon, E. L., M. S. Powell, T. P. Quinn and A. Talbot. 2004. Population structure of Columbia River basin chinook salmon and steelhead trout. Reviews in Fisheries Science 12: 99-232.

Carlson, S. M., H. B. Rich, Jr. and T. P. Quinn. 2004. Reproductive lifespan and sources of mortality for alternative male life history strategies in sockeye salmon, *Oncorhynchus nerka.* Canadian Journal of Zoology 82: 1878-1885

Dickerson, B. R., M. F. Willson, P. Bentzen and T. P. Quinn. 2004. Size-assortative mating in salmonids: negative evidence for pink salmon in natural conditions. Animal Behaviour 68: 381-385.

Gende, S. M. and T. P. Quinn. 2004. The relative importance of prey density and social dominance in determining energy intake by bears feeding on Pacific salmon. Canadian Journal of Zoology 82: 75-85.

Gende, S. M., Quinn, T. P., Hilborn, R., Hendry, A. P., and B. Dickerson. 2004. Brown bears selectively kill salmon with higher energy content but only in habitats that facilitate choice. Oikos 104: 518-528.

Gende, S. M., T. P. Quinn, M. F. Willson, R. Heintz, and T. M. Scott. 2004. Magnitude and fate of salmon-derived nutrients and energy in a coastal stream ecosystem. Journal of Freshwater Ecology 19: 149-160.

Hendry, A. P., V. Castric, M. T. Kinnison, and T. P. Quinn. 2004. The evolution of philopatry and dispersal: homing versus straing in salmonids. Pages 52-91 in A. P. Hendry, and S. C. Stearns, editors. Evolution illuminated: salmon and their relatives. Oxford University Press, Oxford.

McLean, J. E., Bentzen, P., and Quinn, T. P. 2004. Differential reproductive success of sympatric, naturally spawning hatchery and wild steelhead (*Oncorhynchus mykiss*). Environmental Biology of Fishes 69: 359-369.

Nowak, G. M., R. A. Tabor, E. J. Warner, K. L. Fresh and T. P. Quinn. 2004. Ontogenetic shifts in habitat and diet of cutthroat trout in Lake Washington, Washington. North American Journal of Fisheries Management 24: 624-635.

Quinn, T. P. and K. W. Myers. 2004. Anadromy and the marine migrations of Pacific salmon and trout: Rounsefell revisited. Reviews in Fish Biology and Fisheries 14: 421-442.

Quinn, T. P., L. A. Vøllestad, J. Peterson and V. Gallucci. 2004. Influences of fresh water and marine growth on the egg size – egg number tradeoff in coho and chinook salmon. Transactions of the American Fisheries Society 133: 55-65.

Seamons, T. R., P. Bentzen and T. P. Quinn. 2004. The effects of adult length and arrival date on individual reproductive success in wild steelhead trout (*Oncorhynchus mykiss*) Canadian Journal of Fisheries and Aquatic Sciences 61:193-204.

Seamons,T. R., P. Bentzen and T. P. Quinn. 2004. The mating system of steelhead (*Oncorhynchus mykiss*), inferred by molecular analysis of parents and progeny. Environmental Biology of Fishes 69: 333-344.

Stewart, I. J., S. M. Carlson, C. P. Boatright, G. B. Buck, and T. P. Quinn. 2004. Site fidelity of spawning sockeye salmon (*Oncorhynchus nerka* W.) in the presence and absence of olfactory cues. Ecology of Freshwater Fishes 13: 104-110.

Vøllestad, L. A., J. Peterson and T. P. Quinn. 2004. Effects of fresh water and marine growth rates on early maturity in male coho and chinook salmon. Transactions of the American Fisheries Society 133: 495-503.

2005

Dickerson, B. R., K. W. Brinck, M. F. Willson, P. Bentzen and T. P. Quinn. 2005. Relative importance of body size and timing of arrival to breeding grounds in reproductive success of pink salmon. Ecology 86: 347-352.

Dickerson, B. R., M. F. Willson, P. Bentzen and T. P. Quinn. 2005. Heritability of life history and morphological traits in a wild pink salmon, *Oncorhynchus gorbuscha*, population assessed by DNA parentage analysis. Transactions of the American Fisheries Society 134: 1323-1328.

Magnuson, J. J. and T. P. Quinn. 2005. Arthur D. Hasler: He showed us the way. (obituary). Environmental Biology of Fishes 74: 67-77.

McLean, J. E., P. Bentzen, and T. P. Quinn. 2005. Nonrandom, size- and timing-biased breeding in a hatchery population of steelhead trout. Conservation Biology 19: 446-454.

Meehan, E. P., E. E. Seminet-Reneau and T. P. Quinn. 2005. Bear predation on Pacific salmon facilitates colonization of carcasses by fly maggots. American Midland Naturalist 153: 142-151.

Newell, J. C., and T. P. Quinn. 2005. Behavioral thermoregulation by maturing adult sockeye salmon (*Oncorhynchus nerka*) in a stratified lake prior to spawning. Canadian Journal of Zoology 83: 1232-1239

Quinn, T. P. 2005. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press, Seattle. 378 pages.

Quinn, T. P. 2005. Review of Inland Fishes of Washington, by Richard Wydoski and Richard Whitney. Quarterly Review of Biology 80: 128-129.

Quinn, T. P. 2005. Comment: Sperm competition in salmon hatcheries - The need to institutionalize genetically benign spawning protocols. Transactions of the American Fisheries Society 134: 1490-1494.

Quinn, T. P. 2005. Review of Atlas of Pacific Salmon, by Xanthippe Augerot. Integrative and Comparative Biology 45: 952

Quinn, T. P., B. R. Dickerson and L. A. Vøllestad. 2005. Marine survival and distribution patterns of two Puget Sound hatchery populations of coho (*Oncorhynchus kisutch*) and chinook (*O. tshawytscha*) salmon. Fisheries Research 76: 209-220

Robins, J. B., C. A. Abrey, T. P. Quinn and D. E. Rogers. 2005. Lacustrine growth of juvenile pink salmon, *Oncorhynchus gorbuscha*, and a comparison with sympatric sockeye salmon, *O. nerka*. Journal of Fish Biology 66: 1671-1680.

2006

Hauser, L., T. R. Seamons, M. Dauer, K.A. Naish, and T.P. Quinn. 2006. An empirical verification of population assignment methods with parentage data: hatchery and wild steelhead (*Oncorhynchus mykiss*) in Forks Creek, Washington, USA. Molecular Ecology 15: 3157-3173.

Hodgson, S., T. P. Quinn, R. Hilborn, R. C. Francis, and D. E. Rogers. 2006. Marine and freshwater climatic factors affecting interannual variation in the timing of return migration to fresh water of sockeye salmon. Fisheries Oceanography 15: 1-24.

Johnson, S. P., S. M. Carlson and T. P. Quinn. 2006. Tooth size and skin thickness in mature sockeye salmon: evidence for habitat constraints and variable investment between the sexes. Ecology of Freshwater Fish 15: 331-338.

Quinn, T. P., P. McGinnity and T. F. Cross. 2006. Long-term declines in body size and shifts in run timing of Atlantic salmon in Ireland. Journal of Fish Biology 68: 1713-1730.

Quinn, T.P. and Myers, K.W. 2006. Patterns of anadromy and migrations of Pacific salmon and trout at sea. Pages 11-24 in Harris, G. & Milner, N. (eds.), Sea Trout: Biology, Conservation and Management, Proceedings of the First International Sea Trout Symposium, Cardiff, July 2004. Blackwell Publishing Ltd, Oxford.

Quinn, T. P., I. J. Stewart and C. P. Boatright. 2006. Experimental evidence of homing to site of incubation by mature sockeye salmon (*Oncorhynchus nerka*). Animal Behaviour 77: 941-949.

Rich, H. B., Jr., S. M. Carlson, B. E. Chasco, K. C. Briggs and T. P. Quinn. 2006. Movements of male sockeye salmon, *Oncorhynchus nerka*, on spawning grounds: the effects of in-stream residency, density, and body size. Animal Behaviour 71:971-981.

2007

Allen, C. S., H. B. Rich, Jr. and T. P. Quinn. 2007. Condition-dependent reproductive tactics by large and small anadromous male sockeye salmon *Oncorhynchus nerka*. Journal of Fish Biology 70: 1302-1307.

Anderson, J. H. and T. P. Quinn. 2007. Movements of adult coho salmon (*Oncorhynchus kisutch*) during colonization of newly accessible habitat. Canadian Journal of Fisheries and Aquatic Sciences 64: 1143-1154.

Carlson, S. M. and T. P. Quinn. 2007. Ten years of varying lake level and selection on size-at-maturity in sockeye salmon. Ecology 88: 2620-2629.

Carlson, S. M., R. Hilborn, A. P. Hendry and T. P. Quinn. 2007. Predation by bears drives senescence in natural populations of salmon. PLoSOne 2(12): e1286.

Garcia de Leaniz, C., I. A. Fleming, S. Einum, E. Verspoor, W. C. Jordan, S. Consuegra, N. Aubin-Horth, D. Lajus, B. H. Letcher, A. F. Youngson, J.H. Webb, L. A. Vøllestad, B. Villanueva, A. Ferguson, and T. P. Quinn. 2007. A critical review of adaptive genetic variation in Atlantic salmon: implications for conservation. Biological Reviews 82: 173-211.

Garcia de Leániz, C., I. A. Fleming, S. Einum, E. Verspoor, S. Consuegra, W. C. Jordan, N. Aubin-Horth, D. L. Lajus, B. Villanueva, A. Ferguson, A. F. Youngson, and T. P. Quinn. 2007. Local adaptation. Pages 195-235 in Verspoor, E. L. Stradmeyer, & J. L. Nielsen (eds.), The Atlantic salmon: Genetics, conservation and management. Blackwell Publishing, Oxford.

Naish, K. A., J. E. Taylor, III, P. S. Levin, T. P. Quinn, J. R. Winton, D. Huppert and R. Hilborn. 2007. An evaluation of the effects of conservation and fishery

enhancement hatcheries on wild populations of salmon. Advances in Marine Biology 53: 61-194.
Newell, J. C., K. L. Fresh, and T. P. Quinn. 2007. Arrival patterns and movements of adult sockeye salmon (*Oncorhynchus nerka*) in Lake Washington: implications for management of an urban fishery. North American Journal of Fisheries Management 27: 908-917.
Quinn, T. P., S. Hodgson, L. Flynn, R. Hilborn and D. E. Rogers. 2007. Directional selection by commercial fisheries and the timing of sockeye salmon (*Oncorhynchus nerka*) migrations. Ecological Applications 17: 731-739.
Quinn, T. P., D. M. Eggers, J. H. Clark, and H. B. Rich, Jr. 2007. Density, climate, and the processes of prespawning mortality and egg retention in Pacific salmon (*Oncorhynchus* spp.). Canadian Journal of Fisheries and Aquatic Sciences 64: 574-582.
Schtickzelle, N. and T. P. Quinn. 2007. A metapopulation perspective for salmon and other anadromous fish. Fish and Fisheries 8: 297-314.
Seamons, T. R., P. Bentzen, and T. P. Quinn. 2007. DNA parentage analysis reveals inter-annual variation in selection: results from 19 consecutive brood years in steelhead trout. Evolutionary Ecology Research 9: 409-431.

2008
Anderson, J. H. P. M. Kiffney, G. R. Pess and T. P. Quinn. 2008. Summer distribution and growth of juvenile coho salmon during colonization of newly accessible habitat. Transactions of the American Fisheries Society 137: 772-781.
Crozier, L. G., A. P. Hendry, P. W. Lawson, T. P. Quinn, N. J. Mantua, J. Battin, R. G. Shaw and R. B. Huey. 2008. Potential responses to climate change in organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1: 252-270.
Hauser, D. D. W., C. S. Allen, H. B. Rich, Jr., and T. P. Quinn. 2008. Resident harbor seals (*Phoca vitulina*) in Iliamna Lake, Alaska: summer diet and partial consumption of adult sockeye salmon (*Oncorhynchus nerka*). Aquatic Mammals 34: 303-309.
Kinnison, M. T., M. J. Unwin and T. P. Quinn. 2008. Eco-evolutionary versus habitat contributions to invasion in salmon: experimental evaluation in the wild. Molecular Ecology 17: 405-414.
Lin, J., T. P. Quinn, R. Hilborn and L. Hauser. 2008. Fine-scale differentiation between sockeye salmon ecotypes and the effect of phenotype on straying. Heredity 101: 341-350.
Lin, J., E. Ziegler, L. Hauser, and T. P. Quinn. 2008. Contrasting patterns of morphological and neutral genetic divergence in geographically proximate populations of sockeye salmon (*Oncorhynchus nerka*) in Lake Aleknagik, Alaska. Journal of Fish Biology 73: 1993-2004.
McLean, J. E., T. R. Seamons, M. B. Dauer, P. Bentzen and T. P. Quinn. 2008. Variation in reproductive success and effective number of breeders in a hatchery population of steelhead trout (*Oncorhynchus mykiss*): Examination by microsatellite-based parentage analysis. Conservation Genetics 9: 295-304.

Taylor, E. B., Lowery, E., Lilliestråle, A., Elz, A., and T. P. Quinn. 2008. Genetic analysis of sympatric char populations in Western Alaska: Arctic char (*Salvelinus alpinus*) and Dolly Varden (*S. malma*) are not two sides of the same coin. Journal of Evolutionary Biology 21: 1609-1625.

Westley, P., R. Hilborn, T. P. Quinn, G. Ruggerone, and D. E. Schindler. 2008. Long-term changes in rearing habitat and downstream movement by juvenile sockeye salmon (*Oncorhynchus nerka*) in an interconnected Alaska lake system. Ecology of Freshwater Fish 17: 443-454.

Westley, P. A. H., S. M. Carlson and T. P. Quinn. 2008. Among-population variation in adipose fin size parallels the expression of other secondary sexual characteristics in sockeye salmon (*Oncorhynchus nerka*). Environmental Biology of Fishes 81: 439-446.

2009

Carlson, S. M., H. B. Rich, Jr., and T. P. Quinn. 2009. Does variation in selection imposed by bears drive divergence among populations in the size and shape of sockeye salmon? Evolution 63: 1244-1261.

Dauer, M. B., T. R. Seamons, L. Hauser, T. P. Quinn, and K. A. Naish. 2009. Estimating the ratio of hatchery-produced to wild adult steelhead on the spawning grounds using scale pattern analyses. Transactions of the American Fisheries Society 138: 15-22.

Denton, K. P., H. B. Rich, Jr., and T. P. Quinn. 2009. Diet, movement, and growth of non-anadromous Dolly Varden *Salvelinus malma* in response to sockeye salmon *Oncorhynchus nerka* subsidies. Transactions of the American Fisheries Society 138: 1207-1219.

Doctor, K. K. and T. P. Quinn. 2009. The potential for adaptation-by-time in sockeye salmon (*Oncorhynchus nerka)*: The interactions of body size and in-stream reproductive lifespan with date of arrival and breeding location. Canadian Journal of Zoology 87: 708-717.

Kendall, N. W. and T. P. Quinn. 2009. Effects of population-specific variation in age and length on fishery selection and exploitation rates of sockeye salmon. Canadian Journal of Fisheries and Aquatic Sciences 66: 896-908.

Kendall, N. W., J. J. Hard and T. P. Quinn. 2009. Quantifying six decades of fishery selection for size and age at maturity in sockeye salmon. Evolutionary Applications 2: 523-536.

Quinn, T. P. 2009. Review of David Sear and Paul Devries, editors. 2008. Salmonid Spawning Habitat in Rivers – Physical Controls, Biological Responses, and Approaches to Remediation. American Fisheries Society, Bethesda. Quarterly Review of Biology 84: 211-212.

Quinn, T. P. and T. R. Seamons. 2009. Tales from scales: old DNA yields insights into contemporary evolutionary processes affecting fishes. (Invited commentary on paper by Hansen et al.). Molecular Ecology 18: 2546-2546.

Quinn, T. P., S. M. Carlson, S. M. Gende, and H. B. Rich, Jr. 2009. Transportation of Pacific salmon carcasses from streams to riparian forests by bears. Canadian Journal of Zoology 87: 195-203.

Quinn, T. P., K. Doctor, N. Kendall and H. B. Rich, Jr. 2009. Diadromy and the life history of sockeye salmon: nature, nurture, and the hand of man. American Fisheries Society Symposium 69: 23-42.

Quinn, T. P. 2009. Changing themes in the study of diadromous fishes American Fisheries Society Symposium 69: 823-829.

Quinn, T. P. 2009. Pacific salmon population structure and dynamics: A perspective from Bristol Bay on life history variation across spatial and temporal scales. American Fisheries Society Symposium 70: 857-871

Rich, H. B., Jr., T. P. Quinn, M. D. Scheuerell, and D. E. Schindler. 2009. Climate and intra-specific competition control the growth and life history of juvenile sockeye salmon (*Oncorhynchus nerka*) in Iliamna Lake, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 66: 238-246.

Seamons, T. R., M. B. Dauer, J. Sneva and T. P. Quinn. 2009. Use of parentage assignment and DNA genotyping to validate scale analysis for estimating steelhead trout (*Oncorhynchus mykiss*) age and spawning history. North American Journal of Fisheries Management 29: 396-403.

2010

Anderson, J. H., P. L. Faulds, W. I. Atlas, G. R. Pess, and T. P. Quinn. 2010. Selection on breeding date and body size in colonizing coho salmon, *Oncorhynchus kisutch.* Molecular Ecology 19: 2562-2573.

Armstrong, J. B., D. E. Schindler, K. L. Omori, C. P. Ruff, and T. P. Quinn. 2010. Thermal heterogeneity mediates the effects of pulsed subsidies across a landscape. Ecology 91:1445-1454.

Denton, K. P., H. B. Rich, Jr., J. W. Moore and T. P. Quinn. 2010. The utilization of a Pacific salmon subsidy by three populations of charr (*Salvelinus* spp.). Journal of Fish Biology 77: 1006–1023

Doctor, K. K., R. Hilborn, M. Rowse and T. P. Quinn. 2010. Spatial and temporal patterns of upriver migration by sockeye salmon, *Oncorhynchus nerka*, populations in the Wood River system, Bristol Bay, Alaska. Transactions of the American Fisheries Society 139: 80-91.

Greene, C. M., J. E. Hall, K. R. Guilbault, and T. P. Quinn. 2010. Improved viability of populations with diverse life history portfolios. Biology Letters 6: 382-386.

Kendall, N. W., A. H. Dittman, and T. P. Quinn. 2010. Comparative maturation schedules of two Columbia River sockeye salmon, *Oncorhynchus nerka*, populations. Endangered Species Research 13: 51-61.

Kendall, N. W., H. B. Rich, Jr., L. R. Jensen, and T. P. Quinn. 2010. Climate effects on inter-annual variation in growth of the freshwater mussel, *Anodonta beringiana*, in an Alaskan lake. Freshwater Biology 55:2339-2346.

Moore, M. E., F. A. Goetz, D. M. Van Doornik, E. P. Tezak, T. P. Quinn, J. J. Reyes-Tomassini, and B. A. Berejikian. 2010. Early marine migration patterns of wild coastal cutthroat trout (*Oncorhynchus clarki clarki*), steelhead trout (*Oncorhynchus mykiss*), and their hybrids. Public Library of Science One 5(9): E12881

Reed, T. E., G. Martinek, and T. P. Quinn. 2010. Lake-specific variation in growth, migration timing, and survival of juvenile sockeye salmon, *Oncorhynchus nerka*:

separating environmental from genetic influences. Journal of Fish Biology 77: 692-705.
Schindler, D. E., R. Hilborn, B. Chasco, C. P. Boatright, T. P. Quinn, L. A. Rogers, and M. S. Webster. 2010. Population diversity and the portfolio effect in an exploited species. Nature 465: 609-612.
Seamons, T. R. and T. P. Quinn. 2010. Sex-specific patterns of lifetime reproductive success in single and repeat breeding steelhead trout (*Oncorhynchus mykiss*). Behavioral Ecology and Sociobiology 64: 505-513.
Westley, P. A. H., D. E. Schindler, G. T. Ruggerone, T. P. Quinn and R. Hilborn. 2010. Natural habitat change, commercial fishing, climate, and dispersal interact to restructure an Alaskan fish metacommunity. Oecologia 163: 471-484.
Woody, C. A., R. M. Hughes, E. J. Wagner, T. P. Quinn, L. H. Roulson, L. M. Martin, and K. Griswold. 2010. The Mining Law of 1872: Change is overdue. Fisheries 35: 321-331.

2011
Baker, M. R., N. W. Kendall, T. A. Branch, D. E. Schindler, and T. P. Quinn. 2011. Selection due to non-retention mortality in gillnet fisheries for salmon. Evolutionary Applications 4: 429-443.
Carlson, S. M., T. P. Quinn and A. P. Hendry. 2011. Eco-evolutionary dynamics in Pacific salmon. Heredity 106: 438-447.
Chamberlin, J. W., T. E. Essington, J. W. Ferguson, and T. P. Quinn. 2011. The influence of hatchery rearing practices on salmon migratory behavior: Is the tendency of Chinook salmon to remain within Puget Sound affected by size and date of release? Transactions of the American Fisheries Society 140: 1398-1408.
Chamberlin, J., K. L. Fresh, A. N. Kagley, and T. P. Quinn. 2011. Movements of yearling Chinook salmon (*Oncorhynchus tshawytscha*) during their first summer in marine waters of Hood Canal, Washington. Transactions of the American Fisheries Society. 140: 429-439.
Gomez-Uchida, D., M. J. Smith, C. Habicht, J. E Seeb, T. P Quinn, and L. W Seeb. 2011. Single nucleotide polymorphisms unravel hierarchical divergence and signatures of selection among Alaskan sockeye salmon (*Oncorhynchus nerka*) populations. BMC Evolutionary Biology 11:48 (17 pp.).
Kendall, N. W. and T. P. Quinn. 2011. Length and age trends of Chinook salmon in the Nushagak River, Alaska related to commercial and recreational fishery selection and exploitation. Transactions of the American Fisheries Society 140: 611-622.
Kinnison, M. T., T. P. Quinn and M. J. Unwin. 2011. Correlated contemporary evolution of life history traits in New Zealand Chinook salmon, *Oncorhynchus tshawytscha.* Heredity 106: 448-459.
Krkošek, M., R. Hilborn, R. M. Peterman, and T. P. Quinn. 2011. Cycles, stochasticity, and density dependence in pink salmon population dynamics. Proceeding of the Royal Society of London (B) 278: 2060-2068.
Lin, J. E., R. Hilborn, T. P. Quinn, and L. Hauser. 2011. Self-sustaining populations, population sinks or aggregates of strays: chum (*Oncorhynchus keta*) and Chinook salmon (*O. tshawytscha*) in the Wood River system, Alaska. Molecular Ecology 40: 4925-4937.

Pess, G. R., P. M. Kiffney, M. C. Liermann, T. R. Bennett, J. H. Anderson, and T. P. Quinn. 2011. The influences of body size, habitat quality, and competition on the movement and survival of juvenile coho salmon, *Oncorhynchus kisutch*, during the early stages of stream re-colonization. Transactions of the American Fisheries Society 140: 883-897.

Quinn, T. P., T. R. Seamons, L. A. Vøllestad, and E. Duffy. 2011. Effects of growth and reproductive history on the egg size - fecundity tradeoff in steelhead. Transactions of the American Fisheries Society 140: 123-135.

Quinn, T. P., M. J. Unwin and M. T. Kinnison. 2011. Contemporary divergence in migratory timing of naturalized populations of Chinook salmon, *Oncorhynchus tshawytscha*, in New Zealand. Evolutionary Ecology Research 13: 45-54

Quinn, T. P., J. Chamberlin, and E. L. Brannon. 2011. Experimental evidence of population-specific spatial distributions of Chinook salmon, *Oncorhynchus tshawytscha.* Environmental Biology of Fishes 92: 313-322.

2012

Andrews, K. S. and T. P. Quinn. 2012. Combining fishing and acoustic monitoring data to evaluate the distribution and movements of spotted ratfish *Hydrolagus colliei.* Marine Biology159: 769-782.

Gowell, C. P., T. P. Quinn and E. B. Taylor. 2012. Coexistence and origin of trophic ecotypes of pygmy whitefish, *Prosopium coulterii*, in a southwestern Alaskan lake. Journal of Evolutionary Biology 25: 2432-2448.

Kendall, N. W. and T. P. Quinn. 2012. Quantifying and comparing size-selectivity among Alaskan sockeye salmon fisheries. Ecological Applications 22: 804-816.

Pess, G. R., R. Hilborn, K. Kloehn, and T.P. Quinn. 2012. The influence of population dynamics and environmental conditions on pink salmon re-colonization after barrier removal. Canadian Journal of Fisheries and Aquatic Sciences 69: 970-982.

Quinn, T. P., A. H. Dittman, H. Barrett, C. Cunningham, and M. H. Bond. 2012. Chemosensory responses juvenile coho salmon, *Oncorhynchus kisutch*, Dolly Varden, *Salvelinus malma,* and sculpins (*Cottus* spp.) to eggs and other tissues from adult Pacific salmon. Environmental Biology of Fishes 95: 301-307.

Quinn, T. P., C. J. Sergeant, A. H. Beaudreau, and D. A. Beauchamp. 2012. Spatial and temporal patterns of vertical distribution for three planktivorous fishes in Lake Washington. Ecology of Freshwater Fish 21: 337-348.

Quinn, T.P., N. W. Kendall, H.B. Rich, Jr., and B. E. Chasco. 2012. Diel vertical movements, and effects of infection by the cestode *Schistocephalus solidus* on daytime proximity of three-spined sticklebacks (*Gasterosteus aculeatus*) to the surface of a large Alaskan lake. Oecologia 168: 43-51.

Quinn, T. P., H. B. Rich, Jr., D. Gosse, and N. Schtickzelle. 2012. Population dynamics and asynchrony at fine spatial scales: A case history of sockeye salmon population structure in Alaska. Canadian Journal of Fisheries and Aquatic Sciences 69: 297-306.

Quinn, T. P., T. R. Seamons, and S. P. Johnson. 2012. Stable isotopes of carbon and nitrogen indicate differences in marine ecology between wild and hatchery-produced steelhead trout, *Oncorhynchus mykiss*. Transactions of the American Fisheries Society 141: 526-532.

Seamons, T. R., L. Hauser, K. A. Naish, and T. P. Quinn. 2012. Can interbreeding of wild and artificially propagated animals be prevented by using broodstock selected for a divergent life history? Evolutionary Applications 5: 705-719.

Sharma, R. and T. P. Quinn. 2012. Linkages between life history type and migration pathways in freshwater and marine environments for Chinook salmon, *Oncorhynchus tshawytscha.* Acta Oecologica 41: 1-13.

2013

Anderson, J. H., G. R. Pess, P. M. Kiffney, T. R. Bennett, P. L. Faulds, W. I. Atlas, and T. P. Quinn. 2013. Dispersal and tributary immigration by juvenile coho salmon contribute to spatial expansion during colonization. Ecology of Freshwater Fish 22: 30-42.

Anderson, J. H., P. Faulds, W.I. Atlas, and T.P. Quinn. 2013. Reproductive success of captively bred and naturally spawned Chinook salmon colonizing newly accessible habitat. Evolutionary Applications 6: 165-179.

Bond, M. H. and T. P. Quinn. 2013. Patterns and influences on Dolly Varden migratory timing in Chignik Lakes, Alaska, and comparison to populations throughout the Northeastern Pacific and Arctic oceans. Canadian Journal of Fisheries and Aquatic Sciences. 70: 655-665.

Buehrens, T. W., J. Glasgow, C. O. Ostberg, and T. P. Quinn. 2013. Spatial segregation of spawning habitat limits hybridization between sympatric native steelhead and coastal cutthroat trout. Transactions of the American Fisheries Society 142: 221-233.

Cunningham, C. J., G. T. Ruggerone, and T. P. Quinn. 2013. Size-selectivity of predation by brown bears depends on the density of their sockeye salmon prey. American Naturalist 181: 663-673.

Cunningham, C. J., M. G. Courage, and T. P. Quinn. 2013. Selecting for the phenotypic optimum: size-related tradeoffs between mortality risk and reproductive output in female sockeye salmon. Functional Ecology 27: 1233-1243.

Essington, T. E., K. Dodd and T. P. Quinn. 2013. Shifts in the estuarine demersal fish community following a fishery closure in Puget Sound, WA. Fishery Bulletin 111: 205-217.

Goetz, F. A., B. Baker, T. Buehrens, and T. P. Quinn. 2013. Diversity of movements by individual anadromous coastal cutthroat trout in Hood Canal, Washington. Journal of Fish Biology 83:1161-1182

Kendall, N. W. and T. P. Quinn. 2013. Size-selective fishing affects sex ratios and the opportunity for sexual selection in Alaskan sockeye salmon *Oncorhynchus nerka.* Oikos 122: 411-420.

Naish, K. A., T. R. Seamons, M. B. Dauer, L. Hauser, and T. P. Quinn. 2013. Relationship between effective population size, inbreeding, and adult fitness-related traits in a steelhead (*Oncorhynchus mykiss*) population released in the wild. Molecular Ecology 22: 1295-1309.

Putman, N. F., K. J. Lohmann, E. M. Putman, T. P. Quinn, A. P. Klimley, and D. L. G. Noakes. 2013. Evidence for geomagnetic imprinting as a homing mechanism in Pacific salmon. Current Biology 23: 312-316.

Quinn, T. P., N. Harris, J. A. Shaffer, C. Byrnes, and P. Crain. 2013. Juvenile coho salmon, *Oncorhynchus kisutch*, in the Elwha River estuary prior to dam removal: Seasonal occupancy, size distribution, and comparison to nearby Salt Creek. Transactions of the American Fisheries Society 42: 1058-1066.

Rohde, J., A. N. Kagley, K. L. Fresh, F. A. Goetz, and T. P. Quinn. 2013. Partial migration and diel movement patterns in Puget Sound Coho Salmon (*Oncorhynchus kisutch*). Transactions of the American Fisheries Society 142: 1615-1628.

Simmons, R. K., T. P. Quinn, L. W. Seeb, D. E. Schindler, and R. Hilborn. 2013. Summer emigration and resource acquisition within a shared nursery lake by sockeye salmon (*Oncorhynchus nerka*) from historically discrete rearing environments. Canadian Journal of Fisheries and Aquatic Sciences 70: 57-63.

Simmons, R. K., T. P. Quinn, L. W. Seeb, D. E. Schindler, and R. Hilborn. 2013. Role of estuarine rearing for sockeye salmon in Alaska (USA). Marine Ecology Progress Series 481: 211–223.

Storer, C. C., T. P. Quinn, and S. B. Roberts. 2013. Quantitative PCR analysis used to characterize physiological changes in brain tissue of senescent sockeye salmon. Biogerentology 14: 483-490.

Westley, P. A. H., T. P. Quinn and A. H. Dittman. 2013. Rates of straying by hatchery-produced Pacific salmon (*Oncorhynchus spp*.) and steelhead (*Oncorhynchus mykiss*) differ among species, life history types, and populations. Canadian Journal of Fisheries and Aquatic Sciences. 70: 735-746.

Woods, P. J., D. Young, S. Skúlason, S. S. Snorrason, and T. P. Quinn. 2013. Resource polymorphism and diversity of Arctic charr *Salvelinus alpinus* in a series of isolated lakes in southwestern Alaska. Journal of Fish Biology 82: 569-587.

Woods, P. J., S. Skúlason, S. S. Snorrason, B. K. Kristjánsson, H. J. Malmquist, and T. P. Quinn. 2013. Intraspecific diversity in Arctic charr, *Salvelinus alpinus,* in Iceland: I. Detection using mixture models. Evolutionary Ecology Research 14: 973-992.

Woods, P. J., S. Skúlason, S. S. Snorrason, B. K. Kristjánsson, H. J. Malmquist, and T. P. Quinn. 2013. Intraspecific diversity in Arctic charr, *Salvelinus alpinus,* in Iceland: II. What environmental factors influence resource polymorphism in lakes? Evolutionary Ecology Research 14: 993-1013.

2014

Adkison, M. D., M. B. Ward, and T. P. Quinn. 2014. Nest site preference and intrasexual competition in female sockeye salmon, *Oncorhynchus nerka*. Environmental Biology of Fishes 97: 385-399.

Bond, M. H., B. R. Beckman, L. Rohrbach, and T. P. Quinn. 2014. Differential growth in estuarine and freshwater habitats indicated by plasma IGF1 concentrations and otolith chemistry in Dolly Varden charr *Salvelinus malma.* Journal of Fish Biology 85: 1429-1445.

Bond, M. H., P. A. Crane, W. A. Larson, and T. P. Quinn. 2014. Is isolation by adaptation driving genetic divergence among proximate char populations? Ecology and Evolution 4: 2515-2532.

Buehrens, T. W., P. Kiffney, G. R. Pess, T. R. Bennett, S. M. Naman, G. Brooks, and T. P. Quinn. 2014. Increasing juvenile Coho Salmon densities during early recolonization have not affected resident Coastal Cutthroat Trout growth, movement or survival. North American Journal of Fisheries Management. 34:892–907.

Chamberlin, J. W. and T. P. Quinn. 2014. Effects of natal origin on localized distributions of Chinook salmon, *Oncorhynchus tshawytscha*, in the marine waters of Puget Sound, Washington. Fisheries Research 153: 113-122.

Jaecks, T., and T. P. Quinn. 2014. Ontogenetic shift to dependence on salmon-derived nutrients in Dolly Varden char from the Iliamna River, Alaska. Environmental Biology of Fishes 97: 1323-1333.

Kendall, N. W. U. Dieckmann, M. Heino, A. E. Punt, and T. P. Quinn. 2014. Evolution of age and length at maturation of Alaskan salmon under size-selective harvest. Evolutionary Applications 7: 313-322.

McMillan, J. R., G. R. Pess, M. L. McHenry, R. Moses, and T. P. Quinn. 2014. Documentation of unusual, fall spawning by Coastal Cutthroat Trout in the Elwha River system, Washington. Transactions of the American Fisheries Society 143: 1605-1611.

Pess, G. R., T. P. Quinn, D. E. Schindler, and M. C. Liermann. 2014. Freshwater habitat associations between pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), and Chinook salmon (*O. tshawytscha*) in a watershed dominated by sockeye salmon (*O. nerka*) abundance. Ecology of Freshwater Fish 23: 360-372.

Pess, G. R., T. P. Quinn, S. R. Gephard, and R. Saunders. 2014. Re-colonization of Atlantic and Pacific rivers by anadromous fishes: Linkages between life history and the benefits of barrier removal. Reviews in Fish Biology and Fisheries 24: 881-900.

Putman, N. F., M. M. Scanlan, E. J. Billman, J. P. O'Neil, R. B. Couture, T. P. Quinn, K. J. Lohmann, and D. L. G. Noakes. 2014. Inherited magnetic map guides ocean navigation in juvenile Pacific salmon. Current Biology 24: 446-450.

Quinn, T. P., J. A. Shaffer, J. Brown, N. Harris, C. Byrnes, and P. Crain. 2014. Juvenile Chinook salmon, *Oncorhynchus tshawytscha*, use of the Elwha River estuary prior to dam removal. Environmental Biology of Fishes 97: 731-740.

Quinn, T. P., C. J. Cunningham, J. Randall, and R. Hilborn. 2014. Can intense predation by bears exert a depensatory effect on recruitment in a Pacific salmon population? Oecologia 176: 445-456.

Quinn, T. P., A. J. Wirsing, B. Smith, C. J. Cunningham, and J. Ching. 2014. Complementary use of motion-activated cameras and unbaited wire snares for DNA sampling reveals diel and seasonal activity patterns of brown bears foraging on adult sockeye salmon. Canadian Journal of Zoology 92: 893-903.

Quinn, T. P., M. Bond and S. Slater. 2014. Use of stable isotopes and otolith micro-chemistry to evaluate migration in male Chinook salmon, *Oncorhynchus tshawytscha*, from an Alaskan river. Northwest Science 88: 360-366.

Rohde, J., K. L. Fresh, and T. P. Quinn. 2014. Factors affecting partial migration in Puget Sound Coho Salmon (*Oncorhynchus kisutch*). North American Journal of Fisheries Management 34: 559-570.

Taugbøl, A., C. Junge, T. P. Quinn, A. Herland, L. A. Vøllestad. 2014. Genetic and morphometric divergence in threespine stickleback in the Chignik catchment, Alaska. Ecology and Evolution 4: 144-156.

2015

Anderson, J. H., P. L. Faulds, K. D. Burton, M. E. Koehler, W. I. Atlas, and T. P. Quinn. 2015. Dispersal and productivity of Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon colonizing newly accessible habitat. Canadian Journal of Fisheries and Aquatic Sciences 72: 454-465.

Bond, M. H., J. A. Miller, and T. P. Quinn. 2015. Beyond dichotomous life histories in partially migrating populations: Cessation of anadromy in a long-lived fish. Ecology 96: 1899-1910.

Goetz, F. A., E. Jeanes, M. E. Moore, and T. P. Quinn. 2015. Comparative migratory behavior and survival of wild and hatchery steelhead (*Oncorhynchus mykiss*) smolts in riverine, estuarine, and marine habitats of Puget Sound, Washington Environmental Biology of Fishes 98: 357-375.

Harmon, B. S., R. Hilborn, and T. P. Quinn. 2015. Infection by the cestode parasite *Schistocephalus* sp. and effects on diet, body condition, and survival of sculpins *Cottus aleuticus* and *C. cognatus.* Journal of Fish Biology 86: 1621-1629.

Hart, L. M., M. H. Bond, S. L. May-McNally, J. A. Miller, and T. P. Quinn. 2015. Use of otolith microchemistry and stable isotopes to investigate the ecology and anadromous migrations of Northern Dolly Varden from the Egegik River, Bristol Bay, Alaska. Environmental Biology of Fishes 98: 1633-1643.

Jones, M. H., J. E. Seeb, K. I. Warheit, T. R. Seamons, T. P. Quinn, and L. W. Seeb. 2015. Consequences of emergence timing for the growth and relative survival of Steelhead Trout fry from naturally spawning wild and hatchery parents. Transactions of the American Fisheries Society 144: 977-989.

Kendall, N. W, J. R. McMillan, M. R. Sloat, T. W. Buehrens, T. P. Quinn, G. R. Pess, K. V. Kuzishchin, M. M. McClure, and R. W. Zabel. 2015. Anadromy and residency in steelhead and rainbow trout *Oncorhynchus mykiss*: a review of the processes and patterns. Canadian Journal of Fisheries and Aquatic Sciences 72: 319-342

May-McNally, S. L., T. P. Quinn, P. J. Woods, and E. B. Taylor. 2015. Evidence for genetic distinctions between sympatric ecotypes of Arctic char (*Salvelinus alpinus*) in southwestern Alaskan lakes. Ecology of Freshwater Fish 24: 562-574.

May-McNally, S. L., T. P. Quinn, and E. B. Taylor. 2015. Low levels of hybridization between sympatric Arctic char (*Salvelinus alpinus*) and Dolly Varden char (*Salvelinus malma*) highlights their genetic distinctiveness and ecological segregation. Ecology and Evolution 5: 3031-3045.

McMillan, J. R., G. R. Pess, M. Liermann, S. A. Morley, M. L. McHenry, L. A. Campbell, and T. P. Quinn. 2015. Using redd attributes, fry density and otolith microchemistry to distinguish the presence of steelhead and Rainbow Trout *Oncorhynchus mykiss* in the Elwha River dam removal project. North American Journal of Fisheries Management 35: 1019-1033.

Moore, M. E., B. A. Berejikian, F. A. Goetz, A. G. Berger, S. S. Hodgson, E. J. Connor and T. P. Quinn. 2015. Multi-population analysis of Puget Sound steelhead survival and migration behavior. Marine Ecology Progress Series 537: 217-232.

Quinn, T.P. 2015. Turning class field trips into long-term research: A great idea with a few pitfalls. Fisheries 40: 65-68.

Quinn, T. P., M. H. Bond, and H. Berge. 2015. Use of egg size differences in anadromous (sockeye salmon) and non-anadromous (kokanee) forms of *Oncorhynchus nerka* to infer ancestral origins of the Elwha River's landlocked population. Ecological Research 30: 547-554.

Smith, J. M., K. L. Fresh, A. N. Kagley, and T. P. Quinn. 2015. Ultrasonic telemetry reveals seasonal variation in depth distribution and diel vertical migrations of sub-adult Chinook and coho salmon in Puget Sound. Marine Ecology Progress Series 532: 227-242.

Sprehn, C. G., M. J. Blum, T. P. Quinn, and D. C. Heins. 2015. Landscape genetics of *Schistocephalus solidus* parasites in threespine stickleback (*Gasterosteus aculeatus*) from Alaska. PLoS One 10(4) e0122307.

Thornton, E. J., R. W. Hardy and T. P. Quinn. 2015. Experimental determination of the limits of using stable isotopes to distinguish steelhead and Rainbow Trout offspring. North American Journal of Fisheries Management 35:810–817.

Westley, P. A. H., A. H. Dittman, E. J. Ward, and T. P. Quinn. 2015. Signals of climate, conspecific density, and watershed features in patterns of homing and dispersal by Pacific salmon. Ecology 96: 2823-2833.

2016

Berdahl, A., P. A. H. Westley, S. A. Levin, I. D. Couzin and T. P. Quinn. 2016. A collective navigation hypothesis for homeward migration in anadromous salmonids. Fish and Fisheries 17: 525-542.

Dennert, A. M., S. L. May-McNally, M. H. Bond, T. P. Quinn, and E. B. Taylor. 2016. Trophic biology and migratory patterns of sympatric Dolly Varden (*Salvelinus malma*) and Arctic char (*S. alpinus*). Canadian Journal of Zoology 94: 529-539.

Hansen, A. G. J. R. Gardner, D. A. Beauchamp, R. Paradis, and T. P. Quinn. 2016. Recovery of Sockeye Salmon in the Elwha River, Washington after dam removal: dependence of smolt production on the resumption of anadromy by landlocked kokanee. Transactions of the American Fisheries Society 145: 1303-1317.

Jaecks, T., M. H. Bond, and T. P. Quinn. 2016. Can dietary reliance on Pacific salmon eggs create otolith Sr/Ca signatures that mimic anadromy in resident salmonids? Environmental Biology of Fishes 99: 237-247.

Quinn, T. P. 2016. Review of: Migration Ecology of Marine Fishes. By David Hallock Secor. Johns Hopkins University Press, Baltimore, Maryland. 2015.

Quinn, T. P., P. McGinnity, and T. E. Reed. 2016. The paradox of 'premature migration' by adult anadromous salmonid fishes: Patterns and hypotheses. Canadian Journal of Fisheries and Aquatic Sciences 73: 1015-1030.

Tillotson, M. D., and T. P. Quinn. 2016. Beyond correlation in the detection of climate change impacts: Testing a mechanistic hypothesis for climatic influence on sockeye salmon (*Oncorhynchus nerka*) productivity. Public Library of Science One 11(4): e0154356. doi:10.1371/journal.pone.0154356

2017

Arostegui, M. C., J. M. Smith, A. N. Kagley, D. Spilsbury-Pucci, K. L. Fresh, and T. P. Quinn. 2017. Spatially clustered movement patterns and segregation of sub-adult Chinook Salmon within the Salish Sea. Marine and Coastal Fisheries 9: 1-12.

Arostegui, M. C., T. E. Essington, and T. P. Quinn. 2017. Interpreting vertical movement behavior with holistic examination of depth distribution: A novel method reveals cryptic diel activity patterns of Chinook salmon in the Salish Sea. Animal Biotelemetry 5(2) DOI 10.1186/s40317-016-0116-5.

Berdahl, A., P. A. H. Westley, and T. P. Quinn. 2017. Social interactions shape the timing of spawning migrations in an anadromous fish. Animal Behaviour 126: 221-229.

Bond, M. H., P. A. H. Westley, A. H. Dittman, D. Holecek, T. Marsh, and T. P. Quinn. 2017. Combined effects of barge transportation, river environment, and rearing location on straying and migration rate of Snake River fall-run Chinook Salmon. Transactions of the American Fisheries Society 146: 60-73.

Havey, M. A., A. H. Dittman, T. P. Quinn, S. C. Lema, and D. May. 2017. Experimental evidence for olfactory imprinting by Sockeye Salmon, *Oncorhynchus nerka*, at embryonic and smolt stages. Transactions of the American Fisheries Society 146: 74-83.

Hovel, R. A., S. M. Carlson and T. P. Quinn. 2017. Climate change alters the reproductive phenology and investment of a lacustrine fish, the threespine stickleback. Global Change Biology 23: 2308-2320.

Hovel, R. A., J. T. Thorson, J. L. Carter, and T. P. Quinn. 2017. Within-lake habitat heterogeneity mediates community response to warming trends. Ecology 98: 2333-2342.

Kagley, A. N., J. M. Smith, K. L. Fresh, K. E. Frick, and T. P. Quinn. 2017. Residency, partial migration, and late egress of sub-adult Chinook salmon (*Oncorhynchus tshawytscha*) and comparisons with coho salmon (*O. kisutch*) in Puget Sound, Washington. Fishery Bulletin 115: 544-555.

Lamperth, J., T. P. Quinn and M. Zimmerman. 2017. Levels of stored energy but not marine foraging patterns differentiate seasonal ecotypes of wild and hatchery steelhead trout, *Oncorhynchus mykiss*, returning to the Kalama River, Washington. Canadian Journal of Fisheries and Aquatic Sciences 74: 157-167.

Quinn, T. P., M. H. Bond, S. J. Brenkman, R. Paradis, and R. J. Peters. 2017. Re-awakening dormant life history variation: stable isotopes indicate anadromy in bull trout following dam removal on the Elwha River, Washington. Environmental Biology of Fishes 100: 1659-1671.

Quinn, T. P., C. J. Cunningham, and A. J. Wirsing. 2017. Diverse foraging opportunities drive the functional response of local and landscape-scale bear predation on Pacific salmon. Oecologia 183: 415-429.

Reed, T. E., E. de Eyto, K. O'Higgins, P. Gargan, W. Roche, J. White, N. O'Maoileidigh, T. P. Quinn, and P. McGinnity. 2017. Availability of holding habitat in lakes and rivers affects the incidence of spring ("premature") upriver migration by Atlantic salmon. Canadian Journal of Fisheries and Aquatic Sciences 74: 668-679.

Shaffer, A., C. Naumann, F. Juanes, D. Parks, M. Hocking, C. Byrnes, T. McBride, J. Michel, and T. P. Quinn. 2017. Nearshore fish community responses to large scale dam removal: implications for watershed restoration and fish management. Aquatic Sciences 79: 643-660.

Sparks, M. M., P. A. H. Westley, J. A. Falke, and T. P. Quinn. 2017. Thermal adaptation and phenotypic plasticity in a warming world: Insights from common garden experiments on Alaskan sockeye salmon. Global Change Biology 23: 5203-5217.
Thornton, E. J., J. J. Duda and T. P. Quinn. 2017. Influence of species, size, and relative abundance on the outcomes of competitive interactions between brook trout and juvenile coho salmon. Ethology, Ecology and Evolution 29: 157-169.
Tillotson, M. D. and T. P. Quinn. 2017. Climate and conspecific density trigger pre-spawning mortality in sockeye salmon (*Oncorhynchus nerka*). Fisheries Research 188: 138-148.

2018

Arostegui, M. C., and T. P. Quinn. 2018. Trophic ecology of nonanadromous rainbow trout in a postglacial lake system: partial convergence of adfluvial and fluvial forms. Canadian Journal of Zoology 96: 818-827.
Arostegui, M. C., R. A. Hovel, and T. P. Quinn. 2018. *Schistocephalus solidus* parasite prevalence and biomass intensity in threespine stickleback vary by habitat and diet in boreal lakes. Environmental Biology of Fishes 101: 501-514.
Gomez-Uchida, D., D. Cañas-Rojas, C. Riva-Rossi, J. Ciancio, M. Pascual, B. Ernst, E. Aedo Marchant, S. Musleh, F. Valenzuela-Aguayo, T.P. Quinn, J. Seeb, and L. Seeb. 2018. Genetic signatures of artificial and natural dispersal linked to colonization of South America by non-native Chinook salmon (*Oncorhynchus tshawytscha*). Ecology and Evolution 8: 6192-6209.
Hasselman, D. J., P. Bentzen, S. Narum, and T. P. Quinn. 2018. Rapid formation of population genetic structure following the introduction and establishment of non-native American shad (*Alosa sapidissima*) along the Pacific Coast of North America. Biological Invasions 20:3123–3143.
Kiffney, P. M., B. Cram, P. Faulds, K. Burton, M. Koehler, and T. P. Quinn. 2018. Spatiotemporal patterns of mountain whitefish (*Prosopium williamsoni*) in response to a restoration of longitudinal connectivity. Ecology of Freshwater Fish 27: 1037-1053.
Lincoln, A. E., J. A. Shaffer, and T. P. Quinn. 2018. Opportunistic use of estuarine habitat by juvenile bull trout, *Salvelinus confluentus*, from the Elwha River before, during, and after dam removal. Environmental Biology of Fishes 101: 1559-1569.
Ohlberger, J., T. W. Buehrens, S. J. Brenkman, P. Crain, T. P. Quinn, and R. Hilborn. 2018. Effects of past and projected river discharge variability on freshwater production in an anadromous fish. Freshwater Biology 63: 331-340.
Putman, N. F., M. M. Scanlan, A. M. Pollock, J. P. O'Neil, R. B. Couture, J. S. Stoner, T. P. Quinn, K. J. Lohmann, and D. L. G. Noakes. 2018. Geomagnetic field influences upward movement of young Chinook salmon emerging from nests. Biology Letters 14:20170752
Quinn, T. P. 2018. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press, Seattle. Second edition, 547 pp.
Quinn, T. P. 2018. From magnets to bears: Is a career studying salmon narrow or broad? ICES Journal of Marine Science 75: 1546-1552.

Quinn, T.P., J. M. Helfield, C. Austin, R. Hovel, and A. G. Bunn. 2018. A multi-decade experiment shows that fertilization by salmon carcasses enhanced tree growth in the riparian zone. Ecology 99: 2433-2441.

Tillotson, M. D., R. P. Kelly J. J. Duda, M. Hoy, J. Kralj, and T. P. Quinn. 2018. Concentrations of environmental DNA (eDNA) reflect spawning salmon abundance at fine spatial and temporal scales. Biological Conservation 220: 1-11.

Tillotson, M. and T. P. Quinn. 2018. Selection on the timing of migration and breeding: A neglected aspect of fishing-induced evolution and trait change. Fish and Fisheries 19: 170-181.

Wirsing, A. J., T. P. Quinn, C. J. Cunningham, J. R. Adams, A. D. Craig, and L. P. Waits. 2018. Alaskan brown bears (*Ursus arctos*) aggregate and display fidelity to foraging neighborhoods while preying on Pacific salmon along small streams. Ecology and Evolution 8: 9048-9061.

Woods, P. J., S. Skúlason, S. S. Snorrason, and T. P. Quinn. 2018. Eco-evolutionary feedbacks in the functional role of a polymorphic colonizer: Arctic charr in subarctic lakes of Alaska and Iceland. Evolutionary Ecology Research 19: 149-169.

2019

Arostegui, M. C., and T. P. Quinn. 2019. Reliance on lakes by salmon, trout, and charr (*Oncorhynchus*, *Salmo*, and *Salvelinus*): An evaluation of spawning habitats, rearing strategies, and trophic polymorphisms. Fish and Fisheries 20: 775-794.

Arostegui, M. C., and T. P. Quinn. 2019. Ontogenetic and ecotypic variation in the coloration and morphology of rainbow trout (*Oncorhynchus mykiss*) in a stream-lake system. Biological Journal of the Linnean Society 128: 681-699.

Arostegui, M. C., T. P. Quinn, L. W. Seeb, J. E. Seeb, and G. J. McKinney. 2019. Retention of a chromosomal inversion from an anadromous ancestor provides the genetic basis for alternative freshwater ecotypes in rainbow trout. Molecular Ecology 28:1412–1427.

Austin, C. S., M. H. Bond, J. M. Smith, E. D. Lowery, and T. P. Quinn. 2019. Partial migration and life history variation in a facultatively anadromous, iteroparous salmonid, bull trout (*Salvelinus confluentus*). Environmental Biology of Fishes 102: 95-104.

Austin, C. S., T. E. Essington, and T. P. Quinn. 2019. Spawning and emergence phenology of bull trout *Salvelinus confluentus* under differing thermal regimes. Journal of Fish Biology 94: 191-195.

Axworthy, J. B., J. M. Smith, M. S. Wing, and T. P. Quinn. 2019. Sex biased individual variation in movement patterns of a highly mobile, near-shore marine planktivore, the reef manta ray, *Manta alfredi.* Journal of Fish Biology 95: 1399-1406.

Barnett, H. K., T. P. Quinn, K. L. Fresh, M. E. Koehler, K. D. Burton, M. Bhuthimethee, N. P. Peterson. 2019. Differential marking of embryos by location and date of release reveals within-river natal homing and parental influence on progeny return timing in Sockeye Salmon. Transactions of the American Fisheries Society 148: 393-405.

Cathcart, C. N. P. A.H. Westley, K. J. Dunker, T. P. Quinn, A. J. Sepulveda, F. A. von Hippel, A. Wizik, and D. B. Young. 2019. Trophic plasticity and the invasion of a renowned piscivore: A diet synthesis of northern pike (*Esox lucius*) from the native and introduced range of Alaska, U.S.A. Biological Invasions 21: 1379-1392.

Goetz, F. A., and T. P. Quinn. 2019. Behavioral thermoregulation by adult Chinook salmon (*Oncorhynchus tshawytscha*) in estuary and freshwater habitats prior to spawning. Fishery Bulletin 17: 258-271.

Hovel, R. A., K. L. Fresh, S. L. Schroder, A. H. Litt, and T. P. Quinn. 2019. A wide window of migration phenology captures inter-annual variability of favourable conditions: Results from a whole-lake experiment with juvenile Pacific salmon. Freshwater Biology 64: 46-55.

Howard, I., E. Davis, G. Lippert, T. P. Quinn, and C. L. Wood. 2019. Abundance of an economically important nematode parasite increased in Puget Sound between 1930 and 2016: Evidence from museum specimens confirms historical data. Journal of Applied Ecology 56: 190-200.

Lincoln, A. E., and T. P. Quinn. 2019. Optimal foraging or surplus killing: selective consumption and discarding of Pacific salmon by brown bears. Behavioral Ecology 30: 202-212.

Ohlberger, J., S. J. Brenkman, P. Crain, G. R. Pess, J. J. Duda, T. W. Buehrens, T. P. Quinn, and R. Hilborn. 2019. A Bayesian life-cycle model to estimate escapement at MSY in salmon based on limited information. Canadian Journal of Fisheries and Aquatic Sciences 76: 299-307.

Oke, K. B., C. J. Cunningham, T. P. Quinn, and A. P. Hendry. 2019. Independent lineages in a common environment: the roles of determinism and contingency in shaping the migration timing of even- versus odd-year pink salmon over broad spatial and temporal scales. Ecology Letters 22: 1547-1556.

Oke, K. B., E. Motivans, T. P. Quinn, and A. P. Hendry. 2019. Sexual dimorphism modifies habitat-associated divergence: Evidence from beach and creek breeding sockeye salmon. Journal of Evolutionary Biology 32: 227-242.

Sparks, M. M., J. A. Falke, T. P. Quinn, M. D. Adkison, D. E. Schindler, K. Bartz, D. Young, and P. A. H. Westley. 2019. Influences of spawning timing, water temperature, and climatic warming on early life history phenology in western Alaska sockeye salmon. Canadian Journal of Fisheries and Aquatic Sciences 76: 123-135.

Tillotson, M. D., H. K. Barnett, M. Bhuthimethee, M. E. Koehler, and T. P. Quinn. 2019. Artificial selection on reproductive timing in hatchery salmon drives a phenological shift and potential maladaptation to climate change. Evolutionary Applications 12: 1344-1359.

Manuscripts in press:

Feddern, M. L., G. Holtgrieve, J. Hart, S. Perakis, H. Ro, T. P. Quinn. Riparian soil nitrogen cycling and isotopic enrichment in response to a long-term carcass manipulation experiment. Ecosphere

Johnson, M. A., D. L. G. Noakes, T. A. Friesen, A. H. Dittman, R. B. Couture, C. B. Schreck, C. Banner, D. May, and T. P. Quinn. Growth, survivorship, and juvenile physiology of triploid steelhead (*Oncorhynchus mykiss*). Fisheries Research

Lincoln, A., R. Hilborn, A. J. Wirsing, and T. P. Quinn. Managing salmon for wildlife: Do fisheries limit salmon consumption by bears in small streams? Ecological Applications

Michel, C. J., J. M. Smith, B. M. Lehman, N. J. Demetras, D. D. Huff, P. L. Brandes, J. A. Israel, T. P. Quinn, and S. A. Hayes. Limitations of active removal to manage predatory fish populations. North American Journal of Fisheries Management

Wirsing, A. J., T. P. Quinn, J. R. Adams, and L. P. Waits. Optimizing selection of brown bear hair for noninvasive genetic analysis. Wildlife Society Bulletin

CERTIFICATE OF SERVICE

I hereby certify that on December 3, 2019, I caused the foregoing Expert Report of Thomas P. Quinn, Ph.D. and supporting documents to be served on counsel of record for the State Defendants and Defendant-Intervenors.

Dated this 3rd day of December, 2019.

/s Amy R. Atwood
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UNITED STATES DISTRICT COURT

DISTRICT OF OREGON

PORTLAND DIVISION

CENTER FOR BIOLOGICAL DIVERSITY, ET AL, Plaintiffs, v. DAUGHERTY, ET AL, Defendants, and OREGON FOREST INDUSTRIES COUNCIL, ET AL, Defendant-Intervenors.	Case No: 18-CV-1035 (MO) **EXPERT REPORT OF JOSHUA J. ROERING, PH.D.**

I. INTRODUCTION

I, Joshua J. Roering, Ph.D., state and declare as follows:

1. I, Dr. Joshua J. Roering, have been retained by plaintiffs in the above-captioned case to provide expert testimony on the impacts of logging and roads on geomorphic processes, particularly landsliding and road erosion in the Oregon Coast Range. Specifically, I have been

asked by the plaintiffs to provide testimony on landslide initiation, runout, and deposition as well as road erosion. In the past several years, I have visited the Tillamook State Forest to document landslide initiation and runout processes related to timber harvest and road practices.

2. The conclusions expressed herein are based on my extensive review of the relevant scientific literature as well as my own research on landslide and erosion processes in western Oregon and elsewhere. As detailed below, the hillslopes of western Oregon are very steep and highly dissected by valleys that have been formed by debris flows over geologic timescales. A multitude of scientific papers demonstrate how timber harvest practices increase the frequency of landsliding in these settings primarily by the post-harvest decay and reduction of root reinforcement. These shallow landslides often transition into debris flows that traverse the valley network and readily enter salmon-bearing streams. In addition, many papers demonstrate that hauling along hydrologically connected roads frequently contributes flows with high suspended sediment concentration to nearby streams owing to the reduced infiltration capacity of forest roads and abundant loose sediment.

3. This report and its attachments contain exhibits that may be used to summarize or support my opinions. I am being compensated by plaintiffs at a rate of $100/hour for time spent testifying in depositions or in trial, and at a rate of $50/hour for all other time spent on the matter. These rates are considerably less than the rates similarly qualified experts regularly charge in analogous proceedings; I am charging these reduced rates in light of the critical public interest in conserving salmon habitat. I have not testified as an expert at trial or by deposition in any case in the past twenty years. Unless otherwise noted, all opinions expressed reflect a reasonable level of scientific certainty and my understanding of geomorphic processes in steep, forested landscapes.

II. SUMMARY OF QUALIFICATIONS

4. I am Professor and Head of the Department of Earth Science at the University of Oregon and I have been on the faculty there since 2000. I received B.S. and M.S. degrees in Geological and Environmental Science from Stanford University in 1994 and 1995, respectively, and a doctorate degree in Geology from the University of California, Berkeley, in 2000. My research addresses hillslope geomorphology, with emphasis on digital terrain analysis, landscape evolution, and sediment production and transport processes.

5. From 2006 to 2008, I was an associate editor for the Journal of Geophysical Research-Earth Surface, and from 2012 to 2017, I served as an associate editor for the journal Earth Surface Processes and Landforms. I served on the Editorial Board of the journal Geology from 2006 to 2008 and from 2011 to 2014 I served on the Executive Committee of the American Geophysical Union's Earth and Planetary Surface Processes Focus Group. In 2014-2015, I was elected to the Board of Directors of UNAVCO, a 110+ employee, non-profit, NSF-funded geodesy consortium based in Boulder, Colorado.

6. In 2018, I was elected Fellow of the American Geophysical Union, a recognition bestowed to 0.1 percent of the 62,000-member scientific organization each year. Since 2001, my research grants from the National Science Foundation, NASA, and US Geological Survey have supported the research activities of my laboratory with total funds to the University of Oregon exceeding $2.5 million.

7. My experience includes extensive research on hillslope processes and landscape evolution. In particular, I have studied sediment production in steep, forested landscapes, including the mechanics of slope instability (i.e., landsliding). I have published over sixty articles on this and other research, almost exclusively in peer-reviewed professional journals, and have co-authored over ninety presentations at scientific meetings. I am a member of the American Geophysical Union and the Geological Society of America. My curriculum vitae and list of publications is attached to this report as Exhibit A.

8. From 1995 to 2000, I conducted my Ph.D. research on erosional processes, including landslides, involving extensive field work in the Oregon Coast Range. Prior to coming to the University of Oregon, I was a post-doctoral fellow at University of Canterbury, New Zealand, working on landslide processes and earthquake hazards. Since 2000, I have served on the faculty of the University of Oregon where I regularly teach geomorphology courses with significant field components and advise students on geomorphic thesis projects based in the Oregon Coast Range and elsewhere. The following publications are among those relevant to this case and establish my expertise in this topic:

Helen W. Beeson et al., *Deep-Seated Landslides Drive Variability in Valley Width and Increase Connectivity of Salmon Habitat in the Oregon Coast Range*, 54 J. Am. Water Resources Ass'n, 1325–1340 (2018).

Adam M. Booth, Josh J. Roering & J. Taylor Perron, *Automated Landslide Mapping Using Spectral Analysis and High-Resolution Topographic Data: Puget Sound lowlands, Washington, and Portland Hills, Oregon*, 109 Geomorphology, 132–147 (2009).

Kelly M. Burnett et al., *The Variability of Root Cohesion as an Influence on Shallow Landslide Susceptibility in the Oregon Coast Range*, 38 Can. Geotech. J., 995–1024 (2001).

Molly Jackson & Joshua J. Roering, *Post-Fire Geomorphic Response in Steep, Forested Landscapes: Oregon Coast Range, USA*, 28 Quaternary Sci. Rev., 1131–1146 (2009).

Christine May et al., *Controls on Valley width in Mountainous Landscapes: The Role of Landsliding and Implications for Salmonid Habitat*, 41 Geology 503–506 (2013).

Jill A. Marshall & Joshua J. Roering, *Diagenetic Variation in the Oregon Coast Range: Implications for Rock strength, Soil production, Hillslope Form, and Landscape Evolution*, 119 JGR, 1395–1417 (2014).

Brian D. Penserini, Joshua J. Roering & Ashley Streig, *A Morphologic Proxy for Debris Flow Erosion with Application to the Earthquake Deformation Cycle, Cascadia Subduction Zone, USA*, 282 Geomorphology, 150–161 (2017).

Joshua J. Roering et al., *Evidence for Biotic Controls on Topography and Soil Production*, 298 Earth and Planetary Sci. Letters, 183–190 (2010).

Joshua J. Roering et al., *Shallow Landsliding, Root Reinforcement, and the Spatial Distribution of Trees in the Oregon Coast Range*, 40 Can. Geotech. J.,, 237–253 (2003).

Joshua J. Roering, James W. Kirchner & William E. Dietrich, *Characterizing Structural and Lithologic Controls on Deep-Seated Landsliding: Implications for Topographic Relief and Landscape Evolution in the Oregon Coast Range, USA*, 117 GSA Bulletin, 654 (2005).

III. SHALLOW LANDSLIDING, TIMBER HARVESTING, AND SEDIMENT PRODUCTION IN THE OREGON COAST RANGE

9. Shallow landsliding is the primary erosional process in the Oregon Coast Range. According to the Oregon Department of Forestry ("ODF"), headwall sites (steep, convergent terrain) with a high risk of spawning shallow, rapidly moving landslides exhibit slope angles greater than sixty-five percent based on ten meter digital elevation models. Within the Tyee Core Area, ODF deems that slopes steeper than sixty percent are highly prone to shallow landsliding (ODF FP Technical Note #2, 2003). Topographic analyses of digital elevation models demonstrate that the vast majority of hillslopes in the Oregon Coast Range have slope angles that exceed these thresholds (Montgomery, 2001), making much of the landscape highly slide-prone.

10. In addition to being steep, landforms in the Oregon Coast Range are also heavily dissected by channels. While the steep angles promote shallow landsliding, the dense network of channels means that these mass failures need only travel a relatively short distance before entering the channel network. In this sense, the topography of this region leads to most

landslides delivering sediment directly to stream channels in the course of their runout.

11. Steep convergent terrain often serves as the initiation site for shallow landslides that can transform into debris flows, which are fluidized mixtures of sediment and water that flow downstream through the channel network for distances of hundreds to thousands of meters. Dietrich and Dunne's (1978) seminal work recognizing topographic hollows as sites of repeated landslide initiation was conducted in the Oregon Coast Range, as were subsequent studies using topographic data to identify zones susceptible to shallow landsliding (e.g., Montgomery & Dietrich, 1994; Montgomery et al. 2000). This work and other studies conducted in the Coast Range demonstrate that steep, convergent terrain defined as high-risk sites by ODF are strongly correlated with shallow landslides and can be identified using topographic data of sufficient resolution.

12. In the Pacific Northwest, numerous studies have shown that forest removal on high-risk sites increases the likelihood of shallow landslides. Evidence supporting the connection between timber harvest and shallow landsliding is vast and diverse (Takahasi, 1968; Endo & Tsuruta, 1969; Riestenberg & Sovonick-Dunford, 1983; Terwilliger & Waldron, 1991; Wu et al., 1979; Ziemer & Swanston, 1977; Reneau & Dietrich, 1987). In particular, (1) landslide inventories reveal higher landslide densities (typically reported as number of landslides per square kilometer) in clearcut terrain (Robison, 1999; Brardonini et al., 2003; Guthrie, 2002; Turner et al., 2010), (2) studies of root strength in forest stands with varying management histories demonstrate that root tensile load at failure decreases rapidly following timber harvest (Burroughs & Thomas, 1977; Schmidt et al., 2001), (3) laboratory measurements on rooted soils show increased strength above non-rooted soils, and (4) slope stability models including root reinforcement indicate that slopes are less likely to fail with the trees in place.

13. Plant root reinforcement contributes to the stability of steep slopes mantled by relatively coarse, cohesionless soils in the Oregon Coast Range. Models of slope failure that account for decreased lateral and basal root strength that typically occurs in the decade following timber harvest suggest a reduction in rainfall intensity and soil saturation required to trigger shallow landslides, thereby increasing the probability of landslides including debris flows (e.g., Schmidt et al., 2001; Wu & Sidle, 1995). Field-based analyses of shallow landsliding in an intensively studied, clearcut industrial forest site in the Oregon Coast Range support this prediction in that nearly half of the shallow landslides that followed harvest activities were triggered by relatively frequent (at approximately a four-year recurrence interval) rainfall events (Montgomery et al., 2000). The rate of landsliding (number of slides per square kilometer per year) observed in ten years following the harvest was calculated to be more than ten times greater than long-term (or background) rates. These results illustrate that common storms can generate extensive landsliding after timber harvest due to root strength decline as well as hydrologic changes associated with road building (Montgomery, 1994). A survey of landslide inventory studies in the Pacific Northwest demonstrates that landslide densities in terrain subject to timber harvesting experience a two to four times increase over ten to thirty year periods of study (Ice, 1985). Landslide erosion associated with roads can also be several hundred times greater than in forested areas (Swanson et al., 1987).

14. Following the 1996 storms in the Oregon Coast Range, I participated in a study measuring root strength on failed and unfailed hillslopes to determine how root reinforcement varies with forest stand properties (Schmidt et al., 2001). The median soil strength due to root reinforcement was found to be approximately one order of magnitude lower in clearcut sites and industrial forests than in unmanaged sites. This study also demonstrated that root reinforcement

predominately occurs along the lateral margins of unstable soil masses rather than along the base as was previously assumed. This invalid assumption led to underestimates of the contrasting root reinforcement found on clearcut hillslopes relative to hillslopes with mature forest cover. The study also reported that shallow landslides mapped in mature stands of industrial forest occurred in locales with a low density (or absence) of conifer trees. In sum, this study supports the notion that loss of root strength increases the frequency of shallow landslides.

15. Following a severe 2007 rain storm in Southwest Washington, Weyerhaeuser scientists mapped shallow landslides in areas with varying forest stand age and peak rainfall intensity (Turner et al.). In the area that experienced the highest rainfall intensities, which exceeded the 100-year event, landslide densities were highest in clearcut terrain and decreased with forest stand age. This study confirms that root reinforcement contributes to slope stability during intense storm events that caused record flooding in nearby streams.

16. Because root strength plays a prominent role in slope stability, prohibiting clearcutting on high-risk sites in order to maintain existing vegetation and root strength can be effective in reducing timber harvest-related slope failures in the Oregon Coast Range. The loss of root strength occurs regardless of the harvest technique used and increased susceptibility to shallow landsliding is an inherent byproduct of harvest activities.

17. When shallow rapid landslides enter and flow within steep channels, they often evolve into debris flows. Debris flows spawned by shallow landslides in steep, forested terrain like the Oregon Coast Range (May, 2002) typically deposit upon reaching valley slopes of less than five degrees (Benda & Cundy, 1990). As a result of this high mobility, debris flows are capable of traversing more than eighty percent of the channel network in mountainous terrain (Stock & Dietrich, 2003). During runout, debris flows tend to scour channels with slopes steeper

than eleven degrees and can traverse valley network junction angles less than seventy degrees (measured in planform). The average runout length of debris flows in clearcut and industrial forests is 280 to 290 meters, although more than twenty-five percent of debris flows had runouts exceeding 500 meters (May, 2002). Given that the average spacing between hillslopes and valleys is approximately 100 meters, individual debris flows can thus traverse multiple junctions within a watershed and thus impart a profound impact on channel form and sediment loading. Debris flows exhibit fluid-like behavior and entrain colluvium and wood debris that has collected in valley floors, often increasing their volume by ten times or more during their runout. According to May's Oregon Coast Range study of fifty-eight debris flows that occurred in 1996, the average rate at which debris flows entrain sediment during runout is five cubic meters per meter of channel length (May, 2002). As such, individual debris flows with runout lengths of 300 meters deliver approximately 1500 cubic meters of sediment to the channel network, while long-runout debris flows can deliver greater than 2000 cubic meters. Because the width of valley floors is relatively narrow (less than twenty meters) in steep, headwater catchments (May et al., 2013), the delivery of large debris flow deposits can have a profound and persistent influence on channel properties and sediment yield.

18. In steep, mountainous landscapes with forest cover, routine stream flows are often insufficient to transport significant sediment and wood deposits. Instead, debris flows end up being the primary mechanism by which sediment is transported to the second and third order streams in the channel network. Increased shallow landslide rates associated with timber harvesting significantly increase the frequency with which valley floors are subject to sediment deposition with concurrent impacts to channel and streambed morphology.

19. In industrial forests of the Oregon Coast Range, landslides typically supply less

wood and gravels to downstream reaches than in old-growth forests because large logs and riparian forests have been removed through logging (May, 2002). Instead, shallow landslides in these settings, and particularly debris flows, deliver a disproportionate amount of fine sediment to channel networks.

20. Hatten et al. (2018) used suspended sediment data from harvested and unmanaged watersheds in the Oregon Coast Range to conclude that contemporary harvest practices did not affect sediment yields over the course of monitoring between 2009 and 2016. The catchment exhibits a lower density of debris flow source areas than the unmanaged catchments used for comparison and thus appears to have a lower intrinsic propensity to produce landslides and debris flows. Also, the study was based a particularly small catchment area and the period of monitoring spanned a small number of water years (less than three) during which reduced root reinforcement on the hillslopes would have led to high landslide susceptibility. As such, this study does not accurately account for the frequently occurring coincidence of moderate-to-high intensity storms and clearcut conditions that trigger shallow landsliding. In fact, a recent lake sediment analysis by Richardson et al. (2018) highlights the rapid sedimentation that results when periods of timber harvest activity are followed by moderate-to-intense storms that increase sediment delivery to downstream reaches.

21. The context of climate events that trigger shallow landslides and debris flows in the western US has advanced significantly in recent years due to increasing awareness and quantification of atmospheric rivers. "Atmospheric rivers (AR) are long, narrow zones within extratropical cyclones that contain large quantities of water vapor and strong winds and are responsible for greater than ninety percent of all atmospheric water vapor transport in midlatitudes. They are thousands of kilometers long and, on average, only 400 km wide;

seventy-five percent of the water vapor transport occurs below 2.25-km altitude. ARs produce extreme precipitation in coastal regions because they transport large quantities of water vapor and comprise almost ideal conditions for producing heavy orographic rains and flooding when they encounter mountains." (Ralph & Dettinger, 2012). These climate phenomena have been studied in the context of landslide occurrence in the western US and studies report that the vast majority of historic shallow landslides were associated with atmospheric rivers (Cordeira et al., 2019; Oakley et al., 2017, 2018; Young et al., 2017). The Oregon coast receives the strongest atmospheric rivers on average and every one to two years events with intensities that are known to be capable of triggering shallow landslides impact western Oregon (Dettinger et al., 2018). As a result, the frequency with which western Oregon is subject to landslide-inducing rainfall events is high, occurring annually. Furthermore, the role of clearcutting in making terrain highly susceptible to slope failure is profound. Taken together, planned and on-going timber harvest in steep terrain of western Oregon is relatively certain to result in shallow landslides and debris flows.

IV. ROAD-RELATED SEDIMENT PRODUCTION IN THE OREGON COAST RANGE

22. In forested steeplands such as the Oregon Coast Range, gravel-surfaced roads can generate overland flow and surface erosion during rainfall events. Road drainage features, such as culverts, ditches, and cross drains, can transmit these sediment-laden flows from roads into natural waterways depending on the location and geometry of roads and channel networks. In addition, sidecast and fill materials associated with road construction can also fail during rainfall events and deliver sediment to channel networks. ODF recognizes forest roads as important sources of erosion and sedimentation and seeks to minimize road construction and use to decrease adverse effects of sediment delivery to natural waterways (ODF Road Manual, 2006).

23. Forest road construction involves the compaction of soils and aggregate during installation, drastically reducing the infiltration capacity of roads relative to undisturbed forest soils. As a result, relatively low intensity rainfall events can generate overland flow on road surfaces. In Western Washington, Reid and Dunne (1984) demonstrated that all rainfall events with intensity greater than 0.5 mm/hr generated overland flow and sediment mobilization along road surfaces. Because rainfall events with intensity greater than 1 mm/hr are common each year in the Oregon Coast Range (Goard, 2003), runoff and erosion along forest roads occurs frequently. In addition, cutbanks created along Oregon Coast Range roads can intercept shallow subsurface flow along forested hillslopes and contribute to increased runoff atop road surfaces (Gilbert, 2002).

24. Overland flow along roads can mobilize road aggregate materials, particularly fine particles, as well as particles derived from the underlying natural soil and bedrock, producing runoff with high concentrations of suspended sediment (Reid & Dunne, 1984; Fu et al., 2010). Field data gathered in the Pacific Northwest and elsewhere demonstrate that traffic intensity has a substantial impact on the concentration of suspended sediments in road runoff (Reid & Dunne; Toman & Skaugset, 2011; Sheridan et al., 2006; Ziegler et al., 2001). In these studies, the concentration of suspended sediment in road runoff increased four to twenty times as a vehicle passed before declining slowly in the ten to twenty minutes following vehicle passage. In the Clearwater River of Western Washington, the concentration of suspended sediments sourced from heavily used roads (more than four loaded logging trucks per day) is more than fifty times greater than that from lightly used roads (no logging trucks but some light vehicles) (Reid & Dunne, 1984). Thus, the use of forest roads by logging trucks greatly increases the potential for sediment mobilization and delivery to channel networks.

25. Routine road maintenance activities, such as ditch cleaning and vegetation removal along cutbanks, can also substantially increase road-derived sediment yield (Ziegler et al.). In the Oregon Coast Range, Luce and Black (2001) monitored sediment traps for sixty-eight road segments of varying slope, area, soil type, and treatment. They note that road maintenance activities such as re-grading and ditch cleaning increased sediment production by 7 times when compared with non-treated road sites. Furthermore, their data indicate that rates of erosion increase rapidly with the slope angle of road segments such that steep road segments have a high potential for delivering sediment to channels. Scientific papers that report road surface sediment production rates also note variability related to traffic levels, drainage design, geological substrate, maintenance, and other factors (Ramos-Scharron & MacDonald, 2005; Dube et al., 2004). According to Ramos-Scharron and MacDonald, average rates of road-derived sediment production are 5 to 10 $kg/m^2/yr$ (where m^2 refers to road surface area), although much higher rates of 55 to 125 $kg/m^2/yr$ have been observed in sites with high traffic intensity or highly erosive soils (Reid & Dunne; Ramos-Scharron & MacDonald). For the Clearwater Basin, Western Washington, road-related sediment production rates are 1, 10, and 125 $kg/m^2/yr$ for light, moderate, and heavy use roads, respectively (Reid & Dunne, 1984). In nearby small catchments of SE Washington, moderate- to heavy-use roads produced 2 to 4 $kg/m^2/yr$ (Bilby et al., 1989), coinciding with the low range of values reported by Ramos-Scharron & MacDonald.

26. More recently, Arismendi et al. (2017) studied the delivery of fine-grained sediment from unpaved forest roads and observed minimal impact of roads on observed suspended sediment concentrations. The study methodology used a relatively limited data acquisition scheme such that water samples were collected twice a day, specifically at noon and midnight. Because the suspended sediment contributions from hauling activities are short-lived

during vehicle passage (minutes to tens of minutes), this sampling scheme is deficient and, in my opinion, does not accurately reflect actual suspended sediment inputs. In addition, one of the two sampling sites only collected samples at midnight, a time when road erosion due to hauling is likely to be absent. Rather, the timing and magnitude of suspended sediment input to streams from roads increases strongly with precipitation intensity and the number of passages of logging trucks (van Meerveld et al., 2014).

27. Catchment-averaged road-related sediment delivery to streams can be calculated by multiplying the road-related sediment production rate by the fraction of catchment area covered by roads and the fraction of roads hydraulically connected to stream networks. In the Clearwater River, Reid and Dunne (1984) report that roads account for approximately one percent of the landscape surface and that approximately seventy-five percent of the roads are hydraulically connected. For light, moderate, and heavy traffic levels, these values imply road-related sediment delivery rates of 0.0075, 0.075, and 0.94 kg/m^2/yr, respectively, where m^2 now refers to catchment area. In the Clearwater River, long-term average erosion rates unaffected by historical land-use activities have been inferred from fission track analyses and imply catchment averaged sediment production rates of 0.5 kg/m^2/yr (Pazzaglia & Brandon, 2001). The analysis of Reid and Dunne thus indicates that road-related sediment yield is fifteen percent and greater than 150 percent of the background value for moderate and heavy use roads, respectively.

28. In the Oregon Coast Range and other regions of the Western US, numerous studies have shown that the construction and use of forest roads increase sediment yield by analyzing stream sediment datasets. Working in the Payette River of SW Idaho, Megahan et al. (2001) measured erosion following road construction and concluded that erosion rates were four times higher in the year following road building than in subsequent years because material

disturbed during construction was easily mobilized. In the Alsea River, Central Oregon Coast Range, research based on decades of hydrologic and sediment monitoring data have compared small, mountainous watersheds with different timber harvest treatments to assess how land management influences sediment yield (Brown & Krygier, 1971; Beschta, 1978). Following road construction, but before logging operations, sediment yields doubled in the treated watershed relative to the control (or 'untreated') watershed. This increase occurred in the absence of landsliding and resulted from runoff and erosion of road materials (Brown & Krygier). Longer-term data sets gathered at these sites in the Alsea River confirmed that sediment concentrations in watersheds with roads and timber harvesting consistently exceeded those in untreated sites (Beschta, 1978).

29. A recent study by Bywater-Reyes et al. (2017) in the Trask River of Western Oregon indicates that suspended sediment yield increased up to an order of magnitude following harvest activities (such as building of new roads) with the largest increases occurring in catchments underlain by friable sedimentary bedrock. Computer simulations support these findings and suggest that road use exerts a stronger control on suspended sediment delivery than road density (Arajuo et al., 2013).

30. The study by Hatten et al. also addressed road erosion in concluding that contemporary harvest practices did not affect sediment yields over the course of monitoring between 2009 and 2016. In that study, the road system in the small (ninety-four hectares) clearcut catchment was exclusively placed atop ridgetop locations, minimizing the potential role of hydrologically connected sediment sources.

V. EVALUATION OF IMPACTS OF OREGON DEPARTMENT OF FORESTRY LOGGING ON SHALLOW LANDSLIDES AND ROAD-RELATED SEDIMENT PRODUCTION

31. To assess the impacts of Oregon Department of Forestry authorized logging on shallow landslides and road-related sediment production, I conducted two site visits to the Tillamook State Forest and examined maps, Lidar data and modeling related to individual timber sales, roads and logging planned under ten-year implementation plans developed for the Tillamook and Forest Grove Districts of the Tillamook State Forest.

32. Mr. Curt Bradley, GIS Specialist at the Center for Biological Diversity, provided me with maps that showed timber sale boundaries, haul routes for these sales, hydrologically connected road sections and points in these haul routes, and streams with documented coho salmon presence. Based on data obtained from ODF, Mr. Bradley also mapped the total area to be potentially logged under the ten-year implementation plans within the sub-watersheds in which these timber sales occurred and across the Tillamook and Clatsop State Forests.

33. I instructed Mr. Bradley to add a digital elevation model (DEM) based on lidar data, which shows landscape features un-obscured by vegetation with a resolution of approximately one meter. Upon inspecting slope and shaded relief maps generated from the lidar DEM, I identified areas prone to shallow landsliding within the timber sales discussed in this report, as well as the areas identified for logging in the ten-year implementation plans for the two Districts in the sub-watersheds where the sales occurred. Based on this analysis, landslides associated with these sites have the potential to deliver sediments to known coho salmon-bearing streams.

34. I provided Mr. Bradley with the necessary knowledge to run a shallow landslide model called "SHALSTAB," which allowed him to map areas of high and very high landslide hazard using the lidar DEM. This is a frequently used and widely accepted model from the

published and peer-reviewed literature. I used the model to refine and confirm my conclusions about likely landslide initiation sites and pathways in the individual timber sales and planned logging areas under the ten-year implementation plans.

35. I further provided Mr. Bradley with knowledge to model likely debris flow inundation zones should the very high or landslide areas fail. Based on the information and instruction I provided, Mr. Bradley modeled likely debris flow inundation zones within the timber sales discussed in this declaration, where very high and high-risk areas were not buffered by ODF and potential debris flow inundation zones where roads utilized as haul routes by the sales cross very high, and high-risk, areas. I used this modeling to determine if landslides and debris flows generated by ODF clearcuts or roads are reasonably certain to reach coho salmon-bearing streams.

36. I used the maps of haul routes, hydrologically connected road sections and coho salmon presence to identify timber sales that will likely contribute road-related sediments to coho salmon-bearing streams.

37. Based on assessment of all of the information presented above, I conclude that logging in the timber sales I identified and within the associated sub-watersheds over the period of the ten year implementation plans is reasonably certain to contribute to shallow landslides that deliver sediments to coho salmon-bearing streams. I also conclude that hauling from several of the timber sales is likely to substantially increase fine sediment delivery to streams with coho salmon. The following discussion provides further support for these conclusions.

38. In December 2011, I visited the Tillamook State Forest to document and observe roads, streams, and hillslopes, and the potential for erosion and sedimentation related to land management activities. During the visit, I observed steep, landslide-prone topography and a

dense network of forest roads. Similar to my experiences in other parts of the Oregon Coast Range, watersheds in the Tillamook and portions of the Clatsop State Forests have a high density of stream channels, requiring roads to frequently cross tributaries as they traverse the landscape. At many of these crossings, a significant amount of road surface area is directed towards drainage features and the valley network.

39. Similar to my observations elsewhere in western Oregon, the road surfaces are sensitive to rainfall. During my visit, a light rain or drizzle fell intermittently, saturating road surfaces and generating puddles, particularly along valley bottom roads. Although the rainfall intensity was sufficiently light that overland flow and sediment transport was rare and rapidly dispersed when present, more intense rainfall would generate substantial runoff and sediment transport along road surfaces.

40. On July 9, 2014, I visited several proposed timber sales in the Tillamook State Forest to assess the potential for shallow landsliding and confirm my observations from analysis of DEMs. At each site, I traversed hillslopes and noted observations relevant to shallow landslide potential, namely steep headwalls, unchanneled valleys, and exposures of soil profiles via roadcuts or overturned trees.

A. <u>Wilson River Sites</u>

41. At the West Mill timber sale, I observed steep, unchanneled valleys characteristic of the Oregon Coast Range, which are the source of shallow landslides that translate into debris flows. Several overturned root wads at the site revealed approximately one meter thick soils, which is the typical depth of shallow landslides.

42. At the Diamond Point timber sale, I observed steep, ridge-valley topography with numerous unchanneled valleys just below the ridgeline. A fresh roadcut revealed thick soils.

Axial slope angles averaged thirty-five to forty degrees in unchanneled valleys.

43. At the Deer Fence timber sale, I observed continuously soil-mantled slopes and numerous unchanneled valleys, two of which had axial slope angles of thirty-three and thirty-seven degrees, respectively.

44. At the Lehman Heights timber sale, I traversed the lower slopes and valleys of the proposed harvest unit. At these lower positions, sideslopes that may be prone to shallow landsliding exhibited average angles of thirty degrees although upslope areas appear much steeper, consistent with slope maps generated from airborne lidar data.

45. Near the ridgeline of the Runyon Ex timber sale, I observed steep ridges and unchanneled valleys, with axial slope angles of forty degrees in several cases. Soils were consistently thick (approximately one meter or thicker), sufficient to spawn shallow landslides.

B. Trask River Sites

46. At the Haulin' Wood timber sale, I observed a fresh shallow landslide scar just below the ridgetop. Based on the age of hardwood trees growing on the slide surface, it appeared to be less than ten years old. The axial slope of the unchanneled valley was forty-two degrees and I observed multiple scars that coalesced in the valley axis, indicating a series of failures had occurred at this location. At another ridgeline location in this harvest unit, I observed wider unchanneled valleys with steep (thirty-five degree) axial slope angles. At this location, I also observed two fresh shallow landslides across the valley that appear have spawned debris flows that delivered sediment to the channel network.

47. At the Easy Money timber sale, I traversed a freshly cut ridgetop road and traversed a series of unchanneled ridges and valleys on either side of the ridgeline. I observed slope angles in unchanneled valleys of thirty-eight and forty-one degrees and additional sites in

the unit had a similar morphologic appearance. At this site, excavated soil, bedrock, and debris from road construction was frequently sloughed down into unchanneled valleys adding to the potential for shallow landsliding.

48. At all of the sites visited, these shallow landslide-prone areas had the potential to deliver sediment to downstream portions of the channel network identified as coho salmon-bearing streams.

49. Based on my field observations and examination of lidar DEMs, SHALSTAB model output and debris flow inundation modeling, I have determined that harvest activities associated with forty-seven timber sales from the ODF's 2018, 2019 and 2020 "Annual Operations Plans" are reasonably certain to result in shallow landslides that will impact coho salmon-occupied streams, including those identified in Table 1 below as having high landslide hazard (HLHL) areas.

50. I have also determined that harvest activities associated with thirty-five timber sales are reasonably certain to contribute fine sediments to coho salmon-occupied streams through hydrologically connected road segments or points on identified haul routes, including those identified in Table 1 below as having hydrologically connected roads (HCR).

51. The timber sales occur in a total of eleven sub-watersheds on the Tillamook and Forest Grove Districts. As demonstrated by the maps developed by the Center, there will be extensive logging in these and other watersheds under the ten-year implementation plans and Forest Management Plan for these districts, including an average of twenty-six percent of the total area in the eleven watersheds and as high as forty-seven percent in one of the watersheds in the next forty years. Much of this logging is slated to occur in high and very high landslide risk areas.

52. The eleven sub-watersheds that I examined have average road densities of over five miles per square mile, which is very high, and at least 456 miles of hydrologically connected roads. These conditions significantly add to the certainty that logging activities will contribute sediments to coho salmon-bearing streams.

VI. CONCLUSION

53. In sum, the timber sales I identified in this report and the Implementation Plans for the Tillamook and Forest Grove Districts, which identify substantial portions of the Tillamook and Clatsop State Forests for regeneration harvest and road construction, maintenance and use, are reasonably certain to increase sediment delivery to streams. Clearcutting will reduce root reinforcement of shallow colluvial soils and in combination with common rainfall events trigger shallow landslides that transition into debris flows and deliver directly to stream channels of the Tillamook and Clatsop State Forests. Construction of new forest roads will increase the density of road area with hydrologic connection to streams. Because road-stream channel connectivity is often unavoidable and road surfaces are highly sensitive to low- and moderate-intensity rainfall, the guidelines set forth in the 2003 ODF Wet Weather Road Use Technical Report will not eliminate sediment delivery to channels due to new road construction and road use in the Tillamook State Forest.

54. Reducing the likelihood of timber harvest-related sediment delivery to coho salmon-bearing streams from either shallow landslides or road-related sediments will require a prohibition on logging or road construction in areas identified as high or very high landslide risk and restricting hauling of timber to days when rainfall is below 1mm/hour.

DATED: December 2, 2019

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VII. TABLE 1

Name	Concern	District	AOP Year	Acres Total	Acres Clear-cut	Acres Partial Cut	New Road Miles	Maintained Road Miles
Ax Ridge	HLHL	Tillamook	2015	302	237	65	5.3	1.6
BD7	HLHL, HCR	Forest Grove	2019	150	150		0.74	11.37
Big Louie	HLHL	Forest Grove	2019	90	90		0.37	7.2
Brimstone	HLHL	Tillamook	2017	27	27		0.98	3.16
Broken Arrow	HLHL, HCR	Tillamook	2018	405	405		2.11	7.4
Buck Shot	HCR	Astoria	2020	177	177		0	10.4
Clean Slate	HCR	Astoria	2020	226	226		0	17.2
Coast Bill	HLHL	Tillamook	2020 ALT	331	331		2.25	10.46
Cruisin Murphy	HLHL	Tillamook	2020	194	194		0.46	13.79
Daisy Chain	HCR	Astoria	2018	77	77		0.2	7
Devil Ray	HLHL	Forest Grove	2020	189	189		0.84	11.9
Dragons Roost	HCR	Astoria	2020	202	202		0.1	23.9
Duchess and the Duke	HLHL	Forest Grove	2019	83	83		0.52	9.18
East Foley	HLHL	Tillamook	2019	226	226			10.4
Fireworks	HLHL	Tillamook	2016	330	330		0	15
Flinstone	HCR	Astoria	2019	49	49			
Forgotten Shorts	HLHL	Astoria	2020	67	67		0	1.9
Franken Fir	HLHL, HCR	Tillamook	2018	313	313		1.54	7.1
General Lee	HLHL, HCR	Tillamook	2018	157	157		0.94	10.9
Gold Rush	HLHL, HCR	Tillamook	2019	180	180		2.17	6.3
Ground Round	HCR	Forest Grove	2018	43	43			4
Hanns Down	HCR	Forest Grove	2019	104	104			9.97
Hembre Falls	HLHL	Tillamook	2020 ALT	181	181		0.51	9.3
High Standards	HLHL, HCR	Tillamook	2017	110	110		1.96	3.53
Hindsight	HCR	Forest Grove	2020	104	104			3.1

Homesteader	HCR	Astoria	2015	437	203	234	1.1	7.9
Hopscotch	HLHL	Tillamook	2018	111	0		0.9	6.1
Jethro Toll	HLHL	Tillamook	2019	333	333		1.75	6.97
Jordan Ridge	HLHL	Tillamook	2020 ALT	176	176		0.63	1.15
Kilchis Saddle	HLHL	Tillamook	2020	220	220		2.16	13.24
Knot Berry	HLHL	Tillamook	2017	193	193		1.67	2.6
Lobo Canyon	HLHL, HCR	Tillamook	2016	194	194		0.99	4.19
Long Walker	HCR	Astoria	2018	224	190	34	1.6	8.7
Lost Hill	HLHL	Tillamook	2018	236	236		1.9	6.5
Lost Overlook	HLHL	Astoria	2019	76	76			
Lost Pony	HLHL, HCR	Astoria	2015	159	159		0.2	5.3
Lou's Leftovers	HCR	Forest Grove	2019	123	123		0.3	8.89
Mor Nor Wolf	HCR	Forest Grove	2015	189	189		1.42	4.93
More Cow Bell	HLHL	Forest Grove	2019	96	96		1.14	11.14
My Mulligan	HCR	Forest Grove	2017	108	108		0	0
Nehalem Breaks	HCR	Forest Grove	2016	145	145		1.04	2.71
Nowhere Land	HCR	Astoria	2015	137	137		0.4	0.7
Old Bungee	HLHL, HCR	Tillamook	2020	225	225		0.91	9.62
Packy	HCR	Astoria	2015	213	213		0.6	12.4
Power Trip	HLHL	Forest Grove	2019	70	70		0.14	3.87
Quarter Mile	HLHL	Astoria	2015	68	68		1.9	0.8
Razorback	HLHL	Forest Grove	2020	113	113			12.32
Rocky 2	HLHL	Tillamook	2020	178	178		1.48	0.73
Rocky Rd	HLHL, HCR	Tillamook	2017	613	298	315	6.25	2.85
Round House	HCR	Forest Grove	2015	297	157	140	2.45	4.68
Sloopy	HLHL	Forest Grove	2019	69	69			16.85
Smith & Archers	HLHL	Tillamook	2020	205	205		1.97	8.81
South Bushong	HLHL	Tillamook	2019	222	222		0.81	9.88
South Minich	HLHL	Tillamook	2020	119	119		0.06	2.83

Southern Steamer	HLHL, HCR	Tillamook	2018	209	209		3.25	13.8
Spruce Run Ridge	HLHL, HCR	Astoria	2018	223	3	220	0.6	7.8
The Simms	HLHL, HCR	Tillamook	2016	949	949		3.36	3.4
Thor's Summit	HLHL, HCR	Tillamook	2018	107	107		2.4	12
Three Little Ridges	HCR	Tillamook	2016	348	348		3	8
Upper Horsehawk	HLHL	Astoria	2019	92	92		0.6	0.4
Voltaires Flair	HCR	Forest Grove	2017	363		363	0	0.5
Wild Bill	HCR	Astoria	2019	56	56		0.3	17.3
Willy Nilly	HLHL	Forest Grove	2019	189	189		0.59	21.19
Woods Way	HCR	Forest Grove	2017	110	110		0.87	2.3
Woody Woodpecker	HLHL	Astoria	2019	297	100	197		
Wooley Grade	HLHL	Tillamook	2020	102	102		0	7.77
ZZ Tops	HLHL	Tillamook	2020 ALT	126	126		1.38	6.2

VIII. LITERATURE CITED

H. Andres Araujo et al., *Modelling Changes in Suspended Sediment from Forest Road Surfaces in a Coastal Watershed of British Columbia: Modelling Changes In Suspended Sediment From Forest Road Surfaces*, 28 Hydrological Processes, 4914–4927 (2014).

Ivan Arismendi et al., *Suspended Sediment and Turbidity after Road Construction/Improvement and Forest Harvest in Streams of the Trask River Watershed Study, Oregon*, 53 Water Resources Res., 6763–6783 (2017).

Lee E. Benda & Terrance W. Cundy, *Predicting Deposition of Debris Flows in Mountain Channels*, 27 Can. Geotech. J., 409–417 (1990).

Robert L. Beschta, *Long-Term Patterns of Sediment Production Following Road Construction and Logging in the Oregon Coast Range*, 14 Water Resources Res., 1011–1016 (1978).

Robert E. Bilby et al., *The Generation and Fate of Road-Surface Sediment in Forested Watersheds in Southwestern Washington*, 35 Forest Sci., 453–468 (1989).

Francesco Brardinoni et al., *Complex Mass Wasting Response of Drainage Basins to Forest Management in Coastal British Columbia*, 49 Geomorphology, 109–124 (2003).

George W. Brown & James T. Krygier, *Clear-Cut Logging and Sediment Production in the Oregon Coast Range*, 7 Water Resources Res., 1189–1198 (1971).

K.M. Burnett et al., *The Variability of Root Cohesion as an Influence on Shallow Landslide Susceptibility in the Oregon Coast Range*, 38 Can. Geotech. J., 995–1024 (2001).

Edward R. Burroughs & Byron R. Thomas, *Declining Root Strength in Douglas-fir After Felling as a Factor in Slope Stability* (USDA Forest Serv. Res. Paper No. INT-190, 1977).

Sharon Bywater-Reyes et al., *Geology and Geomorphology Control Suspended Sediment Yield and Modulate Increases Following Timber Harvest in Temperate Headwater Streams*, 548 J. Hydrology, 754–769 (2017).

Jason M. Cordeira et al., *A 142-Year Climatology of Northern California Landslides and Atmospheric Rivers*, 100 Bull. Am. Meteorological Soc'y, 1499–1509 (2019).

Michael D. Dettinger et al., *Empirical Return Periods of the Most Intense Vapor Transports during Historical Atmospheric River Landfalls on the U.S. West Coast*, 19 J. Hydrometeorology, 1363–1377 (2018).

William E. Dietrich & Thomas Dunne, *Sediment Budget for a Small Catchment in Mountainous Terrain*, 29 Zietschrift fur Geomorphologie Suppl., 191–206 (1978).

Kathy Dubé et al., *Washington Road Surface Erosion Model Manual* (Prepared for Wash. Dep't Nat. Resources, 2004).

Taizo Endo & Teiji Tsuruta, *The Effect of Tree Roots on the Shearing Strength of Soil: Annual Report, Forest Experiment Station, Hokkaido*, 167–182 (1969).

Baihua Fu et al., *A Review of Surface Erosion and Sediment Delivery Models for Unsealed Roads*, 25 Envtl. Modelling & Software, 1–14 (2010).

Erin H. Gilbert, *Characterization of Road Hydrology in the Oregon Coast Range* (August 30, 2002) (M.S. thesis, Oregon State University).

Deborah Goard, *Characterizing the Spatial Distribution of Short Duration, High Intensity Rainfall in the Central Oregon Coast Range* (November 24, 2003) (M.S. thesis, Oregon State University).

R.H. Guthrie, *The Effects of Logging on Frequency and Distribution of Landslides in Three Watersheds on Vancouver Island, British Columbia*, 43 Geomorphology, 273–292 (2002).

Jeff A. Hatten et al., *Effects of Contemporary Forest Harvesting on Suspended Sediment in the Oregon Coast Range: Alsea Watershed Study Revisited*, 408 Forest Ecology and Mgmt., 238–248 (2018).

High Landslide Hazard Locations, Shallow, Rapidly Moving Landslides and Public Safety: Screening and Practices (ODF Forest Practices Tech. Note No. 2) (2003).

George G. Ice, *Catalog of Landslide Inventories for the Northwest* (1985).

Charles H. Luce & Thomas A. Black, *Sediment Production from Forest Roads in Western Oregon*, 35 Water Resources Res., 2561–2570 (1999).

Christine L. May, *Debris Flows Through Different Forest Age Classes in the Central Oregon Coast Range*, 38 J. Am. Water Resources Ass'n, 1097–1113 (2002).

Christine L. May et al., *Controls on Valley width in Mountainous Landscapes: The Role of Landsliding and Implications for Salmonid Habitat*, 41 Geology, 503–506 (2013).

Walter F Megahan, Monte Wilson & Stephen B Monsen, *Sediment Production from Granitic Cutslopes on Forest Roads in Idaho, USA*, 26 Earth Surface Processes and Landforms, 153–163 (2001).

David R. Montgomery, *Road Surface Drainage, Channel Initiation, and Slope Instability*, 30 Water Resources Res., 1925–1932 (1994).

David R. Montgomery, *Slope Distributions, Threshold Hillslopes, and Steady-state Topography*, 301 AJS, 432–454 (2001).

David R Montgomery et al., *Forest Clearing and Regional Landsliding*, 28 Geology, 311–314 (2000).

David R. Montgomery & William E. Dietrich, *A Physically Based Model for the Topographic Control on Shallow Landsliding*, 30 Water Resources Res., 1153–1171 (1994).

Nina. S. Oakley et al., *A 22-Year Climatology of Cool Season Hourly Precipitation Thresholds Conducive to Shallow Landslides in California*, 22 Earth Interact., 1–35 (2018).

Nina S. Oakley et al., *Synoptic Conditions Associated with Cool Season Post-Fire Debris Flows in the Transverse Ranges of Southern California*, 88 Nat. Hazards, 327–354 (2017).

ODF State Forests Program Forest Roads Manual (2006).

Frank J. Pazzaglia & Mark T. Brandon, *A Fluvial Record of Long-term Steady-State Uplift and Erosion Across the Cascadia Forearc High, Western Washington State*, 301 Am. J. Sci., 385–431 (2001).

F. M. Ralph & M. D. Dettinger, *Historical and National Perspectives on Extreme West Coast Precipitation Associated with Atmospheric Rivers during December 2010*, 93 Bull. Am. Meteorological Soc'y, 783–790 (2012).

Carlos E. Ramos-Scharrón & Lee H. MacDonald, *Measurement and Prediction of Sediment Production from Unpaved Roads, St. John, US Virgin Islands*, 30 Earth Surface Processes and Landforms, 1283–1304 (2005).

Leslie M. Reid & Thomas Dunne, *Sediment Production from Forest Road Surfaces*, 20 Water Resources Res., 1753–1761 (1984).

Steven L. Reneau & William E. Dietrich, *Size and Location of Colluvial Landslides in a Steep Forested Landscape*, *in* Erosion and Sedimentation in the Pacific Rim, 39–48 (Int'l Ass'n Hydrological Sci. Publication No. 165, 1987).

K.N.D. Richardson et al., *1500 Years of Lake Sedimentation Due to Fire, Earthquakes, Floods and Land Clearance in the Oregon Coast Range: Geomorphic Sensitivity to Floods During Timber Harvest Period*, 43 Earth Surface Processes and Landforms, 1496–1517 (2018).

Mary M. Riestenberg & Susan Sovonick-Dunford, *The Role of Woody Vegetation in Stabilizing Slopes in the Cincinnati, Area, Ohio*, 94 GSA Bull., 506–518 (1983).

E. George Robison et al., *Storm Impacts and Landslides of 1996: Final Report* (ODF Forest Prac. Monitoring Program Tech. Rep. No. 4, 1996).

Gary J. Sheridan et al., *The Effect of Truck Traffic and Road Water Content on Sediment Delivery from Unpaved Forest Roads*, 20 Hydrological Processes, 1683–1699 (2006).

J. Stock & William E. Dietrich, *Valley Incision by Debris Flows: Evidence of a Topographic Signature*, 39 Water Resources Res., ESG 1–25 (2003).

Frederick J. Swanson et al., *Mass Failures and Other Processes of Sediment Production in Pacific Northwest Forest Landscapes*, *in* Streamside Management: Forestry and Fishery Interactions, 9–38 (E.O. Salo & T. W. Cundy eds., 1987).

T. Takahasi, *Studies on the Forest Faculties to Prevent Landslide*, 18 Bull. Fac. Agric., Shizuoko U., 85–101 (1968).

Valery J. Terwilliger & Lawrence J. Waldron, *Effects of Root Reinforcement on Soil-Slip Patterns in the Transverse Ranges of Southern California*, 103 GSA Bull., 775–785 (1991).

Elizabeth Myers Toman & Arne E. Skaugset, *Reducing Sediment Production from Forest Roads during Wet-Weather Hauling*, 2203 Transp. Res. Rec., 13–19 (2011).

T.R. Turner et al., *Landslide Densities Associated with Rainfall, Stand Age, and Topography on Forested Landscapes, Southwestern Washington, USA,* 259 Forest Ecology Mgmt. v. 259, 2233–2244 (2010).

H. J. van Meerveld et al., *Controls on Sediment Production from an Unpaved Resource Road in a Pacific Maritime Watershed*, 50 Water Resources Res., 4803–4820 (2014).

Tien H. Wu et al., *Strength of Tree Roots and Landslides on Prince of Wales Island, Alaska*, 16 Can. Geotech. J., 19–33 (1979).

Weimin Wu & Roy C. Sidle, *A Distributed Slope Stability Model for Steep Forested Basins*, 31 Water Resources Res., 2097–2110 (1995).

Allison M. Young, Klint T. Skelly & Jason M. Cordeira, *High-Impact Hydrologic Events and Atmospheric Rivers in California: An Investigation Using the NCEI Storm Events Database*, 44 Geophysical Res. Letters, 3393–3401 (2017).

Alan D. Ziegler et al., *Interstorm Surface Preparation and Sediment Detachment by Vehicle Traffic on Unpaved Mountain Roads*, 26 Earth Surface Processes and Landforms, 235–250 (2001).

Robert R. Ziemer & Douglas N. Swanston, *Root Strength Changes After Logging in Southeast Alaska* (USDA Forest Serv. Res. Note No. PNW-306, 1977).

CERTIFICATE OF SERVICE

I hereby certify that on December 3, 2019, I caused the foregoing Expert Report of Joshua Roering Ph.D., Exhibit A, and supporting citations to be served on counsel of record for the State Defendants and Defendant-Intervenors.

Dated this 3rd day of December, 2019.

/s Amy R. Atwood
Amy R. Atwood
Attorney for Plaintiffs

EXHIBIT A

Joshua Joseph Roering

13-Nov-2019

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APPOINTMENTS

2019-	Head, Department of Earth Sciences, University of Oregon
2012-	Professor, Department of Earth Sciences, University of Oregon
2004-	Executive Committee, Environmental Studies Program, Univ of Oregon
2015-2019	Associate Head, Department of Earth Sciences, University of Oregon
2006-2012	Associate Professor, Department of Earth Sciences, University of Oregon
2001-2006	Assistant Professor, Department of Earth Sciences, University of Oregon
2000-2001	Postdoctoral Research Fellow, Univ of Canterbury, Christchurch, New Zealand
1995-2000	Graduate Student Researcher and Instructor, University of California, Berkeley
1994-1995	Graduate Student Researcher, Stanford University
1993	Wilderness Technician, National Park Service, Yosemite National Park
1992	Legislative Research Assistant (intern), Sierra Club, Washington D.C.

EDUCATION

Ph.D **University of California, Berkeley**, Geology, 2000
supervisors: Dr. William E. Dietrich and Dr. James W. Kirchner
Dissertation: "Topographic, experimental, and numerical investigations of nonlinear sediment transport and hillslope evolution"

M.S. **Stanford University**, Geological and Environmental Science, 1995
supervisors: Dr. David D. Pollard and Dr. J Ramon Arrowsmith
Thesis: "Near-surface and secondary deformation associated with blind thrust faults"

B.S. **Stanford University**, Geological and Environmental Science, 1994

RESEARCH INTERESTS

Quantitative geomorphology, earth surface processes, landscape evolution, tectonic geomorphology, landslide processes, high resolution topographic data

HONORS AND RECOGNITION

Fellow, American Geophysical Union, 2018
Exceptional Reviewer, *GEOLOGY*, Geological Society of America, 2014
Distinguished Lecturer, NSF GeoPRISMS Program, 2013-2014, 2014-2015
Fund for Faculty Excellence Award, University of Oregon, 2012
G.K. Gilbert Award for Excellence in Geomorphic Research, American Assoc. of Geog., 2011
Ersted Award for Distinguished Teaching, University of Oregon, 2005
Outstanding Student Paper, Hydrology Section, American Geophysical Union, 1998

GRANTS

Pending proposals

- *"Building a high-resolution landslide chronology for Cascadia megathrust earthquakes: Collaborative Research with University of Oregon and University of Arizona",* **National Earthquake Hazards Reduction Program (NEHRP), USGS,** 2020, $76,958 (UO portion). Lead PI (w/ Co-PI Bryan Black, Univ of Arizona).

Funded proposals

- *"Modern importance of shear on crustal faults in the Cascadia forearc: Examining tectonics and seismic hazard in the southern Willamette Valley, Oregon"*, **USGS EDMAP Program**, 2019, $17,473, Co-PI w/ W. Struble.
- *"Landslide Risk Management in Remote Communities: Integrating Geoscience, Data Science, and Social Science in Local Context"*, **NSF: Smart and Connected Cities** (CNS-1831770)**,** 2018-2022, $2,962,572 (UO portion $499,964), Co-PI with R. Lempert (RAND Corporation).
- *"RAPID: Post-fire lidar change detection, Eagle Creek fire, Columbia River Gorge, Oregon",* **NSF: Geomorphology and Land-use Dynamics** (EAR-1829442), 2018, $13,406, Lead-PI.
- *"Using landslide-dammed lakes to identify coseismic slope instability in Cascadia"*, collaborative w/ University of Texas and Department of Geology and Mineral Industries (DOGAMI), **National Earthquake Hazards Reduction Program (NEHRP), USGS,** 2018, $64,851 (UO portion). Lead PI (with Co-PIs Bryan Black, Univ of Texas, and Bill Burns, DOGAMI).
- "Form, process, and evolution of carbonate hillslopes in semi-arid climate", **US-Israel Binational Science Foundation (BSF)**, 2017-2021, $10,552 (UO portion), Co-PI w/ I. Haviv (Ben Gurion Univ, Israel).
- *"Investigation of Cascadia Earthquake Triggered Landslides"*, collaborative w/ Department of Geology and Mineral Industries (DOGAMI), **National Earthquake Hazards Reduction Program (NEHRP), USGS,** 2016-2017, $62,541 (UO portion). Lead PI (with Co-PI Bill Burns, DOGAMI).
- "*Collaborative Research:* Clarifying the ingredients and significance of nonlocal versus local sediment transport on steepland hillslopes", **NSF: Geomorphology and Land-use Dynamics** (EAR-1420898), 2014-2017, $113,000 (UO portion), Co-PI w/ D. Furbish and D. Morgan (Vanderbilt).
- "*Understanding oceanic and terrestrial controls on dissolved oxygen variability in the Coos Bay estuary*", **Oregon Sea Grant**, 2014-2016, $170,000. Co-PI w/ D. Sutherland (UO) and D. Gavin (UO).
- *"Incorporating hillslope transport into landscape evolution experiments"*, **NSF: Geomorphology and Land-use Dynamics** (EAR-1252177), 2013-2015, $184,000. Sole PI.
- "*Geomorphic change and hazard potential from landslides in a tectonically active landscape: Integrated investigations using InSAR, LiDAR, air photos, and ground-based studies",* **NASA: Earth Surface and Interior** (NNX15AR59G), 2012-2015, $489,952. Lead PI w/ Co-Is D. Schmidt (UW) and W. Schulz (US Geological Survey).
- *"Oregon: A cultural and natural history"*, a new, one-term block of integrated courses (Geology, Biology, and History), **Williams Fund for Undergraduate Education, University of Oregon**, 2011, $31,000, Co-PI w/ Bitty Roy (UO Biology) and Matt Dennis (UO History).

- *"Collaborative Research: Climatic and biotic controls on Late Quaternary erosion in the Oregon Coast Range"*, **NSF: Geomorphology and Land-use Dynamics** (EAR-0952186), 2010-2013, $324,535. Lead PI w/ Co-PI D. Gavin (UO) and Co-PI D. Granger (Purdue Univ).
- *"Sediment production via landsliding: Estimating temporal and spatial variability in the Waipaoa drainage basin, New Zealand, using InSAR, airborne LiDAR, and cosmogenic radionuclides"*, **NSF: MARGINS** (OCE-0841111), 2009-2012, $340,000. Lead PI w/ Co-PI D. Schmidt (UO).
- *"Quantifying landslide movement over seasonal to millenial timescales: Coupled analyses using InSAR, LiDAR, and cosmogenic radionuclides"*, **NASA: Earth Surface and Interior** (NNX08AF95G), 2008-2010, $263,000. Lead PI w/ Co-I. D. Schmidt (UO).
- *"Acquisition of a Computational Facility, Geological Sciences, University of Oregon",* **NSF: Instrumentation and Facilities**, 2007, $75,000, Co-I w/ D. Toomey (UO).
- *"Landsliding and the evolution of mountainous landscapes",* **NSF: Geomorphology and Land Use Dynamics** (EAR-0447190), 2005-2008, $154,010. Sole-PI.
- *"Quantifying climatic controls on sediment production and hillslope evolution"*, **NSF: Geology and Paleontology** (EAR-0309975), 2003-2006, $240,000. Sole-PI.

PUBLICATIONS (* denotes 1st author student/postdoc advisee)

Google Scholar: https://scholar.google.com/citations?user=VrTILJ0AAAAJ

Manuscripts

- *Roth, D.L., T.H. Doane, J.J. Roering, D.J. Furbish, and A. Zettler-Mann, (in review), **Particle motion on burned and vegetated hillslopes.**
- *Marshall, J.A., J.J. Roering, P.J. Bartlein, and A.W. Rempel, (in review), **Frost weathering across unglaciated North America during the Last Glacial Maximum**, *Science Advances*.
- *Wall, S., J.J. Roering, and F. Rengers, (in review), **Characterization of a runoff-initiated post-fire debris flow in the Western Cascades, Oregon**, *Landslides*.
- Ben-Asher, M., I. Haviv, J.J. Roering, and O. Crouvi, (in revision), **The potential influence of dust flux and chemical weathering on hillslope morphology: convex soil-mantled carbonate hillslopes in the East Mediterranean**, *Geomorphology*.
- *Lai, Larry Syu-Heng, J.J. Roering, N. Finnegan, R. Dorsey, and J.Y-Yee Yen, (in review), **Coarse sediment supply sets the slope of bedrock channels in rapidly uplifting terrain,** *GEOLOGY*.

Peer-reviewed publications

88 Thomas, A.M, Z. Spica, M. Bodmer, W. Schulz, and J.J. Roering, (in press), **Using a dense seismic array to determine resonances, structure, and ground motions at the Two Towers earthflow in northern California**, *Seismological Research Letters.*

87 Bodmer, M., D.R. Toomey, J.J. Roering, and L. Karlstrom, (in press), **Asthenospheric buoyancy and the origin of high-relief topography along the Cascadia forearc**, *Earth and Planetary Science Letters*.

86. *Struble, W., J.J. Roering, B. Black, W. Burns, N. Calhoun, and L. Wetherell, (in press), **Dendrochronological dating of landslides in western Oregon: Searching for signals of the Cascadia 1700 AD earthquake**, *Geological Society of America Bulletin*.

85 Finnegan, N., K. Broudy, A. Nereson, J.J. Roering, G. Bennett, and A. Handwerger, (2019), **Fluvial boulder transport controls valley blocking by earthflows in the California Coast Range, USA**, *Earth Surface Dynamics (ESURF)*, doi.org/10.5194/esurf-2018-75.

84 Johnson, G.M., D. A. Sutherland, J.J. Roering, N. Mathabane, and D.G. Gavin, (2019), **Estuarine dissolved oxygen inferred from sedimentary trace metal and organic matter preservation**, *Estuaries and Coasts, v.* 42, p. 1211-1225, doi.org/10.1007/s12237-019-00580-8.

83 *Schachtman, N.S., J.J. Roering, J.A. Marshall, D.G. Gavin, and D.E. Granger, (2019), **The interplay between physical and chemical erosion fluxes over interglacial-glacial cycles**, *GEOLOGY*, doi.org/10.1130/G45940.1

82. O'Hara, D.O., L. Karlstrom, and J.J. Roering, (2019), **Distributed landscape response to localized uplift and the fragility of steady states**, *Earth and Planetary Science Letters*, doi.org/10.1016/j.epsl.2018.11.006.

81. Emery-Wetherell, M.M., C. Matthew, C. Church, E. Dellard, E.B. Davis, and J.J. Roering, (2019), **The correlation of topographically-derived relative wetness with terrestrial mollusk presence and abundance**, *Malacologia*, 62, p. 225-236, https://doi.org/10.4002/040.062.0203.

80. Beeson, H.W, R.L. Flitcroft, M.A. Fonstad, and J.J. Roering, (2018), **Deep-Seated Landslides Drive Variability in Valley Width and Increase Connectivity of Salmon Habitat in the Oregon Coast Range**, *Journal of the American Water Resources Association,* doi:10.1111/1752-1688.12693.

79. Perkins, J., J.J. Roering, W. Burns, W. Struble, B. Black, K. Schmidt, A. Duvall, and N. Calhoun, (2018), **Hunting for the legacy of landslides from Cascadia's great earthquakes**, Eos (AGU), v. 99, https://doi.org/10.1029/2018EO103689.

78. Doane, T., D. Roth, J.J. Roering, and D. Furbish, (2018), **Compression and decay of hillslope topographic variance in Fourier wavenumber domain**, *Journal of Geophysical Research-Earth Surface*, doi.org/10.1029/2018JF004724.

77 Furbish, D.J., J.J. Roering, A. Keen-Zebert, P.C. Almond, T. Doane, and R. Schumer, (2018), **Soil particle transport and mixing near a hillslope crest: 2. Cosmogenic nuclide and optically stimulated luminescence tracers**, *Journal of Geophysical Research-Earth Surface,* doi.org/10.1029/2017JF004316.

76 Furbish, D.J., J.J. Roering, P.C. Almond, and T. Doane, (2018), **Soil particle transport and mixing near a hillslope crest: 1. Particle ages and residence times**, *Journal of Geophysical Research-Earth Surface,* doi.org/10.1029/2017JF004315.

75 Schulz, W.H., J.B. Smith, G. Wang, Y. Jiang, and J.J. Roering, (2018)**, Clayey landslide initiation and acceleration strongly modulated by soil swelling**, *Geophysical Research Letters,* doi: 10.1002/2017GL076807.

74 Doane, T.H., D.J. Furbish, J.J. Roering, R. Schumer, and D.J. Morgan, (2018), **Nonlocal sediment transport on steep lateral moraines, eastern Sierra Nevada Mountains, California, USA**, *Journal of Geophysical Research-Earth Surface,* doi:10.1002/2017JF004325.

73 Ben-Asher, M., I. Haviv, J.J. Roering, and O. Crouvi, (2017), **The influence of climate and micro-climate (aspect) on soil creep efficiency: cinder cone morphology and evolution along the eastern Mediterranean Golan Heights**, *Earth Surface Processes and Landforms*, doi: 10.1002/esp.4214.

72 Brantley, S.L., D.M. Eissenstat, J.A. Marshall, S.E. Godsey, Z. Balogh-Brunstad, D.L. Karwan, S.A. Papuga, J.J. Roering, T.E. Dawson, J. Evaristo, O.A. Chadwick, J.J. McDonnell, and K.C. Weathers, (2017), **Reviews and syntheses: On the roles trees play in building and plumbing the Critical Zone,** *Biogeosciences,* doi:10.5194/bg-14-5115-2017.

71 *Penserini, B., J.J. Roering, and A. Streig, (2017), **A morphologic proxy for debris flow erosion with application to the earthquake deformation cycle, Pacific Northwest, USA**, *Geomorphology*, doi:10.1016/j.geomorph.2017.01.018.

70 *Marshall, J.A., J.J. Roering, D. Granger, and D.G. Gavin, (2017), **Late Pleistocene climate controls on erosion in western Oregon**, *Geological Society of America Bulletin,* doi:10.1130/B31509.1.

69 *Sweeney, K.S., and J.J. Roering, (2016), **Rapid fluvial incision of a late Holocene lava flow: Insights from lidar, alluvial stratigraphy, and numerical modeling**, *Geological Society of America Bulletin*, doi:10.1130/B31537.1.

68 Rempel, A.W., J.A. Marshall, and J.J. Roering, (2016), **Modeling relative frost weathering rates at geomorphic scales,** *Earth and Planetary Science Letters*, doi:10.1016/j.epsl.2016.08.019.

67 *Handwerger, A.L., A.W. Rempel, J.J. Roering, and G.E. Hilley, (2016), **Rate-weakening friction characterizes both slow sliding and catastrophic failure of landslides**, *Proceedings of the National Academy of Sciences*, doi:10.1073/pnas.1607009113.

66. *Bennett, G.L., J.J. Roering, B.H. Mackey, A.L. Handwerger, and D.A. Schmidt, (2016), **Historic drought puts the brakes on earthflows in northern California,** *Geophysical Research Letters,* doi:10.1002/2016GL068378.

65. *Cerovski-Darriau, C., and J.J. Roering, (2016), **Influence of Anthropogenic Land-Use Change on Hillslope Erosion in the Waipaoa River Basin, New Zealand**, *Earth Surface Processes and Landforms,* doi:10.1002/esp.3969.

64 May, C.L., J.J. Roering, K. Snow, K. Griswold, and R. Greswell, (2016), **The waterfall paradox: How knickpoints disconnect hillslope and channel processes, isolating salmonid populations in ideal habitats**, *Geomorphology*, doi:10.1016/j.geomorph.2016.03.029.

63 Bennett, G.L.*, S. Miller, J.J. Roering, and D.A. Schmidt, (2016), **Landslides, threshold slopes, and the survival of relict terrain in the wake of the Mendocino Triple Junction,** *Geology*, doi:10.1130/G37530.1.

62 Kuehl, S.A., Alexander, C.R., Blair, N.E., Harris, C.K., Marsaglia, K.M., Ogston, A.S., Orpin, A.R., Roering, J.J., Bever, A.J., Bilderback, E.L., Carter, L., Cerovski-Darriau, C., Childress, L.B., Corbett, D.R., Hale, R.P., Leithold, E.L., Litchfield, N., Moriarty, J.M., Page, M.J., Pierce, L.E.R., Upton, P. and Walsh, J.P., (2015), **A Source to Sink Perspective of the Waipaoa River Margin,** *Earth-Science Reviews*, doi:10.1016/j.earscirev.2015.10.001, 34pp.

61 Marshall, J. A.*, J.J. Roering, P.J. Bartlein, D.G. Gavin, D.E. Granger, A.W. Rempel, S. Praskievicz, and T.C. Hales, (2015), **Frost for the trees: Did climate increase erosion in unglaciated landscapes during the Late Pleistocene?**, *Science Advances*, doi:10.1126/sciadv.1500715, 10pp.

60 Handwerger, A.L.*, J.J. Roering, D.A. Schmidt, and A.W. Rempel, (2015), **Kinematics of earthflows in the Northern California Coast Ranges using satellite interferometry**, *Geomorphology*, doi:10.1016/j.geomorph.2015.06.003.

59 Sweeney, K.E.*, J.J. Roering, and C. Ellis, (2015), **Experimental evidence for hillslope control of landscape scale**, *Science*, v. 349, p. 51-53, doi:10.1126/science.aab0017.

58 Roering, J.J., B.H. Mackey, A.L. Handwerger, A.M. Booth, D.A. Schmidt, G.L. Bennett, and C. Cerovski-Darriau, (2015), **Beyond the angle of repose: A review and synthesis of landslide processes in response to rapid uplift, Eel River, Northern California**, *Geomorphology*, doi:10.1016/j.geomorph.2015.02.013, (*invited review*), 23pp.

57 Pelletier, J., K.S. Sweeney, J.J. Roering, and N. Finnegan, (2014), **Controls on the geometry of potholes in bedrock channels**, *Geophysical Research Letters*, doi:10.1002/2014GL062900.

56 Cerovski-Darriau, C.*, J.J. Roering, M. Marden, A.S. Palmer, and E.L. Bilderback, (2014), **Quantifying temporal variations in landslide-driven sediment production by reconstructing paleolandscapes using tephrochronology and lidar: Waipaoa River, New Zealand**, *G-cubed (Geochemistry, Geophysics, and Geosystems),* doi:10.1002/2014GC005467.

55 Bilderback, E., J. Pettinga, N. Litchfield, M. Quigley, M. Marden, J.J. Roering, and A.S. Palmer, (2014), **Hillslope response to climate-modulated river incision in the Waipaoa Catchment, East Coast North Island, New Zealand**, *Geological Society of America Bulletin,* doi:10.1130/B31015.1.

54 McGuire, L., J. Pelletier, and J.J. Roering, (2014), **Development of topographic asymmetry: Insights from dated cinder cones in the western United States**, *Journal of Geophysical Research - Earth Surface,* doi:10.1002/2014JF003081.

53 Marshall, J.A.* and J.J. Roering, (2014), **Diagenetic variation in the Oregon Coast Range: Implications for rock strength, soil production, hillslope form, and landscape evolution,** *Journal of Geophysical Research - Earth Surface*, doi:10.1002/2013JF003004.

52. Chadwick, O.A., J.J. Roering, A.M. Heimsath, S.R. Levick, L.M. Khomo, and G.P. Asner, (2013), **Shaping post-orogenic landscapes by climate and chemical weathering**, *Geology,* doi:10.1130/G34721.1.

51 Handwerger, A.L.*, J.J. Roering, and D.A. Schmidt, (2013), **Controls on the seasonal deformation of slow-moving landslides**, *Earth and Planetary Science Letters*, doi:10.1016/j.epsl.2013.06.047.

50 Furbish, D.J., and J.J. Roering, (2013), **Sediment disentrainment and the concept of local versus nonlocal transport on hillslopes**, *Journal of Geophysical Research - Earth Surface*, doi:10.1002/jgrf.20071.

49 Roering, J.J., B.H. Mackey, J.A. Marshall, K. Sweeney, A.M. Booth, N. Deligne, A.M. Handwerger, and C. Cerovski-Darriau, (2013), **'You are HERE': Connecting the dots with airborne lidar for geomorphic fieldwork**, *Geomorphology*, doi:10.10106/j.geomorph.2013.04.009, (*invited*).

48. Booth, A.M.*, J.J. Roering, and A.W. Rempel, (2013), **Topographic signatures of deep-seated landslides and a general landscape evolution model**, *Journal of Geophysical Research - Earth Surface,* doi:10.1002/jgrf.20051.

47 Roering, J.J. and T.C. Hales, (2013), **Changing Hillslopes: Inheritance and Evolution of Slopes**, *Treatise on Geomorphology,* (editor): J. Schroder, v. 7, p. 284-305, Academic Press, San Diego, CA.

46 May, C., J. J. Roering, L.S. Eaton, and K.M. Burnett, (2013), **Controls on valley width in mountainous landscapes: The role of landsliding and implications for salmonid habitat**, *Geology,* doi:10.1130/G33979.1.

45 Deligne, N.I.*, K.V. Cashman, and J.J. Roering, (2013), **After the lava flow: the importance of external soil sources for plant colonization of recent lava flows in the central Oregon Cascades, USA,** *Geomorphology,* doi:10.10106/j.geomorph.2012.12.009.

44 Gavin, D., Anderson, M., and J.J. Roering, (2013), **Stumps, Tsunamis, and the Northern Range Limit of Sequoia sempervirens,** *Northwest Science,* v. 87, p. 81-94.

43 Lindeburg, K., P. Almond, J.J. Roering, and O.A. Chadwick, (2013), **Pathways of soil genesis in the Oregon Coast Range, USA**, *Plant and Soil,* doi 10.1007/s11104-012-1566-z.

42 Sweeney, K.E.*, J.J. Roering, P. Almond, and T. Reckling, (2012), **How steady are 'steady-state' landscapes? Using soil spectroscopy to quantify erosional variability,** *Geology,* v. 40, p. 807-810.

41 Roering, J.J., (2012), **Landslides Limit Mountain Relief** (News & Views), *Nature Geoscience*, v. 5, p. 446-447, doi:10.1038/ngeo1511.

40 Retallack, G.J. and J.J. Roering, (2012), **Water table platforms of rocky coasts and rivers**, *GSA Today*, v. 22, no. 6, p 4-10, doi: 10.1130/GSATG144A.1.

39 Mackey, B.H.*, J.J. Roering, and M.P. Lamb, (2011), **Landslide-dammed paleolake perturbs marine sedimentation and drives genetic change in anadromous fish**, *Proceedings of the National Academy of Sciences*, doi:10.1073/pnas.1110445108.

38 Booth, A.M.* and J.J. Roering, (2011), **A 1-D mechanistic model for the evolution of earthflow-prone hillslopes,** *Journal of Geophysical Research-Earth Surface*, doi:10.1029/2011JF002024.

37. Mackey, B.H.* and J.J. Roering, (2011), **Regional earthflow activity, erosion rates, and spatial characteristics determined from airborne LiDAR and historical aerial photographs, Eel River, California**, *Geological Society of America Bulletin*, doi:10.1130/B30306.1.1.

36 Roering, J.J., J. A. Marshall, A. Booth, M. Mort, and Q. Jin, (2010), **Evidence for biotic controls on topography and soil production**, *Earth and Planetary Science Letters,* v. 298, p. 183-190.

35. Calabro, M.*, D. Schmidt, and J.J. Roering, (2010), **An examination of seasonal deformation at the Portuguese Bend Landslide, Southern California, using radar interferometry**, *Journal of Geophysical Research-Earth Surface*, v.115, F02020, doi:10.1029/2009JF001314 (14 pg).

34. Hughes, M.*, P. Almond, J. Roering, and P. Tonkin, (2010), **Late Quaternary loess landscape evolution on an active tectonic margin, Charwell Basin, South Island, New Zealand,** *Geomorphology*, v. 122, p. 294-308.

33 Roering, J. J., L. Stimely, B. Mackey, and D. Schmidt, (2009), **Using DInSAR, airborne LiDAR, and archival air photos to quantify landsliding and sediment transport**, *Geophysical Research Letters*, v. 36, doi:10.1029/2009GL040374. (5 pg)

32. Walther, S.C.*, Roering, J.J., Almond, P.C., and Hughes, M.W., (2009), **Long-term biogenic soil mixing and transport in a hilly, loess-mantled landscape, Blue Mountains, SE Washington,** *Catena*, v. 79, p. 170-178.

31. Hughes, M.*, P. Almond, and J. Roering, (2009), **Increased sediment transport via bioturbation at the last glacial-interglacial transition,** *Geology*, v. 37, p. 919-922.

30. Mackey, B.H.*, J. Roering, and J. McKean, (2009), **Long-term kinematics and sediment flux of an active earthflow, Eel River, California,** *Geology,* v. 37, p. 803-806.

29. Booth, A.M.*, J.J. Roering, and J.T. Perron, (2009), **Automated landslide mapping using spectral analysis and high-resolution topographic data: Puget Sound lowlands, Washington, and Portland Hills, Oregon,** *Geomorphology*, v. 109, p. 132-147.

28. Jackson, M.* and J.J. Roering, (2009), **Post-fire geomorphic response in a steep, forested landscape: Oregon Coast Range, USA**, *Quaternary Science Reviews*, v. 28, p. 1131-1146.

27. Hales, T.C.* and J.J. Roering, (2009), **A frost buzzsaw mechanism for erosion of the Eastern Southern Alps, New Zealand**, *Geomorphology*, v. 107, p. 241-253.

26. Almond, P.C., J.J. Roering, M.W. Hughes, F.S. Lutter, and C. Leboutellier, (2008), **Climatic and anthropogenic effects on soil transport rates and hillslope evolution,** in: Sediment Dynamics in Changing Environments, *International Association of Hydrologic Sciences (IAHS) Publication 325*, p. 417-424.

25. Roering, J.J., (2008), **How well can hillslope evolution models 'explain' topography? Simulating soil transport and production with high-resolution topographic data,** *Geological Society of America Bulletin,* v. 120, p. 1248-1262.

24. Furbish, D.J., M. Schmeeckle, and J.J. Roering, (2008), **Thermal and force-chain effects in an experimental, sloping granular shear flow**, *Earth Surface Processes and Landforms,* v. 33, p. 2108-2117.

23. Roering, J.J., J.T. Perron, and J.W. Kirchner, (2007), **Functional relationships between denudation and hillslope form and relief,** *Earth and Planetary Science Letters,* v. 264, p. 245-258.

22. Reiners, P.W., S. Thomson, D. McPhillips, R. Donelick, and J.J. Roering, (2007), **Wildfire thermochronology and the fate and transport of apatite in hillslope and fluvial environments,** *Journal of Geophysical Research-Earth Surface,* v. 112, F04001, doi:10.1029/2007JF000759.

21. Almond, P., J.J. Roering, and T. C. Hales, (2007), **Using soil residence time to delineate spatial and temporal patterns of transient landscape response**, *Journal of Geophysical Research-Earth Surface*, v. 112, F03S17, doi:10.1029/2006JF000568.

20. Hales, T.C.* and J.J. Roering, (2007), **Climatic controls on frost cracking and implications for the evolution of bedrock landscapes***, Journal of Geophysical Research-Earth Surface,* v. 112, F02033, doi:10.1029/2006JF000616.

19. Dorsey, R.J. and J.J. Roering, (2006), **Quaternary landscape evolution in the San Jacinto Fault Zone, Peninsular Ranges of Southern California: Transient response to strike-slip fault initiation**, *Geomorphology*, v. 73, p. 16-32.

18. Hales, T.C.*, D.L. Abt, E.D. Humphreys, and J.J. Roering, (2005), **A lithospheric instability origin for Columbia River flood basalts and Wallowa Mountains uplift in northeast Oregon**, *Nature*, v. 438, p. 842-845.

17 Hales, T.C.* and J.J. Roering, (2005), **Climate controlled variations in scree production, Southern Alps, New Zealand**, *Geology*, v. 33, p. 701-704.

16. Roering, J.J. and M. Gerber*, (2005), **Fire and the evolution of steep, soil-mantled landscapes**, *Geology*, v. 33, p. 349-352.

15. Roering, J.J., J.W. Kirchner, and W.E. Dietrich, (2005), **Characterizing structural and lithologic controls on deep-seated landsliding: Implications for topographic relief and landscape evolution in the Oregon Coast Range, USA**, *Geological Society of America Bulletin*, v. 117, p. 654-668.

14. Roering, J.J., (2004), **Soil creep and convex-upward velocity profiles: Theoretical and experimental investigation of disturbance-driven sediment transport on hillslopes**, *Earth Surface Processes and Landforms,* v. 29, p. 1597-1612.

13. Kobor, J. S.* and J.J. Roering, (2004), **Systematic variation of bedrock channel gradients in the central Oregon Coast Range: Implications for rock uplift and shallow landsliding**, *Geomorphology*, v. 62, p. 239-256.

12 Roering, J.J., P. Almond, P. Tonkin, and J. McKean, (2004), **Constraining climatic controls on hillslope dynamics using a coupled model for the transport of soil and tracers: Application to loess-mantled hillslopes, Charwell River, South Island, New Zealand**, *Journal of Geophysical Research-Earth Surface,* v. 109, F01010, doi:10.1029/2003JF000034.

11. McKean, J. and J.J. Roering, (2004), **Landslide detection and surface morphology mapping with airborne laser altimetry**, *Geomorphology*, v. 57, p. 331-351.

10. Reid, M.E., D.L. Brien, R.G. Lahusen, J.J. Roering, J. de la Fuente, and S.D. Ellen, (2003), **Debris flow initiation from large, slow-moving landslides**, *in* D. Rickenmann & C. Chen (editors), *Debris-Flow Hazards Mitigation: Mechanics, Prediction and Assessment*, American Society of Civil Engineers (ASCE), Millpress, Rotterdam, p. 155-166.

9. Roering, J.J., K.M. Schmidt, J.D. Stock, W.E. Dietrich, and D.R. Montgomery, (2003), **Shallow landsliding, root reinforcement, and the spatial distribution of trees in the Oregon Coast Range**, *Canadian Geotechnical Journal*, v. 40, p. 237-253.

8 Dietrich, W.E., D.G. Bellugi, L.S. Sklar, J.D. Stock, A.M. Heimsath, and J.J. Roering, (2003), **Geomorphic transport laws for predicting landscape form and dynamics**, *in* R.M. Iverson and P. Wilcock (editors), *Prediction in Geomorphology*, Geophysical Monograph Series, Volume 135, American Geophysical Union, p. 103-132.

7 Roering, J.J., P. Almond, P. Tonkin, and J. McKean, (2002), **Soil transport driven by biological processes over millenial timescales**, *Geology*, v. 30, p. 1115-1118.

6. Roering, J.J., J.W. Kirchner, L.S. Sklar, and W.E. Dietrich, (2002), **REPLY: Hillslope evolution by nonlinear creep and landsliding: An experimental study**, *Geology*, v. 30, p. 482.

5. Schmidt, K.M., J.J. Roering, J.D. Stock, T. Schaub, W.E. Dietrich, and D.R. Montgomery, (2001), **The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range**, *Canadian Geotechnical Journal*, v. 38, p. 995-1024.

4. Roering, J.J., J.W. Kirchner, and W.E. Dietrich, (2001), **Hillslope evolution by nonlinear slope-dependent transport: Steady-state morphology and equilibrium adjustment timescales**, *Journal of Geophysical Research,* v. 106, p. 16,499-16,513.

3. Roering, J.J., J.W. Kirchner, L.S. Sklar, and W.E. Dietrich, (2001), **Experimental hillslope evolution by nonlinear creep and landsliding**, *Geology*, v. 29, p. 143-146.

2. Roering, J.J., J.W. Kirchner, and W.E. Dietrich, (1999), **Evidence for nonlinear, diffusive sediment transport on hillslopes and implications for landscape morphology**, *Water Resources Research*, v. 35, p. 853-870.

1. Roering, J.J., M.L. Cooke, and D.D. Pollard, (1997), **Why blind thrust faults do not propagate to the Earth's surface: Numerical modeling of coseismic deformation associated with thrust-related anticlines**, *Journal of Geophysical Research,* v. 102, p. 11,901-11,912.

Un-refereed contributions

- Roering, J.J., J R. Arrowsmith, and D.D. Pollard, (1996), **Characterizing the deformation and seismic hazard of a blind thrust fault near Stanford, California: Coseismic elastic modeling**, in: *Toward assessing the risk associated with blind faults, San Francisco Bay region*, edited by: A.S. Jayko, United States Geological Survey Open File Report 96-0267, p. 41-44.

INVITED TALKS

2019: Natural History Society, SE Alaska University; Tulane University; WINGS, University of Oregon Presidential Speaker Series, Portland, Oregon

2018: Oregon State University; Quack Chats (University of Oregon Pub Talk); Southwest Oregon Community College

2017: University of Arizona; Oregon Museum of Science and Industry (OMSI) Science Pub

2016: Cornell University; University of Southern California; Washington State University-Vancouver; California Forest Soils Council; NSF Earthscope Workshop on Mendocino Triple Junction, Humboldt, CA

2015: U.C. Berkeley; University of Pennsylvania; Rutgers University; Portland State University; Colorado State University; NSF Critical Zone Tree Workshop, Penn State University; National Academy of Sciences Landslide Workshop, Washington, D.C.; Eugene Rotary Club

2014: Lamont Doherty Earth Observatory/Columbia University; Lawrence University; Queens College (CUNY); University of Lausanne (Switzerland); ISTERRE, Universite Joseph Fourier (Grenoble, France); Universite Nancy (France); Obsidians Mountaineering Club (Eugene, OR); City Club of Eugene (w/ KLCC radio re-broadcast)

2013: Wesleyan University; Kent State University; Science Pub (Oregon Museum of Science and Industry); Environmental Studies Colloquium (UO)

2012: Northwestern University; Binghamton Geomorphology Symposium (Jackson, WY); Eugene Natural History Society; American Geophysical Union, Fall Mtg.

2011: University of Nevada, Las Vegas; NSF “Stochastic Transport and Emergent Scaling” STRESS workshop, Lake Tahoe, CA; Bureau of Land Management, Soils Meeting, Springfield, OR; AGU Chapman Conference, “Source to Sink Around the World and Through Time” (Oxnard, CA); American Geophysical Union, Fall Mtg.

2010: University of Washington; Washington State University; University of Idaho; Keck Institute for Space Science Workshop: “Monitoring Earth Surface Changes from Space”, Calif. Institute of Technology; UNAVCO Science Meeting, Boulder, CO.

2009: American Geophysical Union, Fall Mtg, San Francisco, CA; Geological Society of America, Annual Mtg., Portland, OR; Dept. of Geology and Mineral Industry (DOGAMI), Portland, OR; Lane County Council of Governments, LiDAR-GIS Workshop, Eugene, OR; Society of American Foresters, Mary’s Peak Chapter, Salem, OR.

2007: Stanford University; Gilbert Club, Berkeley Geomorphology Group, Berkeley, CA; University of Oregon (Geography); "Dynamic Interactions of Life and its Landscape", NSF-sponsored MYRES Workshop, New Orleans, LA; "Studying Earth Surface Processes with High-resolution Topographic Data", NSF Workshop, Boulder, CO.

2006: Yale University; University of California, Santa Barbara; Pennsylvania State University; Pardee Symposium "Erosion: Processes, Rates, and New Measuring Techniques", Geological Society of America, Philadelphia, PA; Society of American Foresters, Coos Chapter, Coos Bay, OR; Quaternary Research Center, University of Washington.

2005: University of California, Santa Cruz; Society of American Foresters, Emerald Chapter, Eugene, OR; National Center for Airborne Laser Mapping Annual Meeting, Gainesville, FL; Oregon State University.

2004: University of Washington; University of Colorado; American Geophysical Union, Fall Meeting; Pardee Symposium "Weathering, Slopes, Climate, and Late-Quaternary Geomorphic Change in Arid and Semi-Arid Landscapes", Geological Society of America, Denver, CO; Humboldt State University; University of Oregon (Center for Ecology and Evolutionary Biology); University of Oregon (Geography); University of Calgary (Biogeosciences Seminar); U.S. Forest Service, Regional Geology/Geotechnical Conference, Portland, OR.

2003: Penrose Conference "Tectonics, Climate, and Landscape Evolution," Taroko National Park, Hualien, Taiwan; National Center for Airborne Laser Mapping Workshop, Gainesville, FL.

2002: Purdue University; Portland State University; Oregon State University; University of Oregon; University of Canterbury, New Zealand.

2001: Lincoln University, New Zealand.

2000: Calif. Institute of Technology; University of Michigan; University of Minnesota; University of New Mexico; University of Oregon; University of Virginia; University of Canterbury, New Zealand.

TEACHING

Courses taught (University of Oregon)

Environmental Geology and Landscape Development (GEOL 102, Winter 2002-2007, 2010, 2012, 2015) 400+ student lecture that provides an introduction to surface processes and environmental geology. Coordinated discussion sections that expose students to geological and topographic maps and solutions to geological problems. Developed and built in-class physical demonstrations to illustrate hydrologic response, pore pressure effects on landsliding, contaminant transport in aquifers, and earthquake-induced landsliding.

Data Analysis for Earth and Environmental Sciences (GEOL 418/518, Spring 2004, 2006-2007, Winter 2009-2011, 2013, 2014, 2016, 2018) 30+ student (undergraduate and graduate) lecture and laboratory course surveying methods of data analysis, including descriptive statistics and data visualization, uncertainty analysis and error propagation, power analysis and hypothesis testing, regression and multiple regression, directional data analysis, and other topics. Implemented weekly computer-based laboratory exercises and problem sets that reflect a tools-based approach to statistical analysis.

Hillslope Geomorphology (GEOL 441/541, Spring 2003, 2005; Fall 2008, 2010, 2012, 2015, 2017) 20+ student (undergraduate and graduate) lecture and laboratory course exploring hillslope processes, including hillslope hydrology, mechanics of mass movements, weathering and soil formation, and overland flow erosion. Developed three field-based projects for which students wrote scientific reports summarizing their field data, analyses, and interpretations. Developed a series of laboratory exercises involving air photos, maps, and computer simulations.

Tectonic Geomorphology (GEOL 410/510, Spring 2008, 2013, Win 2019) 12+ student (undergraduate and graduate) lecture and laboratory course exploring landform evolution in response to tectonic forcing. Topics included: erosional controls on rock uplift, thermochronology, bedrock river incision models, and marine terraces. Developed three field-based projects for which students wrote scientific reports summarizing their field data, analyses, and interpretations. Developed a series of laboratory exercises involving air photos, maps, and computer simulations.

River Mechanics (GEOL 410/510, Fall 2011) 20 student lecture and lab based course on the physics of rivers, including hydraulics, sediment transport, and bedrock incision. Topics included: derivation of fluid momentum equations, velocity profiles, hydraulic modeling using energy equation, and theories for bedrock incision. The course included a field trip with collection and analysis of velocity profile data and a final project using airborne lidar data to reconstruct discharge history, sediment transport, and bedrock incision for a Cascade stream channel.

Oregon Environmental Geology (GEOL 308) & Oregon: A cultural and natural history (ENVS 399) (Spring 2011, 2014, 2017) 20+ student lecture and seminar, part of a 4-course, one-term block of integrated courses including Biology (taught by Prof. Bitty Roy) and History (taught by Prof. Matthew Dennis). Lectures and weekly fieldtrips introduced environmental geologic problems relevant to the Willamette Valley, Oregon Coast and Coastal Ranges, and Eastern Oregon. Seminar included diverse weekly reading and discussion. The block of courses also included a 7+ day field trip based at the Malheur field station and independent student research presentations and reports. Funded by the UO Williams Council, $31,000.

Field Geology (GEOL 450, Summer 2002, 2003, 2006) 10 to 25 student course that introduces students to geological field methods. Co-taught 10-day project comprised of: 1) mapping volcanic features using air photos and field data, and 2) detailed surveying of wave-cut benches and re-construction of paleo-lake levels at Fort Rock, Central Oregon using GPS, total station, and plane table methods.

Student mentoring and collaboration (University of Oregon)

Postdoctoral mentoring

Annette Patton, 2019- , Landslide warning in remote communities

Danica Roth, *2016-2018,* Nonlocal transport on steepland landscapes

Georgina Bennett, *2014-2015*, Remote sensing, landslide inventories, and stream network analysis

Graduate students (primary advisor)

Brooke Hunter, PhD., *current*, Fire and erosion of forested steeplands

Elijah Orland, M.S., *current*, Shallow landslide initiation in SE Alaska

William Struble, PhD., *current*, Earthquakes and steepland landscape evolution

Nathan Schachtman, M.S., *2017,* Paleo-perspective on climate-driven weathering.

Samuel Shaw, M.S., *2017*, The evolution of gully networks on slow-moving landslides.

Brian Penserini, M.S., *2015*, Debris flow network morphometry and earthquake deformation cycle.

Nathan Mathabane, M.S., *2015*, Historical sedimentation in Coos Bay estuary, Oregon.

Corina Cerovski-Darriau, PhD., *2015*, Landsliding in the Waipaoa catchment, New Zealand.

Kristin Sweeney, PhD., *2015*, Experimental landscape evolution and bedrock channel incision modeling.

Jill Marshall, PhD., *2015*, Climate and biotic controls on soil production and sediment transport.

Alex Handwerger, PhD., *2015*, Satellite interferometry for landsliding.

Adam Booth, PhD., *2012*, Modeling slope instability and landscape evolution.

Benjamin Mackey, PhD., *2009*, The contribution of slow-moving landslides to landscape evolution.

Laura Stimely, M.S., *2009*, Quantifying Landslide Movement at the Boulder Creek Earthflow Using L-band InSAR (co-advised with D. Schmidt).

Max Calabro, M.S., *2008*, An examination of surface displacement at the Portuguese Bend landslide, Southern California, using radar interferometry (co-advised with D. Schmidt).

T.C. Hales, Ph.D., *2006*, Climatic controls on scree production and erosion of the Southern Alps, New Zealand.

Amanda MacLeod, M.S., *2006,* Coupling meteorological data with hydrologic and slope stability models to constrain controls on shallow landsliding.

Suzanne Walther, M.S., *2006*, Using soil stratigraphy and tephra chronology to constrain climatic controls on sediment production and landscape evolution, Eastern Washington.

Molly Gerber, M.S., *2004*, Post-fire erosional response in the Oregon Coast Range.

Michelle Mort, M.S., *2003*, Quantifying rates of bedrock erosion by tree throw and root action in the Oregon Coast Range.

Undergraduate thesis supervision

Leah Youngquist, B.S honors thesis, *2018*, Mapping the critical zone using portable XRF, Oregon Coast Range

Noah A Paoa Kannegiesser, B.S honors thesis, *2018*, Controls of badland erosion, Painted Hills, Central Oregon.

Logan Wetherell, B.S., thesis, *2014*, Lichenometry for exposure dating along the Oregon Coast.

Adam Schreiner-McGraw, B.S. honors thesis, *2012*, Soil spectroscopy for landslide chronology in the Oregon Coast Range.

Colgan Smith, B.S. honors thesis, *2009*, Post-glacial river incision and gorge formation in Southern Alps, New Zealand.

Jacob Selander, B.S. honors thesis, *2004*, Characterizing knickpoints and their tectonic implications in the Siuslaw River, Oregon Coast Range.

Jeremy Sierra Kobor, B.S., honors thesis, *2002*, Using the stream power model and topographic data to quantify differential uplift in the Oregon Coast Range, (co-advised with Becky Dorsey).

Sarah Chylek, undergraduate honors thesis, *2002*, Quantifying the signature of captured streams in the Oregon Coast Range using digital elevation models, (co-advised with Becky Dorsey).

SERVICE

Institutional

Chair, Curriculum Committee, Earth Sciences, 2015-2019
Associate Department Head, Earth Sciences, 2015-2019
Chair, Geodesy faculty search committee, Earth Sciences, 2016-2017.
Departmental Merit Review Committee, Earth Sciences, University of Oregon, 2014, 2016, 2018.
General Science Major review committee, College of Arts and Sciences, University of Oregon, 2014-2015.
Departmental promotion and tenure committee, Earth Sciences, UO, 2013-2014, 2014-2015.
Chair, Earth Surface Process Modeling Search Committee, Earth Sciences, UO, 2012-2013.
Chair, Departmental 10-yr review committee, Earth Sciences, University of Oregon, 2011-2012.
Undergraduate Council member, University of Oregon, 2009-2010.
Curriculum Committee member, College of Arts and Sciences, University of Oregon, 2008-2010.
Graduate Admissions Committee, Environmental Studies Program, University of Oregon, 2007, 2009, 2011, 2014, 2015 (chair in 2009 and 2011).
Scholarships and Awards Committee, Environmental Studies Program, University of Oregon, 2006-present.
Diversity Committee, Environmental Studies Program, University of Oregon, 2006-2009.
Curriculum Committee, Department of Earth Sciences, University of Oregon: 2004-2009.
Awards and Admissions Committee, Earth Sciences, University of Oregon, 2009-2014.
Ambassador, Teaching Effectiveness Program, University of Oregon, 2004-2006.
Comprehensive Ph.D. Examination Coordinator, Department of Earth Sciences, University of Oregon: 2001-2006.
Library Representative, 2001-2003, Department of Earth Sciences, University of Oregon
Seminar Coordinator, Spring 2003, Fall 2008, Department of Earth Sciences, University of Oregon
Physical Processes Faculty Search Committee, 2002-2004, Department of Earth Sciences, University of Oregon.
IntroDucktion Academic Advisor, 2003-present, Department of Earth Sciences, University of Oregon
Guest Lecturer, Biology 310: Forest Biology, University of Oregon, Fall 2004.
Guest Lecturer, General Science Freshman Seminar Series, University of Oregon, 2002, 2003.

Professional

Departmental Review Committee, Earth and Environmental Science, Wesleyan University, 2016.
Member, Committee of Visitors EAR Division, National Science Foundation, June 2017
Panel member, PREEVENTS program, National Science Foundation, January 2017, 2018
Chair, Organizing Committee, UNAVCO Science Workshop, Boulder, CO, March 2016
Member, Board of Directors, UNAVCO (110+ employee, non-profit, NSF-funded geodesy consortium), Boulder, CO, 2014-2015.
Panel Member, NSF Program: Frontiers in Earth Surface Dynamics Program (FESD), 2013.
Associate Editor, Earth Surface Processes and Landforms, 2012-2016.
Convener, GeoPRISMS-Earthscope Cascadia Workshop, Portland, OR, April 2012.

Organizer/Convener, Bretz Club: Meeting of Oregon Geomorphologists, Charleston, OR, 2012, 2013.

Panel Member, NASA Earth Surface and Interior program, 2011.

Panel Member, NSF Geomorphology and Land-use Dynamics, 2007-2009.

Editorial Board member, GEOLOGY*,* Geological Society of America, 2006-2008.

Associate Editor, Journal of Geophysical Research – Earth Surface, American Geophysical Union, 2006-2008.

Associate Editor (with Kelin Whipple), Special Volume, Journal of Geophysical Research – Earth Surface, "Beyond Steady State: The Dynamics of Transient Landscapes", American Geophysical Union, 2006-2007.

Chair, Steering Committee, National Center for Airborne Laser Mapping (NCALM), 2007-2008, NSF-sponsored facility, University of Florida and University of California, Berkeley.

Steering Committee Member, National Center for Airborne Laser Mapping (NCALM), 2005-2008, NSF-sponsored facility, University of Florida and University of California, Berkeley.

Convener, *Hydrology Section, American Geophysical Union,* Fall Meeting, 2006, "Earth Surface: Processes and Landscapes", with Elizabeth Safran and Daniel Malmon.

Convener, *Hydrology Section, American Geophysical Union,* Fall Meeting, 2005, "Earth Surface: Processes and Landscapes", with Elizabeth Safran.

Convener, *Hydrology Section, American Geophysical Union,* Fall Meeting, 2005, "Advances in Airborne Laser Swath Mapping: Data Analysis and Discoveries in the Earth Sciences", with Michael Oskin and Clint Slatton.

Convener, Hydrology Section, American Geophysical Union, Fall Meeting, 2002, "Climatic and Tectonic Controls on Hillslope Processes and Sediment Production", with Andrew Meigs and Stephen Lancaster.

Gilbert Club Conference Co-coordinator, 1999-2000, Dept. of Earth and Planetary Science, University of California, Berkeley (informal conference of geomorphologists attended by 100+ participants each year in December following AGU meeting).

Publications reviewed for: Nature, Science, Geology, Proceedings of the National Academy of Sciences, Geophysical Research Letters, Icarus, Earth and Planetary Science Letters, Water Resources Research, American Journal of Science, Journal of Geophysical Research, Geomorphology, Earth Surface Processes and Landforms, Remote Sensing of the Environment, Ecological Engineering, Tectonophysics, and Journal of Geoscience Education.

Proposals reviewed for: NSF-Integrated Earth Systems, NSF-Critical Zone Observatory, NSF-Frontiers in Earth Surface Dynamics, NSF - Geology and Paleontology, NSF - Geomorphology and Land-use Dynamics, NSF-Tectonics, NSF - EarthScope, NSF - MARGINS, NSF – Antarctic Geology and Geophysics, NSF - Instrumentation and Facilities, NASA-Earth Surface and Interior.

Number of publications and proposals reviewed/edited by year: 1999:1, 2000:3, 2001:5, 2002:7, 2003: 10, 2004: 14, 2005: 17, 2006: 28, 2007: 48, 2008: 32, 2009: 21, 2010: 18, 2011: 19, 2012: 24, 2013: 28, 2014: 35, 2015: 30, 2016: 28, 2017: 14.

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UNITED STATES DISTRICT COURT

DISTRICT OF OREGON

PORTLAND DIVISION

CENTER FOR BIOLOGICAL DIVERSITY, ET AL, Plaintiffs, v. DAUGHERTY, ET AL, Defendants, and OREGON FOREST INDUSTRIES COUNCIL, ET AL, Defendant-Intervenors.	Case No: 18-CV-1035 (MO) **AMENDED EXPERT REPORT OF KELLY M. BURNETT, PH.D.**

I. STATEMENT OF QUALIFICATIONS

1. I, Kelly M. Burnett, Ph.D., reside at 5360 SW Whitby Ave, Corvallis, OR 97333. I was retained by Plaintiffs to provide expert testimony regarding the potential of timber sales authorized by the Oregon Department of Forestry (ODF) on the Tillamook and Clatsop State

Forests, *see* Appendix ("App.") A, *infra*, to "take" coho salmon (*Oncorhynchus kisutch*). I understand "take" in the context of the Endangered Species Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect" any individual of the species and to include modifying or degrading habitats of the species, "impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering." Coho salmon in the State Forests contribute to the persistence of the Evolutionarily Significant Unit of Oregon Coast coho salmon, which is listed as Threatened under the federal Endangered Species Act, 16 U.S.C. §§ 1531-1544.

2. Plaintiffs are compensating my time testifying in depositions or in trial at a rate of $100/hour, with a maximum of $700/day, and at a rate of $50/hour for all other time spent on the matter.

3. As a fisheries biologist and watershed scientist, I have expertise that emphasizes Oregon Coast coho salmon and the effects of forestry on landslide and debris flow characteristics. I hold a courtesy faculty appointment in the Department of Fisheries and Wildlife at Oregon State University and an Emeritus Research Scientist position with the USDA Forest Service Pacific Northwest Research Station. I am also on the Graduate Faculty in the Department of Forest Ecosystems and Society and in the Environmental Sciences Program at Oregon State University.

4. I graduated *magna cum laude* from Berry College in 1980, receiving a B.S. degree in Biology and in Chemistry. I received M.S. and Ph.D. degrees in Fisheries Science from Oregon State University in 1987 and 2001, respectively. My graduate research examined water-quality effects on aquatic ecosystems and relationships among salmon, their habitats, watershed characteristics, and forestry practices.

5. My career, spanning over 30 years, focuses on management, policy, and research of aquatic ecosystems in forested landscapes. While working as a research scientist with the USDA Forest Service Pacific Northwest Research Station, I was a principal investigator on several competitively funded research grants, including the Coastal Landscape Analysis and Modeling Study that evaluated the bio-physical effects of alternative forest policies in the Oregon Coast Range. Other of my research projects targeted understanding how stream habitats are distributed and used by salmon, how salmon and their habitats interact with watershed processes and human uses, and how such complex ecosystems can be modeled for planning and evaluating actions to recover and sustain salmon populations. I have presented my research results through numerous invited presentations and 48 peer-reviewed publications.

6. I have relevant experience that includes consulting across disciplines, agencies, and jurisdictions to identify areas of high restoration/conservation value for salmon, review forest management and implementation plans for consistency with best available science, and advise policymakers. Thus, I served on the Forest Ecosystem Management and Assessment Team (FEMAT) convened by President Clinton to formulate and evaluate options for managing federal forest lands in the range of the northern spotted owl. I also served as the National Fish and Aquatic Program Leader with the USDA Forest Service's Washington Office of Research and Development. I have received many awards and my career was recognized for professional excellence in research by the Chief of the US Forest Service (National Rise to the Future Award).

7. My current *curriculum vitae* (Exhibit A) elaborates on my education, professional experience, and publications. It includes a list of all publications from the last 10 years. I have not served as an expert at any time in the past four years.

II. **INTRODUCTION**

8. The timber sales authorized on the Tillamook, Forest Grove, and Astoria Districts of the State Forests, *see* App. A, require activities associated with harvesting trees and transporting logs that can alter the forest and aquatic ecosystems that support coho salmon. Negative consequences of these ecosystem alterations on coho salmon are manifested through many biophysical pathways and processes, including those that influence landscape routing of water, wood, and sediment. Numerous studies have documented the wide-ranging negative effects that forestry practices can have on salmon, specifically on coho salmon, during the freshwater period of their life cycle. Evidence that forestry-related ecosystem alterations can kill salmon and degrade their habitats is provided from studies across the range of Pacific salmon (*Oncorhynchus spp).* Consequently, measures to mitigate impacts on salmon and their habitats are commonly applied, voluntarily or by regulation, in forestry operations. Through mitigation measures in the Northwest Oregon State Forests Management Plan, Implementing Plans, Annual Operations Plans, and other regulatory guidance, the Oregon Department of Forestry recognizes and attempts to address the potential adverse effects to coho salmon of logging and roading.

9. My objective in this report is to assess the likelihood: (1) that authorized timber sales will alter processes of water, wood, and sediment routing to adversely affect coho salmon, and (2) that mitigation measures specified in authorized timber sales will minimize such adverse effects. I based my conclusions on professional judgment, site visits to a representative subset of timber sales on the Tillamook State Forest, and a map-based assessment of 67 authorized timber sales at issue in the lawsuit. Consequently, I conducted a literature review of studies examining: (1) how forestry practices may affect routing processes for water, wood, and sediment; (2) how changes in these processes may affect coho salmon and their habitats; and (3) the types and

effectiveness of mitigation measures implemented on State Forests that are intended to minimize negative effects of forestry practices. Studies from the Oregon Coast Range and studies focusing on coho salmon were emphasized. I also considered my own research in the Oregon Coast Range characterizing relationships among forest management, riverine habitats, and coho salmon abundances. My observations from site visits as well as methods and results for the map-based assessment of authorized timber sales are detailed subsequently in this report.

III. KEY TERMS

10. Bedrock hollow is an area of steep, convergent topography that accumulates soil over centuries and concentrates storm runoff (Dietrich & Dunne, 1978).

11. Debris flow is a rapidly moving slurry of soil, water, and organic material that can travel through small, steep streams before depositing in a less steep area (Benda et al., 2005).

12. Headwater streams are typically small, start high on hillslopes, and have flowing water mostly in wetter periods. These can comprise up to 90% of stream networks in the Oregon Coast Range (Benda & Dunne, 1997a).

13. Hydrologically connected refers to a road that interacts with a stream network primarily via surface flowpaths (Flanagan et al., 1998).

14. Landslides in the context of this report refer to mass movements of shallow soils (Iverson et al., 1997). A landslide that initiates in an inner gorge may deliver sediment directly to coho salmon habitat. Precipitation-generated landslides that initiate in bedrock hollows often produce debris flows that can deliver wood and large volumes of sediment to coho salmon habitats downstream.

15. Limiting factor is a biological, chemical, or physical condition and related ecological processes that can constrain the viability of a population (NMFS, 2016).

16. Riparian area is the transition zone between a stream and upland forest that influences processes and structures of aquatic ecosystem (Gregory et al., 1991).

17. Watershed is the land area within which water drains to a single point. Watersheds can be delineated above any location on a stream. A watershed with a large drainage area is often called a basin.

IV. A CHANGING ENVIRONMENTAL REGIME

18. Populations of coho salmon in the Oregon Coast Range persisted under a dynamic environmental regime that began with the onset of the Holocene Epoch (Waples et al., 2008). The terrain in the Oregon Coast is generally steep and highly dissected by streams. Much of the landscape is prone to initiating landslides and many streams have characteristics that foster transport of debris flows over long distances (Montgomery et al., 2001; Benda & Dunne, 1997a). Consequently, landslides and debris flows are the dominant erosional processes in much of the Oregon Coast Range (Dietrich & Dunne; Swanson et al., 1982). Prior to Euro American settlement, fires that burned entire stands in this heavily forested region were relatively infrequent (return intervals of approximately 200 years) (Impara, 1997; Long et al., 1998; Long et al., 2007). For the 10 to 30 years after a stand-replacing fire, early successional vegetation (herbaceous plants, shrubs, and seedlings) would have dominated (Wimberly, 2002) and the strength of roots holding soil on hillslopes would have declined in burned areas (Jackson & Roering, 2009). When root strength was low following a fire, rainstorms of intensities common in the Oregon Coast Range would have triggered landslides and debris flows in the burned area (Benda & Dunne, 1997a; May & Gresswell, 2003a; Wondzell & King, 2003). Rainstorms here can also initiate landslides and debris flows in intact forests but are more likely to do so after forest disturbance (e.g., May, 2002). Early successional vegetation would have retained legacies

from the pre-fire forest necessary for ecosystem recovery (Swanson et al., 2011). Among the most critical of these legacies for coho salmon were standing dead and dying trees and downed wood in the bedrock hollows, riparian areas, and headwater streams that are capable of initiating or transporting debris flows to coho salmon habitat (May, 2002).

19. As forestry became the main land use over the last century in the Oregon Coast Range (Spies et al., 2007), the dynamic environmental regime under which coho salmon evolved was significantly altered by logging and roading. Although areas of the Oregon Coast Range are currently mapped as open or early successional vegetation (Ohman et al., 2007), such areas now typically derive from clear-cut timber harvest rather than fire. The fire regime was characterized by infrequent disturbances followed by centuries of recovery. Thus, late-successional forests (older than 80 years) dominated the Oregon Coast Range, comprising on average about 60% but at times up to 80% of the area (Wimberly). The single most abundant forest type was old growth (older than 200 years), which occupied on average 42% of the landscape (Wimberly). Pervasive clear cutting in the Oregon Coast Range has left 17% of the area in late-successional forests with only 1% of this in old growth (Ohmann et al.). Late-successional forests are not evenly distributed among ownership classes but are concentrated on federal lands. Forestry practices driven by clear cutting typically leave few standing and downed trees (Ohmann et al.) and log replanted saplings after 60 to 80 years (Cohen et al., 2002). This results in young forests on 71% of the landscape (Ohmann et al.), a scant legacy of large wood, and little time for recovery between disturbances.

20. Timber harvest (i.e., cutting trees, yarding logs, and disposing of logging waste) in the Oregon Coast Range increases sediment production primarily from landslides and debris flows (Swanson et al., 1977; Montgomery et al., 2000). Here, the strength of roots that reinforce

hill slopes and reduce susceptibility to landslide initiation is much lower in clear-cut areas than in fire-regenerated older (200 years) forests and the period of low root strength can be longer following clear cutting than fire, extending up to 100 years (Schmidt et al., 2001). Consistent with this, Miller & Burnett (2007) found that average landslide density in the Oregon Coast Range was less in older forests (6.5 landslides/mile^2) than in recently harvested areas (21.8 landslides/mile^2) or in younger forests (8.0 landslides/mile^2) after accounting for topographic variability between sites, size of the area examined, and detection bias in aerial photo inventories. This study used a regional database from Bush et al. (1997) and Robison et al. (1999) compiled from thousands of landslides initiated by the intense winter storms of 1996/1997 (Hoffmiester, 2000). As compared to landslides and debris flows associated with fire, those associated with timber harvest tend to contain less wood and greater volumes of sediment relative to wood (May, 2002).

21. Timber harvest in the Oregon Coast Range has depended on constructing, maintaining, and using an extensive network of roads, which had no analog under the dynamic environmental regime. Forest road networks are well-documented to alter storm runoff and sediment routing (e.g., Gucinski et al., 2001; Croke & Hairsine, 2006). For most rainfall events in the Oregon Coast Range, the infiltration capacity of forest soils is not exceeded, and thus surface runoff and erosion are low in undisturbed forests (Johnson & Beschta, 1980). Magnitudes of both can increase substantially in association with unpaved roads as shown in many forested mountainous regions (McDonald & Coe, 2008), including the Oregon Coast Range (Luce & Black, 1999). Surface runoff can increase where compacted roadbeds reduce infiltration and cut slopes above roads intercept shallow subsurface flows (Jones et al., 2000). Sediment concentrations in surface runoff from unpaved forest roads can rise considerably with

road use (Bilby et al., 1989; Luce & Black, 2001; Van Meerveld et al., 2014). To illustrate, in a coastal Washington basin, 70% of sediment from surface erosion originated from the 6% of unpaved roads with heavy traffic for log hauling (more than four trucks per day) (Reid et al., 1981) and these roads, when heavily used, produced sediment at seven-and-a-half times the rate when not in use (Reid & Dunne, 1984).

22. Although chronic erosion can be substantial, the majority of road-related erosion is episodic in coastal mountain ranges of the Pacific northwestern United States. Most sediment generated from roads is caused by landslides and debris flows (e.g., Reid et al., 1981). Roads and ditches can concentrate and increase storm runoff to destabilize downslope hill sides and fill slopes (Wemple & Jones, 2003). Roads in western Oregon have been shown to alter landslide and debris flow characteristics, including increasing the likelihood of occurrence, sediment volumes, and runout lengths above those for intact forests or harvested areas (e.g., Amaranthus et al., 1985; May, 2002; Miller & Burnett, 2007). These factors led to sediment production from roads that were 49 times greater than from forested areas in the Oregon Coast Range (Swanson et al., 1977). Landslides and debris flows can originate from ridge-top roads (Montgomery, 1994) but generate the greatest volume of sediment from mid-slope roads (Wemple et al., 2001). In the Oregon Coast Range, Sessions et al. (1987) found landslides associated with both mid-slope and ridge-top roads but observed fewer landslides with smaller volumes where road layout attempted to minimize mid-slope positions. They noted the majority of their inventoried landslides were initiated by storms with a return interval of three to five years and thus by relatively low rainfall amounts typical of such storms.

V. IMPLICATIONS FOR OREGON COAST COHO SALMON

23. Under the dynamic environmental regime, Oregon coastal streams provided high-quality habitats for coho salmon during all freshwater life stages, and thus supported numerous coho salmon year-round as embryos, juveniles, or adults. Characteristics of high-quality habitats for coho salmon have long been understood to include cool, well-oxygenated water, availability of preferred insect prey species, deep pools, abundant large wood, and clean spawning gravels (Quinn, 2018). Upland and riparian forests fostered high-quality habitat for coho salmon by shading streams, regulating water runoff and erosion, stabilizing stream banks, and supplying large wood (Naiman et al., 1992; NRC, 1996). Indeed, at least half of all wood in streams likely came from forests upstream or upslope of coho salmon habitats and was delivered by landslides and debris flows (May & Gresswell, 2003b; Reeves et al., 2003; Bigelow et al., 2007). Some of the storm-generated debris flows that initiated in bedrock hollows and traveled through headwater streams would have deposited in lower gradient channels that provided coho salmon habitat (Benda & Cundy, 1990; Benda & Dunne, 1997b; Benda et al., 2005; Miller & Burnett, 2007). These debris flows consisted of sediment and wood that scoured and/or buried streams (Benda 1990), destroying habitats and undoubtedly killing fish (Everest & Meehan, 1981). Such consequences, however, were typically localized and not synchronized across the landscape, allowing any surviving fish to seek refuge in high-quality habitats of unaffected areas. As stream flows sorted the sediments and scoured around the wood delivered by debris flows, deep pools were formed, gravels were cleaned, and habitat complexity recovered (Reeves et al., 1995). Connections among complex habitats would have supported reproduction, summer rearing, winter rearing, and migration for robust populations of Oregon Coast coho salmon (Ebersole et al., 2006; Flitcroft et al., 2012; Flitcroft et al., 2014; Hance et al., 2016).

24. Although the dynamic regime under which Oregon Coast coho salmon evolved and thrived for 12,000 years was changing, yearly spawning runs in the late 1800s were estimated at 1.5-2.5 million coho salmon adults entering Oregon coastal rivers (Meengs & Lackey, 2005). By contrast, the number of returning coho salmon has averaged 167,000 adults annually since the State adopted its Oregon Coast Coho Conservation Plan (ODFW, 2007) (http://www.odfwrecoverytracker.org). During the years from 2007 to 2018, average annual coho salmon abundance was 11,000 for the Nehalem River basin and 3,300 for the Tillamook Bay basin. These two basins cover most of the area in the Tillamook and Clatsop State Forests. The Nehalem River and Tillamook Bay populations contribute to the North Coast Stratum and are two of the 21 independent populations comprising the Oregon Coast coho salmon ESU (Ford et al., 2015). Average annual abundances of coho salmon in these basins are 5% (Nehalem River basin) and 2% (Tillamook Bay basin) of historical abundances estimated by Meengs & Lackey.

25. Despite overfishing, hatchery practices, and hydropower being key anthropogenic causes of declining populations of salmon in Oregon (Kostow, 1997) and elsewhere throughout their range (Nehlsen et al., 1991), degradation of freshwater habitat is a prime contributor to low abundances of Oregon Coast coho salmon (ODFW; NMFS). The Northwest Oregon State Forests Management Plan acknowledges, "In general, the planning area's instream habitat conditions indicate that current freshwater productivity may be at a low point." (ODF, 2010). The basic recovery strategy for coho salmon populations of the North Coast Stratum aims to protect stream reaches with high-quality rearing habitats by restoring watershed processes and to improve conditions in degraded stream reaches capable of developing high-quality rearing habitats (NMFS). The Oregon Coast Coho Conservation Plan indicates the need for 437 miles of additional high-quality habitat in the Nehalem River and Tillamook Bay basins (ODFW).

26. Forestry-related changes to the dynamic environmental regime caused much of the habitat degradation that was a crucial factor in decisions to list the Oregon Coast coho salmon ESU as Threatened under the United States Endangered Species Act (Stout et al., 2012). The science addressing how forestry can alter water, sediment, and wood routing processes to degrade freshwater habitats and harm salmon is vast and well summarized (e.g., Salo & Cundy, 1987; Meehan, 1991; Murphy, 1995; Spence et al., 1996; Stouder et al., 1997; Northcote & Hartman, 2004). Taking just one of many possible examples, forestry practices can increase runoff and thus increase magnitudes of peak stream flows, including those resulting from storms with rainfall amounts common in any year (Harr et al., 1975; Jones & Grant, 1996). When peak flows increase the depth of annual stream-bed scour below the typical depth that females have adapted for burying their eggs, then spawning nests are destroyed and population reproductive success can suffer (Montgomery et al., 1996, Montgomery et al., 1999).

27. The numerous effects of forestry manifest not in isolation but through multiple interrelated pathways (Hicks et al., 1991). To illustrate, the predominance of young forests in the Oregon Coast Range may widely subject coho salmon to harm that arises from low stream flows. Average summer flows were 50% less for streams in younger forests (younger than 50 years) of the Oregon Cascade Range than for streams in older forests (150 to 500 years) (Perry & Jones, 2016). This was attributed primarily to the water demands of young trees to support high transpiration rates. Lower flows can decrease the total length of available rearing habitat as the stream network contracts in summer and cause pools to become smaller, isolated, or completely dry. Because juvenile coho salmon prefer pools (Bisson et al., 1988), responses of this habitat type to low flows can reduce the abundance and survival of coho salmon (Sharma & Hilborn, 2001; Obedzinski et al., 2018). In an Oregon Coast Range stream with thick alluvial deposits,

May & Lee (2004) found that 83% of pools were dry by late summer. Furthermore, remaining pools were isolated from each other, half as deep as earlier in the season, and supported 59% fewer juvenile steelhead and coho salmon. Fish rearing during summer in small shallow pools, particularly in isolated pools or those lacking large wood, can suffer physiological stress from overcrowding; grow slowly, increasing overwinter mortality; starve due to lack of food drifting from upstream; and become more available to predators (e.g., Magoulick & Kobza, 2003). Lower summer flows can also exacerbate stream warming (Arismendi et al., 2013) that occurs where forestry practices have diminished shade or elevated sediment delivery (Beschta et al., 1987; Poole & Berman, 2001; Cover et al., 2010). Both have contributed to warm stream temperatures that exceed harmful thresholds for coho salmon (Richter & Kolmes, 2005) and are a limiting factor for populations in the Nehalem River and Tillamook Bay basins (NMFS).

28. Loss of stream habitat complexity was identified as the primary limiting factor for Oregon Coast coho salmon populations of the North Coast Stratum (NMFS). This loss was attributed primarily to decreased large wood and increased sediment in streams (Stout et al.). Large wood in coho salmon streams is necessary to store nutrients and spawning gravels, create complex pools for juvenile rearing, and provide cover from predators for migrating adults and rearing juveniles (e.g., Bilby & Bisson, 1998; Naiman et al., 2002). Discontinued practices of splash damming to transport logs and overzealous cleaning of logging slash are partially responsible for the current paucity of in-stream wood (Naiman et al., 2002; Miller, 2010). However, amounts of large wood continue to decline in streams of the North Coast Stratum (NMFS). Negative correlations between large wood and forest cover, as a proxy for recent timber harvest, have been documented for many streams in the Pacific northwestern United States (e.g., Bilby & Ward, 1991; Montgomery et al., 1995; Burnett et al., 2006). Younger forests were

associated with smaller sizes and volumes of wood from a regional sample of Oregon Coast Range streams (Wing & Skaugset, 2002, Anlauf et al., 2011). In a south coastal Oregon basin, Burnett et al. (2006) determined that the density of large wood in pools was positively related to the percent area of older forests. The relationship was strongest when forest cover was considered not just in the riparian zone immediately adjacent to salmon habitats but also included upslope areas and headwater streams as wood sources for these habitats. Headwater streams are essential for supplying food, nutrients, water, sediment, and wood to larger streams (Wipfli et al., 2007).

29. Timber harvest that decreases the amount of large wood in headwater streams can alter sediment and wood routing to coho salmon habitats downstream. Large wood traps sediment in headwaters streams, which otherwise may have limited storage capacity, slowing downstream transport (Gomi et al., 2005). Where headwater streams in the Oregon Coast Range contained less large wood, debris flows traveled farther (May, 2002; Lancaster et al., 2003). Longer travel distances increase the likelihood that a debris flow will run out beyond the headwater stream network to kill coho salmon and destroy their habitats. Longer travel distances were also shown in the Oregon Coast Range to increase the volume of sediment accumulated by debris flows (May, 2002; Reid et al., 2016) further increasing their immediate destructive potential. Debris flows that contain less large wood and more sediment as a result of timber harvest offer little toward the future development of complex rearing and spawning habitat for coho salmon.

30. Roads, as well as timber harvest, are major sediment sources contributing to the loss of stream habitat complexity. By influencing landslide and debris-flow characteristics, roads have greatly increased sediment delivery to streams. Amounts of delivered sediment can

overwhelm stream transport capacity (e.g. Montgomery & Buffington, 1997), producing thick deposits of coarse-grained, unsorted sediments that fill and widen channels, bury spawning beds, and cause pools to lose surface area and depth (e.g., Everest & Meehan, 1981; Buffington et al., 2002). Road-generated sediments can also deliver to streams by overland flow, where roads parallel streams or cross streams via culverts, or by channelized flow, where ditches drain into stream-crossing culverts or gullies form downslope of engineered drainage features (Wemple et al., 1996; Pechenick et al., 2014). In southwestern Washington, approximately 34% of road drainage features that were surveyed entered streams (Bilby et al., 1989). Channelized drainage has also been shown to initiate landsliding below roads in the Oregon Coast Range (Montgomery, 1994). Gullies occurred below the outlet for 38% of 515 culverts sampled in the Oregon Coast Range (Piehl et al., 1988). Of the erosion associated with these culverts, 72% was from landslides. Densities of both streams and forest roads are high in the Oregon Coast Range, maximizing opportunities for hydrologic connections between the two networks and sediment delivery to streams.

31. Although most sediment generated from roads is from landslides and debris flows, erosion from road surfaces yields an equal volume of the fine-grained sediments (Reid et al, 1981) that are particularly harmful to coho salmon when delivered to streams (Koski, 1966; Cederholm et al., 1981). Since Harrison (1923) reported that fine sediments can negatively affect the number of fry emerging from spawning nests, the topic has stimulated sustained interest and at least 100 publications exploring the effects of fine sediments on salmonid egg-to-fry survival (Jensen et al. 2009). In analyzing data from the most rigorous of these studies, Jensen et al. (2009) determined that the odds of survival for coho salmon decrease 18.3% for every 1% increase in fine sediment (grain size less than 0.85 mm) and that fry survival drops to about 10%

when fine sediments exceed 25% of substrates comprising spawning nests. Fine sediments in spawning gravels are thought to cause mortality by entrapping fry, limiting inflows of oxygen, or limiting outflows of metabolic waste products (Beschta & Jackson, 1979; Chapman, 1988; Bennett et al., 2003). Additionally, elevated concentrations of fine sediments on stream bottoms or suspended in the water may reduce survival and growth of juvenile coho salmon by altering abundances or species composition of their stream-insect prey (e.g., Suttle et al., 2004; Cover et al., 2008; Jones et al., 2012). In reviewing the effects on fish of fine sediments suspended in water, Newcombe and Olson (1996) located six studies addressing juvenile coho salmon at various developmental stages after hatching. These studies reported diverse responses, including avoidance behavior, physiological stress, reducing or halting feeding, gill damage, and death. Increased concentrations of fine sediment can negatively influence coho salmon also at higher levels of biological organization (i.e., population and community). Building on the extensive knowledge base for individual fish, Araujo et al. (2015) demonstrated that the abundance of a coho salmon population may decrease with forestry-associated increases of fine sediment. Fine sediments in streams of the Oregon Coast Range were negatively correlated to a community-level index of biotic integrity that included coho salmon (Kaufmann & Hughes, 2006).

32. In summary, under a dynamic environmental regime, conditions for any single watershed may have varied over time and included periods of poor habitat quality. However, logging and roading over much of the Oregon Coast Range have significantly altered processes of water, sediment, and wood routing; synchronized disturbance; and limited opportunities for habitat recovery. Consequently, freshwater habitat is widely degraded and abundances are uniformly low for populations of Oregon Coast coho salmon, including those in streams on the

Tillamook and Clatsop State Forests.

VI. MITIGATION MEASURES

A. Background

33. Mitigation measures in contemporary forestry practices can diminish short-term, site-level consequences, but scientific support for their overall effectiveness in protecting streams is equivocal. Studies showing how forestry adversely affects coho salmon and their habitats span several decades. During this period, forestry practices have evolved to mitigate problems as these became apparent (Cristen et al., 2016; Warrington et al., 2017). Two examples of widely implemented measures are to avoid constructing roads in mid-slope locations and to leave forested riparian buffers along streams. A large body of scientific literature supports the efficacy of riparian buffers to protect riparian and aquatic functions (e.g., Everest & Reeves, 2007; Richardson et al., 2012). Consequently, some form of a riparian buffer is required along all fish-bearing streams on forest lands in Oregon, regardless of jurisdiction (Boisjolie et al., 2017). Although certain mitigation measures have demonstrated benefits and recent research suggests logging with contemporary forestry practices may reduce stream impacts (e.g., Arismendi et al., 2017; Hatten et al., 2018), overall effectiveness in preventing harm to coho salmon remains an open question. Despite some promising results, research studies of contemporary forest practices targeted shorter-term effects and generally did not reflect outcomes of rain or wind storms that can generate debris flows or blow down riparian buffers. Where larger basins have been continuously studied for many years, forestry with mitigation measures common in contemporary practices has caused enduring impacts, many of which manifested downstream

and were not immediately apparent - including declines in coho salmon smolt production (Tschaplinski et al., 2004).

34. Several scientific reviews have expressed serious concerns about forestry practices allowed on private lands and on State Forests and their ability to adequately protect aquatic and riparian resources, including Oregon Coast coho salmon (e.g., IMST, 1999; ODEQ, 2002; Everest & Reeves, 2007; Leinenbach et al., 2013; Stout et al.; NOAA/EPA, 2015; NMFS). Central findings in these reviews were that timber and road management are continuing to elevate sediment loading in streams, increase stream temperatures above harmful thresholds for salmon, and compromise large wood delivery necessary for complex salmon habitat. The reviews emphasized the need for stronger measures along small, non-fish-bearing streams to better protect fish downstream; the high density of roads as long-term sediment sources; and timber harvest in landslide-prone areas that can deliver debris flows to streams.

B. The Northwest Oregon State Forests Management Plan

35. Operations on the Tillamook and Clatsop State Forests are governed by the Northwest Oregon State Forests Management Plan, which focuses on three integrated concepts: (1) landscape management of forest structure, (2) aquatic and riparian conservation, and (3) forest health. Chapter 4 and Appendix J describe landscape management and site-specific mitigation for aquatic and riparian conservation. Mitigation measures include those for management, addressing forest roads, slope stability, and riparian areas. According to the FY 2020 Annual Operations Plan for each of the three Forest Districts, strategies for Riparian Management Areas are the primary means "to maintain, enhance, and restore quality fish habitat."

36. In the following subsections, I describe elements of mitigation strategies for Riparian Management Areas, Slope Stability, and Aquatic Anchors as specified in the Northwest Oregon State Forests Management Plan (Appendix J), Forest District Implementation Plans, Forest District Annual Operations Plans, and other guidance. I then provide a professional opinion regarding the likelihood that these elements will prevent harm to Oregon Coast coho salmon.

C. Riparian Management Areas

37. The Northwest Oregon State Forests Management Plan states that "Riparian management areas will be established immediately adjacent to waterways for the purpose of protecting aquatic and riparian resources, and maintaining the functions and ecological processes of the waterways." Riparian Management Areas are differentiated into three zones: (1) Stream Bank that extends 0-25 ft from the stream; (2) Inner Riparian Management Area that extends 25-100 ft; and (3) Outer Riparian Management Area that extends 100-170 ft. These zones are to be managed consistent with prescriptions in the Northwest Oregon State Forests Management Plan (Appendix J). The prescriptions are summarized by zone in Table 1.

38. The level of allowable timber harvest in these zones differs by stream class. Stream classes are based on fish use (Type-F or Type-N), average annual streamflow (Small, Medium, or Large), and whether flow is year-round (Perennial or Seasonal). In reviewing the application of riparian management zones, Lee et al. (2004) noted that jurisdictions throughout Canada and the United States routinely distinguish stream classes and protection levels based on characteristics of fish presence, stream size, and permanence of flow. Given that in many mountainous areas fishless streams dominate the stream network, provide essential habitat for amphibians and other aquatic taxa, and are essential for ecosystem functions downstream (e.g.,

Olson et al., 2007), rationales for distinguishing streams based on fish presence derive less from ecological differences than from economic and operational concerns regarding timber harvest.

39. High Energy Reaches and Debris Flow Reaches are special classes of Type-N, Small, Seasonal streams. High Energy Reaches favor the transport of coarse sediments and wood during high flows. These have an average gradient exceeding 15% and an active channel width exceeding five feet. Debris Flow Reaches must meet two criteria: (1) high hazard, interpreted as a high likelihood of initiating a debris flow, and (2) high likelihood of delivering to a fish-bearing stream. Various indicators of hazard are considered, but I understand the determination to weigh most heavily on characteristics of the forest and topography (slope steepness, evidence of past landsliding, and presence of a bedrock hollow) (Northwest Oregon State Forests Management Plan - Appendix J). The likelihood of delivery is based on topographic factors (i.e., stream slope, tributary junction angle, and confinement by the adjacent valley) (ODF, 2003; ODF, 2018). After examining maps, available data, and aerial photos, and in some cases, visiting the site, a Geo-technical Specialist expresses hazard and risk as relative (low, moderate, or high) rankings based on professional judgment rather than as numerical values from quantitative analysis. *See* Table 1 on the following page (rest of this page intentionally left blank).

Table 1. Summary of management prescriptions by stream class and Riparian Management Area zones detailed in Appendix J of the Northwest Oregon State Forests Management Plan.

Stream Class	Zone	Management Prescription
Type-F	0-25 ft	No harvest
	25-100 ft	No harvest where mature forest condition (MFC) is or likely to develop Otherwise, thinning to achieve MFC leaving at least 50 trees per acre
	100-170 ft	Harvest leaving at least 10-45 conifer trees and snags per acre
Type-N Large & Medium Perennial	0-25 ft	No harvest
	25-100 ft	No harvest where mature forest condition (MFC) exists Otherwise, thinning to achieve MFC leaving at least 50 trees per acre
	100-170 ft	Harvest leaving at least 10 conifer trees and snags per acre
Type-N Small Perennial	0-25 ft	No harvest
	25-100 ft	Harvest leaving 10-25 trees per acre
	100-170 ft	Harvest leaving 0-10 conifers and snags per acre
Type-N Small High Energy Reach	0-25 ft	No harvest
	25-100 ft	Harvesting leaving 15-25 conifer trees and snags per acre
	100-170 ft	Manage to retain 0-10 conifer trees and snags per acre
Type-N Small Debris-flow Reach	0-25 ft	No harvest
	25-100 ft	Harvesting leaving 10 conifer trees and snags per acre
	100-170 ft	Harvest as upland forest
Type-N Small Seasonal	0-25 ft	Maintain integrity of stream channel
	25-100 ft	Harvest leaving 10 conifer trees and snags per acre where feasible
	100-170 ft	Harvest as upland forest

1. Assessment

40. A key weakness of the riparian management prescriptions is that the narrow width (25 feet) of Stream Bank zones with "no harvest" and thinning/harvest allowed beyond that in Inner Riparian Management Area zones (Table 1) render standing trees in stream-side buffers particularly susceptible to being blown down, minimizing functionality and increasing the potential to harm coho salmon. Trees left in stream-side buffers after timber harvest are subject to damage and toppling during windstorms (Liquori, 2006; Rashin et al., 2006). Many smaller and at least nine large windstorms have occurred in western Oregon since the record setting Columbus Day Storm in 1962. The 2007 storm had hurricane-force wind gusts up to 147 mph

and sustained winds of 50 mph for two days on the Oregon coast (https://www.wrh.noaa.gov/pqr/paststorms/wind.php). In western Washington forests, Schuett-Hames et al. (2012) observed substantial tree mortality (up to 50%) in 50-ft no-harvest buffers from wind damage. This increased short-term wood recruitment to streams but compromised other riparian functions, including longer-term wood recruitment and stream shading.

41. Thinning allowed in the Inner Riparian Management Area zone (25-100 ft) along fish-bearing (Type-F) streams and Type-N Large & Medium Perennial streams (Table 1) to accelerate mature forest condition can harm coho salmon by reducing the volume and size of wood recruited to their habitats. In a simulation study of a central Oregon coastal basin, thinning in riparian areas beyond a 30-ft no-harvest zone decreased total volumes of in-stream large wood by 11% compared to no treatment (Benda et al., 2016). Using a similar approach but a different model, Pollock and Beechie (2014) determined that thinning 30 to 50-year-old forest stands in the Siuslaw National Forest decreased overall long-term wood recruitment to streams in the 12- to 39-inch diameter size class. Such wood pieces are the most functional in Oregon Coast Range streams for creating and maintaining habitat complexity, which is the primary limiting factor for coho salmon in the Nehalem River and Tillamook Bay basins.

42. Allowing timber harvest along fish-bearing (Type-F) streams (Table 1) can increase water temperatures and harm coho salmon. Groom et al. (2011) determined that temperatures were generally unaffected in small and medium fish-bearing streams by timber harvest consistent with Riparian Management Area zone prescriptions in the Northwest Oregon State Forests Management Plan. However, water temperatures increased about 3.5º F at two of the study locations on State Forests. To protect cold-water streams, no more than a 0.5º F increase from human activities, including forestry, is allowed (ODEQ, 2011).

43. Although fish-bearing (Type-F) streams are afforded the most protection on State Forests (Table 1), streams may be misclassified as Type-N, which increases the probability of harm to coho salmon. In a sample from Washington, 23% of fish-bearing streams were incorrectly classified and 56% of the smallest fish-bearing streams were not on forest-practice maps (Rashin et al.). This led the study's authors to highlight the need for field surveys to identify fish-bearing streams. However, field surveys may still result in misclassifications when based on the presence of adult salmon during spawning or fish during summer, which is my understanding for the State Forests. Given that the length of usable habitat expands dramatically with fall rains, much less of the stream network is available to fish during summer than other times of the year. Juveniles of Oregon Coast coho salmon that move in fall from summer rearing habitats to previously dry areas grew faster and had lower over-winter mortality (Ebersole et al., Ebersole et al., 2009; Hance et al.).

44. Timber harvest that is allowed adjacent to Type-N, Small, Seasonal streams and beyond 25 feet of other Type-N, Small streams (Table 1) will reduce stream shade and increase water temperatures that can harm coho salmon downstream. For small and medium streams in western Oregon that require a 20-ft no-harvest buffer and partial cutting beyond that up to 75 feet, Groom et al. (2011) found: (1) shade was the best predictor of post-harvest changes in water temperature; (2) shade was best predicted by the basal area and height of trees within 100 feet of a stream; (3) basal area was greater in sites with more trees, wider uncut buffers, or fewer harvested stream banks; and (4) maximum stream temperatures increased by up to 3.6ºF where shade was reduced to 50%. Another study from western Oregon demonstrated that the seven-day moving average of daily maximum water temperatures increased up to 7ºF after logging in 88% of sampled streams without buffers (Blandon et al., 2018). In this study, evidence of warming in

the receiving stream due to forest harvest extended up to a quarter-mile below an un-buffered stream and was related to the percent of the harvested area and underlying rock type in the upstream watershed. Maximum daily temperatures in coastal fish-bearing streams of western Washington were better explained by the percent area of timber harvest in the upstream watershed or in the entire upstream riparian network than in the immediate upstream riparian area (Pollock et al., 2009). The entire upstream riparian network contained all small non-fish-bearing streams, supporting concerns that timber harvest in these riparian areas contributes to the delivery of warm water downstream that can harm coho salmon. Sweeny and Newbold (2014) concluded, after reviewing 22 site-specific and regional studies, that forested stream-side buffer zones of greater than or equal to 65 feet will limit increases in stream temperatures to 3.6°F but 100-ft buffers are necessary to prevent stream warming.

45. Timber harvest that is allowed beyond 25 feet of Debris Flow Reaches (Table 1) will reduce large wood loading to fish-bearing streams, further decreasing habitat complexity and increasing harm to coho salmon. If a riparian management zone is to match recruitment of large wood from an unmanaged forest, then the scientifically supported and widely accepted practice is to retain trees over the distance from a stream that approximates the height of dominate trees (FEMAT, 1993; Sweeny and Newbold, 2014). For western Oregon, the average maximum height of the tallest dominant trees (greater than or equal to 200 years) varies from 140 to 240 feet (BLM, 2018). Approximately 90% of large wood pieces with an identifiable source came from within 130 feet of streams in old-growth conifer forests (McDade et al., 1990; May & Gresswell, 2003a).

46. The approach to identify Debris Flow Reaches on the State Forests (ODF, 2018) is unnecessarily qualitative and subjective. Quantitative and objective identification of Debris

Flow Reaches can be readily accomplished with available digital data and peer-reviewed models. Elevation data capable of resolving topographic features associated with landslide initiation and debris-flow runout are publicly available from two sources: (1) The Oregon Department of Forestry maintains Digital Elevation Models (DEMs) with a 32-ft resolution for the entire state, and (2) the Oregon Department of Geology and Mineral Industries maintains DEMs with a 3-ft resolution for most of western Oregon, including the Tillamook and Clatsop State Forests. Two published empirical models use these data and are calibrated to and evaluated with field inventories of landslides and debris flows from the Oregon Coast Range (Miller & Burnett, 2007; Miller & Burnett, 2008; Reid et al., 2016). The models produce various quantitative outputs, including probabilities of landslide initiation and debris-flow delivery to a fish-bearing stream, effects of timber harvest and road construction on these probabilities, and sediment volumes. The utility of these models has been demonstrated for mapping locations likely to initiate or be traversed by debris flows that deliver to a fish-bearing channel (Miller & Burnett, 2007) and for mapping zones of likely debris-flow inundation (Reid et al., 2016).

47. The approach used on State Forests to identify Debris Flow Reaches (ODF, 2018) under-represents Type-N, Small, Seasonal streams that can transport debris flows, increasing the potential of timber harvest to harm coho salmon. This conclusion stems in part from an analysis submitted to the Oregon State Board of Forestry (Scurlock, 2019). The analysis relied on outputs derived from 32-ft DEMs using one of the previously described models (Miller & Burnett, 2007; Miller & Burnett, 2008). For private lands in the Siletz River basin, which is just south of the Tillamook State Forest, the modeling approach identified 88 miles of Type-N streams as likely Debris Flow Reaches while the State's approach identified 2.4 miles. The discrepancy may be greater when using DEMs with a higher resolution. Under representation of Debris Flow

Reaches allows timber harvest adjacent to many more of the streams most likely to transport debris flows that directly kill coho salmon and degrade their habitat. Furthermore, Type-N, Small, Seasonal streams subjectively determined to have a "moderate" or "low" likelihood of delivering to a fish-bearing stream are not protected as Debris Flow Reaches. Approximately 460 miles of Type-N streams in the Siletz River basin were identified as having some potential to deliver a debris flow to a fish-bearing stream (Scurlock, 2019). Including only "high" likelihood streams as Debris Flow Reaches can subject coho salmon to harm from timber-harvest generated debris flows.

48. Timber harvest that is allowed adjacent to Type-N, Small, Seasonal streams (Table 1) can increase downstream sediment loading and harm coho salmon. Although erosion from overland flow is rare under intact forests in the Oregon Coast Range, riparian logging can increase this type of erosion along with rill and gully erosion as sediment sources for small streams (May, 2007). For small streams in Washington, Rashin et al. determined that clear cutting without riparian buffers resulted in chronic sediment delivery and extensive streambed siltation. They established evidence of rainfall-induced erosion from both overland flow and gullies with 67% of harvest-associated erosion features supplying sediment to un-buffered streams. Removing riparian forests also decreases large wood recruitment and thus the capacity of small, steep streams to store additional sediment (May & Gresswell, 2003a). Logging-generated sediment in un-buffered streams was a sediment source for fish-bearing streams (Rashin et al.). Because small streams can comprise up to 90% of stream length in the Oregon Coast Range (Benda & Dunne, 1997a), timber harvest adjacent to these streams can greatly increase downstream sediment transport throughout a watershed and degrade coho salmon habitat downstream.

D. Slope Stability

49. In addition to Debris Flow Reaches, three types of unstable slopes are designated for concern regarding aquatic resources: Inner Gorges, Aquatic Adjacent Unstable Areas, and Upland Unstable Areas (ODF, 2018). Management of these areas is intended to decrease timber-harvest related sediment delivery and increase large wood delivery to streams. Inner Gorges are areas adjacent to a stream with a slope greater than 70% and a height greater than 15 feet above the stream and Aquatic Adjacent Unstable Slopes are areas adjacent to a stream with a slope greater than 70% (ODF, 2010). No timber harvest is allowed in either of these areas regardless of stream type. Upland Unstable Areas must meet two criteria: (1) high hazard, interpreted as a high likelihood of initiating a debris flow, and (2) high likelihood of delivering to a Type-N stream. These are identified using the same approach as for Debris Flow Reaches (ODF, 2003; ODF, 2018). Where Upland Unstable Areas occur outside of an Inner Gorge or a Riparian Management Area, timber harvest is allowed but some trees are to be left on "high" risk locations and may be left on "moderate" risk locations and along the path of a potential debris flow.

1. Assessment

50. Weak protection for Upland Unstable Areas can increase sediment delivery to coho-bearing habitat downstream. As previously described, the approach to identify Upland Unstable Areas on the State Forests is unnecessarily qualitative and subjective.

E. Aquatic Anchors

51. Aquatic Anchors were designated by the Oregon Department of Forestry and became effective July 1, 2013, replacing the previous Salmon Anchor Habitat Strategy. The Northwest Oregon Forests Management Plan states, "The Aquatic Anchors will be subject to additional management standards (e.g., in addition to Appendix J) intended to maintain and

enhance habitat for salmonids and headwater amphibians." Based on factors such as population abundance and distribution, habitat condition, and input from fish biologists with the Oregon Department of Fish and Wildlife, Aquatic Anchors were established in eleven watersheds on the Tillamook District, six watersheds on the Forest Grove District, and five watersheds on the Astoria District. I was unable to find a specific management policy for Aquatic Anchors on the Oregon Department of Forestry website. Although I assume consistent stream protection for Aquatic Anchors across the two State Forests, direction specified in Annual Operations Plans varies by District. A review of these Plans suggests that within Aquatic Anchors, Type F, and large and medium Type N streams will have a 100-ft no-harvest buffer and small, perennial, debris flow-prone, and high-energy Type N streams will have a 50-ft no-harvest buffer. Type-N, Small, Seasonal streams appear to be afforded no protection beyond that in the Northwest Oregon State Forests Management Plan. This direction approximates that issued in 2010 (Species of Concern Operational Policy, September 9, 2010).

1. Assessment

52. Increasing the width of no-harvest buffers from 25 feet to 50 feet on small, perennial, debris flow-prone streams and high-energy Type N streams within the Aquatic Anchors may ameliorate but is unlikely to eliminate harm to coho salmon for all the previously declared reasons. Although wider, these buffers are still susceptible to wind damage and insufficient to prevent large wood decreases or water temperature and sediment increases in coho salmon streams. These impacts will be compounded by logging that is allowed adjacent to Type-N, Small, Seasonal streams in Aquatic Anchors.

53. Despite increased protection for some streams, no restrictions are placed on new road construction or the percent area that can be harvested in Aquatic Anchors, contributing to

the potential for cumulative impacts on coho salmon. Observed conditions in streams are often directly proportional to the area disturbed in a watershed, reflecting the cumulative effects of activities over time and space (MacDonald, 2000). The area disturbed in a watershed by roads and timber harvest has been correlated with in-stream changes for peak flows, sediment, large wood, and water temperature (e.g., Jones & Grant; Rice et al., 2004; Burnett et al., 2006; Pollock et al.). Jones & Grant observed that magnitudes of peak annual flows increased when the area clear cut increased to 25% of large watersheds in the western Oregon Cascade Range. The mean annual sediment load increased 212% in clear-cut watersheds and 73% in partially clear-cut watersheds in coastal California, with downstream increases in sediment load generally consistent with the percent of watershed disturbance (Rice et al., 2004). Road density was positively correlated with fine sediments in streams but negatively correlated with the number of pools per mile and the density of large wood in pools (Lee et al., 1997; Burnett et al., 2006), all of which are key indicators of habitat quality for coho salmon. Accordingly, increases in road density were associated with decreases in the number of coho salmon adults in Oregon (Firman et al., 2011) and elsewhere (Bradford & Irvine, 2000). Coho salmon smolt production was uniformly low at road densities exceeding 4 mile/mile^2 (Sharma & Hilborn). The Recovery Plan for Oregon Coast Coho Salmon recommended reducing road densities to restore high-quality coho salmon habitat in the North Coast Stratum (NOAA, 2016). Although thresholds have not been thoroughly validated, levels of both road density and percent area harvested have long been used in assessing whether a watershed is “properly functioning” (NOAA, 1996) during consultations on federal projects for ESA-listed species (e.g., ODOT, 2008).

VII. SITE VISITS

54. I traveled to the Tillamook State Forest on April 5, 2019 and July 10, 2019 to visit timber sales at issue in this lawsuit. General impressions are consistent with my knowledge and experience of the Oregon Coast Range. In the areas visited, I observed: very steep terrain drained by many small streams; several miles of streams with flows, gradients, and valley widths capable of providing high-quality habitat for coho salmon (Burnett et al., 2007); forests of predominately younger age classes; numerous patches of recently logged forest with clear cutting as the primary harvest technique; forested riparian buffers in clear cuts left along larger rivers but typically not on headwater streams; an extensive network of unpaved roads, though most primary roads are gravel; and many roads that would be considered hydrologically connected to streams (i.e., numerous road-stream intersections along with drainage features of roads likely to facilitate transport of fine sediments to streams). On each visit, loaded trucks were hauling logs on Forest roads.

A. April 5, 2019

55. From OR Highway 6, I drove along the unpaved haul route (North Fork Wilson Road, West Fork Road, and the North Fork West Fork Road) for the High Standards timber sale (Figure 1, App. B). The haul route consists mostly of valley bottom roads that cross many small streams draining directly into coho salmon spawning and rearing habitat of the North Fork Wilson River and Rogers Creek. The North Fork West Fork Road diverges from Rogers Creek, steeply ascending to the southernmost unit of the High Standards sale and continues beyond. Along this road, I observed gullies below culverts as well as other evidence of hydrologic connectivity and erosion that can deliver fine sediments to streams. At this sale unit, I noted steep, convergent terrain typical of areas in the Oregon Coast Range that initiate and transport

landslides and debris flows. If a debris flow initiates in this sale unit, it is likely to deposit in coho salmon spawning habitat of Rogers Creek.

56. I returned to Oregon Highway 6 by the same route but detoured on the West Fork Road about 1 mile south of the visited sale unit. Just west of the junction between the West Fork Road and the North Fork West Fork Road, a large debris flow had destroyed the bridge, rendering the road impassable. Based on aerial imagery (Figure 2, App. B), the debris flow appeared to have initiated in a recent clear cut where it was undercut by a mid-slope road constructed for the harvest unit. The debris flow traveled through a small stream channel before depositing in coho salmon spawning habitat in the West Fork of the North Fork Wilson River (Figure 2, App. B). The debris flow delivered an enormous volume of sediment that extended into coho salmon spawning habitat for several hundred feet upstream of the bridge (Figure 3, App. B). In my opinion, any coho salmon present at the time of the debris flow would have been harmed by downstream displacement or killed. Although not based on a quantitative assessment, habitat conditions differed between the stream reach affected by the debris flow and the reach downstream. The affected reach was shallow, lacked pools, and much of the flow was subsurface through the thick deposit of unsorted, coarse-grained sediment. The debris flow apparently removed much of the riparian vegetation, leaving the exposed channel without shade. Diameters of gravels generally appeared larger than the typical range (0.6-1.3 inches) used by female coho salmon for spawning (Kondolf & Wolman, 1993). I did not sample the affected reach for fish, but based on my extensive experience snorkeling in Oregon Coast Range streams, it is highly doubtful that the poor-quality habitat could support rearing juvenile coho salmon.

57. Units from the Ax Ridge Timber sale were viewed from Oregon Highway 6. I expect landslides or debris flows are unlikely to initiate in two of the three units: one is in

relatively gentle terrain and the other was slated for partial harvest with a substantial no-harvest area. The third unit, however, is in steeper terrain with areas of topographic convergence that are more likely to initiate a landslide or debris flow that could deliver to Oregon Highway 6 or possibly beyond to coho salmon rearing and migration habitat in the Wilson River.

58. To access the Broken Arrow and Southern Steamer timber sales, I drove a loop from OR Highway 6 up the South Fork Wilson Road, Jordan Cutoff Road, and back along Jordan Creek Road. The South Fork Wilson Road and parts of the Jordan Creek Road are haul routes for timber sales named in this lawsuit. I visited the two southern units of the Broken Arrow timber sale and the northern unit of the Southern Steamer timber sale. Each of these units was in terrain with potential for debris flows to deliver to Jordan Creek, although slopes in the Southern Steamer unit seemed gentler. I drove north along Hann Creek to view a recent harvest unit in terrain similar to that of Southern Steamer. Here, I observed road-related erosion as a chronic sediment source with runoff delivering directly into a small stream (Figure 4, App. B).

B. July 10, 2019

59. I traveled a loop south from OR Highway 6 around Kansas Creek Road, Hembre Ridge Road, Zig-Zag Road, North Fork Trask River Road, and Trask Cutoff Road. Harvest units were visible along this loop from three timber sales at issue in this lawsuit (Hembre Falls, ZZ Tops, and Jethro Toll) and from a timber sale slated for an offer in December 2019 (Stones Throw). Roads comprising this loop will be primary haul routes for these timber sales. Some of these roads, particularly Zig-Zag Road, are very steep with many points of connection to streams. Erosion control structures had been recently placed at a few road-stream connections. Some of these structures were short relative to the length of potential connection and unlikely to prevent erosion of fine sediments to the stream network during rainfall events (Figure 5, App. B).

VIII. MAP-BASED ASSESSMENT

A. Methods

60. Mr. Curt Bradley, Geographic Information Systems (GIS) Specialist with the Center for Biological Diversity, provided all spatial data layers through a web-based GIS map server and as a separate PDF file for each named timber sale. He also provided summarized data on forest cover and road density in a spreadsheet.

B. Site-Level Effects

61. Data used for the site-level analysis of potential harm to coho salmon originated from three sources: (1) the Oregon Department of Forestry: (a) locations of harvest units and probable haul routes with hydrologically connected road segments delineated, (b) mapped no-harvest buffers (inner gorge, riparian, slope, other) in harvest units, and (c) high landslide hazard locations; (2) the Oregon Department of Fish and Wildlife: (a) streams previously documented as rearing or spawning habitat for coho salmon and (b) all mapped streams; and (3) Mr. Bradley: (a) maps of modeled landslide initiation points (Dietrich et al., 2001) and (b) maps of modeled debris-flow runout paths with areas of inundation (Reid et al., 2016) distinguished as originating from either a harvest unit or a haul road.

62. To assess the likelihood of harm to coho salmon from direct, site-level effects, I:

i. Assigned each timber sale into either a low, medium or high category based on the location of the sale area and haul route relative to terrain that is highly susceptible to landsliding. High landslide susceptibility was expressed as (a) modeled landslide initiation points and (b) high landslide hazard locations (slopes greater than or equal to 70%) (ODF, 2019).

ii. Identified timber sales from which a debris flow was modeled to initiate from a sale unit. Each of these timber sales was designated as producing one or more debris flows modeled to deposit in coho salmon habitat (Spawning, Rearing, or Spawning and Rearing) or in a stream not documented as coho salmon habitat. I assumed that any debris flow can transport sediments that can negatively affect coho salmon downstream, but those depositing in coho salmon habitat have the greatest potential for immediate and direct harm.

iii. Categorized timber sales with debris flows modeled to initiate from a sale unit based on the likely effectiveness (low, medium, or high) of mapped no-harvest buffers (inner gorge, riparian, slope, other) for mitigating negative consequences to coho salmon. I assumed no-harvest buffers will decrease the likelihood of debris-flow initiation and the length of debris-flow travel and increase the probability of wood delivery. Timber sales for which buffers incorporated modeled debris-flow initiation points and areas inundated along runout paths were considered to have buffers with "high" effectiveness. Conversely, timber sales with many un-buffered debris-flow initiation points and runout paths were considered to have buffers with "low" effectiveness.

iv. Assessed the potential of timber-sale haul routes to negatively affect coho salmon by identifying haul routes with (a) points of hydrologic connectivity to streams or (b) from which a debris flow was modeled to initiate. Each timber sale was evaluated as producing one or more debris flows modeled to deposit in coho salmon habitat (Spawning, Rearing, or Spawning and Rearing) or in a stream not documented as coho salmon habitat.

C. Watershed-Level Effects

63. All data used for the watershed-level analysis of potential harm to coho salmon originated from the Oregon Department of Forestry except data for forest age-class across all landowners, which was obtained from Oregon State University LEMMA project (https://lemma.forestry.oregonstate.edu/).

64. To assess the likelihood that the authorized timber sales will harm coho salmon by contributing to cumulative effects, I considered:

i. Percent area of the Nehalem River and Tillamook Bay basins in State Forests to gauge the potential for timber harvest and roads on State Forests to affect the two independent populations of Oregon Coast coho salmon.

ii. Current forest cover and road density across all owners in these basins as context for the authorized timber sales.

iii. Length of maintained roads, hydrologically connected roads, and recently constructed roads on State Forests to address the additive effects of new road construction.

iv. The percent area of State Forests in the youngest vegetation age class (zero to 25 years) to address the effects of additional clear cutting.

v. Locations of authorized timber sales relative to Aquatic Anchors and the percent area of Aquatic Anchors that were recently clear cut to address the effects of new road construction and clear cutting in these salmon conservation areas.

D. Results and Discussion

1. Site-Level Effects (Data Presented in Appendix A, *infra* (Table of Timber Sales)

65. For the 67 authorized timber sales, 67% occurred predominantly in areas considered to have a medium or high susceptibility to landsliding. Debris flows that delivered to a stream were modeled for all but five of the sales located in relatively gentle terrain, indicating the presence of highly unstable areas in an otherwise stable matrix. Debris flows modeled to initiate in harvest units delivered to a stream for 91% of sales and to a coho salmon stream for 81% of sales. Many sales initiated multiple debris flows that delivered to a coho salmon stream, as illustrated in Figure 1 (App. B). For individual harvest units, some debris-flow runout paths occurred in areas mapped by Oregon Department of Forestry as "no-harvest - inner gorge, riparian, slope, or other" (i.e., buffers). However, many debris-flow runout paths occurred outside of these buffers. Where runout paths were modeled through buffers, many debris flows initiated and/or inundated areas beyond the buffer. Taken together, these results support that: (1) debris flows are likely where the Oregon Department of Forestry has mapped Debris Flow Reaches, (2) Debris Flow Reaches under-represent locations likely to initiate and transport a debris flow for delivery to a coho salmon stream, and (3) where buffers are narrower than the width of areas inundated by a debris flow, these debris flows are likely to travel farther and cause more damage downstream. In my professional opinion based on these results, coho salmon are highly likely to be harmed by harvest-related debris flows that initiate and travel though un-buffered areas and mapped buffers are unlikely to fully prevent harm to coho salmon from passing debris flows. Therefore, in my professional opinion, "take" of coho salmon is reasonably certain to occur as a result of timber harvest authorized in these sales.

66. Mapped haul routes were available for 58 sales. A haul route was modeled to initiate a debris flow that delivered to a stream for 60% of these sales and to a coho salmon stream for 38% of these sales. As with harvest units, some haul routes initiated multiple debris flows that delivered to a coho salmon stream (Figure 1, App. B). Haul routes for 50 sales were identified by the Oregon Department of Forestry as having hydrologic connections to streams. In summary, all except two of this subset of authorized timber sales had mapped haul routes that were either hydrologically connected or modeled as initiating a debris flow that delivers to a stream. Therefore, in my professional opinion, coho salmon are highly likely to suffer harm from debris flows and sediment generated by haul routes and "take" of coho salmon is reasonably certain to occur from haul routes associated with the authorized timber sales.

2. Watershed-Level Effects

67. Because State Forests occupy a substantial percentage of the Tillamook Bay and Nehalem River basins, State-authorized logging and roading can contribute to cumulative watershed effects in these basins (Table 2). The average density of mapped roads across all sub-basins is 5.5 mile/mile^2 for the Nehalem River basin and 4.7 mile/mile^2 for the Tillamook Bay basin. Each sub-basin has road densities (3.4 - 6.4 mile/mile^2) that exceed the 3 mile/mile^2 threshold for watersheds considered "not properly functioning" (NOAA 1996) and the 4 mile/mile^2 threshold above which production of coho salmon smolts was consistently low (Sharma & Hilborn). *See* Table 2 on the following page (rest of this page intentionally left blank).

Table 2. Road density and forest cover in basins with independent populations of Oregon Coast coho salmon. The Tillamook and Clatsop State Forests are located in these basins.

Oregon Coast coho salmon independent population	Percent basin area in State Forest	Average road density[1] (mile/mile^2)	Percent forest area[2]		
			0 – 25 yrs	25 – 100 yrs	100 – 150 yrs
Nehalem River Basin	38.4	5.5	30.3	66.0	3.1
Tillamook Bay Basin	61.6	4.7	26.8	68.0	4.1

1. Road data supplied by the Oregon Department of Forestry
2. Forest cover data from https://lemma.forestry.oregonstate.edu/

68. The three State Forest Districts encompass 450 miles of coho salmon streams and maintain 2880 miles of roads (Table 3). The Oregon Department of Forestry considers approximately 452 miles of roads on the three Districts to be hydrologically connected to streams (Table 4). These estimates of road length exclude "legacy" roads that were built before the passage of the Oregon Forest Practices Act in 1971 and are no longer used or maintained. Little is known about the location, length, or condition of these abandoned roads, but such roads undoubtedly continue to influence storm runoff and sediment delivery to streams (IMST). Approximately 170 miles of new roads were constructed across the Districts in the last four years. Even the best road construction methods can generate sediment that can be transported to streams. Many of the authorized timber sales call for road construction, resulting in over 70 miles of newly constructed roads. By adding to the already extensive road network and further increasing road densities, it is my professional opinion that the authorized timber sales are likely to harm coho salmon through cumulative watershed effects on water and sediment routing.

Table 3. Characteristics of the Tillamook and Clatsop State Forests by District.

State Forest District	Coho salmon streams[1] (miles)	Currently maintained roads[2] (miles)	Roads constructed since 2015[3] (miles)	Percent area Aquatic Anchors clear cut since 2014[2]
Tillamook	221	1128	78.6	8.1
Forest Grove	102	802	33.4	7.7
Astoria	127	950	57.1	9.7
Total	450	2880	169.1	

1. GIS analysis of data from Oregon Department of Fish and Wildlife.
2. FY 2020 Annual Operations Plans
3. FY 2015-2019 Annual Operations Plans

69. A substantial percentage of each basin supporting independent populations of coho salmon was logged across all landowners in the past 25 years (Table 2). Although mid-aged forests (25 to 100 years old) occupy the majority of each basin, approximately 30% of the Nehalem River basin and 26% of the Tillamook Bay basin is in the zero to 25-year class. Very little of the area for either basin is in forests older than 100 years. Considering only State Forest lands by sub-basin, the percent area of forest in the zero to 25-year age class ranges from 5.1% to 23.9% (Table 4). Due to the history of logging and fire, forests older than 100 years occupy no more than 6.5% of the area on State Forests in any sub-basin. If clear cutting proceeds as projected on State Forests, the percent area in older forests will likely decrease with a corresponding increase in the youngest vegetation class. The authorized timber sales will add approximately 13,000 acres to the youngest vegetation age class through clear cutting. This can reduce summer stream flows (Perry & Jones) and increase the probability of landslide initiation while the strength of roots stabilizing soil is low (Schmidt et al.). As I detailed in "VI. Mitigation Measures," the prescriptions for Riparian Management Areas in the Northwest Oregon State Forests Management Plan are insufficient to fully prevent the negative effects of timber harvest on streams. Consequently, my professional opinion is that the authorized timber sales are reasonably certain to harm coho salmon by cumulative effects on water temperature as well as on water, wood, and sediment routing.

Table 4. Hydrologically connected roads, forest cover, and projected clear cutting on State Forests by sub-basins comprising independent populations of Oregon Coast coho salmon. All data were created by the Oregon Department of Forestry.

Oregon Coast coho salmon independent population	Sub-basin[1]	Hydrologically connected roads on State Forests (miles)	Percent forest area 0-25 yrs on State Forests	Percent forest area ≥ 100 yrs on State Forests	Percent area clear cut planned over 40 yrs on State Forests[2]
Nehalem River Basin	Headwaters Nehalem River	68.9	15.9	0.9	6.8
	North Fork Nehalem River	22.6	19.0	6.5	10.8
	Upper Nehalem River	58.9	22.3	2.8	10.6
	Middle Nehalem River	102.1	23.9	3.1	18.2
	Lower Nehalem River	0.3	14.1	2.4	21.3
	Salmonberry River	4.9	12.4	0.0	13.7
Total		258.0			
Tillamook Bay Basin	Kilchis River	13.5	5.1	4.6	23.0
	Miami River	0.0	10.4	6.1	8.4
	Trask River	80.6	20.9	0.4	30.7
	Wilson River	99.9	17.2	0.7	33.5
Total		194.0			

1. 10^{th}-code USGS Hydrologic Units
2. Starting in 2011

70. Of the 67 authorized timber sales, just over half have harvest units in Aquatic Anchors. Consistent with this, approximately half of the clear-cut acres and half of the miles of new road construction are authorized for Aquatic Anchors. These authorized sales will add to the substantial area affected by clear cutting in Aquatic Anchors over the last five years (Table 3). With the planned FY 2020 harvest, over 15% the of the area in some Aquatic Anchors (e.g., Buster Creek, Louisignont/Upper Nehalem, Elk Horn, Cedar Creek) and approximately 37% of the area in another (Ben Smith Creek) will have been clear cut since 2014. Each of these Aquatic Anchors contains one or more of the authorized timber sales at issue in the lawsuit. Although several stream classes have no-harvest buffers that are wider in Aquatic Anchors than required in other areas governed by the Northwest Oregon State Forests Management Plan, no enhanced mitigation measures are required for Type-N, Small, Seasonal streams. Given the prevalence of

these small streams, adjacent timber harvest can increase stream temperatures and sediment delivery downstream (e.g., Rashin et al.; Blandon et al.). Thus, in my professional opinion, activities associated with authorized logging, road construction, and timber hauling in Aquatic Anchors are reasonably certain to harm coho salmon in these areas and to harm the broader populations given that Aquatic Anchors are intended to "lower short-term risk to salmonids" (e.g., Forest Grove District Implementation Plan).

IX. CONCLUSIONS

71. It is my professional opinion that the "take" of Oregon Coast coho salmon is reasonably certain to occur from activities associated with the authorized timber sales on the Tillamook and Clatsop State Forests. This conclusion derives primarily from my assessment of mitigation measures prescribed by the Oregon Department of Forestry, site visits to a sample of authorized sales and haul routes on the Tillamook State Forest, and map-based assessments of potential site-level and watershed-level effects of authorized timber sales. However, my conclusion is grounded in years of experience conducting field research in the Oregon Coast Range and supported by a large body of scientific literature documenting that coho salmon have been harmed by forestry practices.

72. Key findings leading to the conclusion that "take" of Oregon Coast coho salmon is reasonably certain to occur are:

i. Mitigation measures that allow timber harvest and thinning in Riparian Management Areas along coho salmon streams are unlikely to prevent loss of habitat complexity due to increased sediment loading and decreased large wood loading in coho salmon streams. The loss of habitat complexity was a crucial factor in decisions to list the Oregon Coast coho salmon as Threatened under ESA and is the primary limiting factor for both independent populations of Oregon Coast coho salmon on the State Forests.

ii. Mitigation measures that allow timber harvest and thinning in Riparian Management Areas along coho salmon streams are unlikely to prevent increases in water temperatures. Elevated stream temperatures are a limiting factor for both independent populations of Oregon Coast coho salmon on the State Forests.

iii. Mitigation measures that allow timber harvest adjacent to small, non-fish-bearing, seasonal streams and near other small, non-fish-bearing streams are unlikely to prevent increased sediment and heat loading downstream that harms Oregon Coast coho salmon on the State Forests.

iv. Mitigation measures that allow timber harvest near Debris Flow Reaches are unlikely to prevent increased sediment loading and decreased large wood loading that harms Oregon Coast coho salmon on State Forests. Furthermore, Debris Flow Reaches exclude many hillslopes and small, non-fish bearing streams that can deliver debris flows to coho salmon streams.

v. Mitigation measures for Aquatic Anchors that insufficiently protect small non-fish-bearing streams and that restrict neither new road construction nor the allowable clear-cut area are unlikely to prevent harm to Oregon Coast coho salmon on the State Forests.

vi. During site visits to the Tillamook State Forest, I observed debris-flow deposits in streams with documented use by coho salmon. In at least one case, the debris-flow initiation site was obviously associated with a recent timber sale. Any coho salmon present in the stream when and where the debris flow deposited would have been displaced, injured, or killed. The sediments deposited in the affected stream reach have sufficiently degraded habitat quality to make spawning or rearing by coho salmon highly unlikely.

vii. During site visits to the Tillamook State Forest, I saw evidence that road segments along haul routes were hydrologically connected to the stream network and are likely to deliver fine-grained sediment to documented coho salmon streams via runoff during rainstorms.

viii. All but six of the authorized timber sales with mapped haul routes had one or more modeled debris flows that initiated in a harvest unit or from a haul route and delivered to a coho salmon stream. Each of these six sales has a hydrologically connected haul route, as identified by the Oregon Department of Forestry. Many harvest units had modeled debris-flow runout paths completely outside of mapped no-harvest stream buffers. Where runout paths were modeled through buffers, many debris flows initiated and/or inundated areas beyond the buffer. These results indicate that stream buffers mapped by the Oregon Department of Forestry are unlikely to prevent harm to coho salmon from debris flows.

ix. The timber sales authorize new road construction and additional clear cutting in areas, including in Aquatic Anchors, with a large percentage of young trees from recent State Forest harvests and where road densities exceed levels harmful to coho salmon. Thus, the authorized timber sales will contribute to cumulative effects that are likely to harm coho salmon by increasing water temperatures as well as by altering water, wood, and sediment routing processes.

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X. LITERATURE CITED

Michael P. Amaranthus et al., *Logging and Forest Roads Related to Increased Debris Slides in Southwestern Oregon*, 83 J. Forestry, 229–233 (1985).

K.J. Anlauf et al., *Explaining Spatial Variability in Stream Habitats Using Both Natural and Management-influenced Landscape Predictors*, 21 Aquatic Conservation: Marine and Freshwater Ecosystems, 704–714 (2011).

H.A. Araujo et al., *Modeling Population Responses of Chinook and Coho Salmon to Suspended Sediment Using a Life History Approach,* 103 Theoretical Population Biology, 71–83 (2015).

Ivan Arismendi et al., *Increasing Synchrony of High Temperature and Low Flow in Western North American Streams: Double Trouble for Coldwater Biota?,* 712 Hydrobiologia, 61–70 (2013).

Ivan Arismendi et al., *Suspended Sediment and Turbidity after Road Construction/Improvement and Forest Harvest in Streams of the Trask River Watershed Study, Oregon*, 53 Water Resources Res., 6763–6783 (2017).

Douglas S. Bateman et al., *Fish Response to Contemporary Timber Harvest Practices in a Second-growth Forest from the Central Coast Range of Oregon,* 411 Forest Ecology and Mgmt., 142–157 (2018).

Lee Benda, *The Influence of Debris Flows on Channels and Valley Floors in the Oregon Coast Range, USA*, 15 Earth Surface Processes and Landforms, 457–466 (1990).

Lee Benda & Thomas Dunne, *Stochastic Forcing of Sediment Supply to Channel Networks from Landsliding and Debris Flow*, 33 Water Resources Res., 2849–2863 (1997a).

Lee Benda & Thomas Dunne, *Stochastic Forcing of Sediment Routing and Storage in Channel Networks*, 33 Water Resources Res., 2865–2880 (1997b).

Lee Benda et al., *Geomorphology of Steepland Headwaters: The Transition from Hillslopes to Channels,* 41 J. Am. Water Resources Ass'n., 835–851 (2005).

Lee Benda et al., *Thinning and In-Stream Wood Recruitment in Riparian Second Growth Forests in Coastal Oregon and the Use of Buffers and Tree Tipping as Mitigation,* 27 J. Forestry Res., 821–836 (2016).

D.H. Bennet et al., *Substrate Composition and Emergence Success of Fall Chinook Salmon in the Snake River*, 77 Northwest Sci., 93–99 (2003).

Robert L. Beschta & W.L. Jackson, *The Intrusion of Fine Sediments into a Stable Gravel Bed*, 36 J. Fisheries Board Can., 204–210 (1979).

Robert L. Beschta et al., *Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions*, in Streamside Management: Forestry and Fishery Interactions, 191–232 (U. Wash. Inst. of Forest Res. Contribution No. 57, E. Salo & T. Cundy eds., 1987).

Robert E. Bilby & James W. Ward, *Characteristics and Function of Large Woody Debris in Streams Draining Old-Growth, Clear-Cut, and Second-Growth Forests in Southwestern Washington*, 48 Can. J. Fisheries and Aquatic Sci., 2499–2508 (1991).

Robert E. Bilby & Peter A. Bisson, *Function and Distribution of Large Woody Debris*, *in* River Ecology and Management: Lessons from the Pacific Coastal Ecoregion, 324–346 (R.J. Naiman & R.E. Bilby eds., 1998).

Robert E. Bilby et al., *The Generation and Fate of Road-Surface Sediment in Forested Watersheds in Southwestern Washington*, 35 Forest Science 453–468 (1989).

P.A. Bisson et al., *Channel Hydraulics, Habitat Use, and Body Form of Juvenile Coho Salmon, Steelhead and Cutthroat Trout in Streams*, 117 Trans. Am. Fisheries Soc'y, 262−273 (1988).

K.D. Bladon et al., *A Multicatchment Analysis of Headwater and Downstream Temperature Effects from Contemporary Forest Harvesting*, 32 Hydrological Processes, 293−304 (2018).

B.A. Boisjolie et al., *Legal Ecotones: A Comparative Analysis of Riparian Policy Protection in the Oregon Coast Range, USA,* 197 J. Envtl. Mgmt., 206−220 (2017).

M.J. Bradford & J.R. Irvine, *Land Use, Fishing, Climate Change, and the Decline of Thompson River, British Columbia, Coho Salmon*, 57 Can. J. Fisheries and Aquatic Sci, 13−16 (2000).

John M. Buffington et al., *Controls on the Size and Occurrence of Pools in Coarse-Grained Forest Rivers*, 18 River Res. and Applications, 507−531 (2002).

Kelly M. Burnett et al., *Comparing Riparian and Catchment Influences on Stream Habitat in a Forested, Montane Landscape*, 48 Am. Fisheries Soc'y Symp., 175–197 (2006).

Kelly M. Burnett et al., *Distribution of Salmon-habitat Potential Relative to Landscape Characteristics and Implications for Conservation*, 17 Ecological Applications, 66–80 (2007).

Kelly M. Burnett et al., *Streamside Policies for Headwater Channels: An Example Considering Debris Flows in the Oregon Coastal Province*, 53 Forest Sci., 239–253 (2007).

Bureau of Land Mgmt., U.S. Dep't of Interior Info. Bull. No. OR-IB-2018-045, Site Potential *Tree Height Data Standard* (2018), https://www.blm.gov/policy/or-ib-2018-045.

G. Bush et al., *Assessment of the Effects of the 1996 Flood on the Siuslaw National Forest*, (Prepared for USDA Forest Serv., 1997).

C.J. Cederholm et al., Presentation to the conference Salmon–Spawning Gravel: A Renewable Resource in the Pacific Northwest?: *Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington* (U. Wash. Contribution No. 543, Oct. 6–7, 1980).

D.W. Chapman, *Critical Review of Variables Used to Define Effects of Fines in Redds of Large Salmonid*s, 117 Trans. of the Am. Fisheries Soc'y, 1–21 (1988).

Warren B. Cohen et al., *Characterizing 23 Years (1972–95) of Stand Replacement Disturbance in Western Oregon Forests with Landsat Imagery,* 5 Ecosystems, 122–137 (2002)

Matthew R. Cover et al., *Quantitative Linkages Among Sediment Supply, Streambed Fine Sediment, and Benthic Macroinvertebrates in Northern California Streams*, 27 J. N. Am. Benthological Society, 135–149 (2008).

Matthew R. Cover et al., *Catastrophic Disturbances in Headwater Streams: The Long-term Ecological Effects of Debris Flows and Debris Floods in the Klamath Mountains, Northern California*, 67 Can. J. Fisheries and Aquatic Sci., 1596–1610 (2010).

Richard Cristan et al., *Effectiveness of Forestry Best Management Practices in the United States: Literature Review*, 360 Forest Ecology and Mgmt., 133

J.C. Croke & P.B. Hairsine, *Sediment Delivery in Managed Forests: A Review*, 14 Envtl. Rev., 59–87 (2006).

William E. Dietrich & Thomas Dunne, *Sediment Budget for a Small Catchment in Mountainous Terrain*, 29 Zietschrift fur Geomorphologie Suppl., 191–206 (1978).

William E. Dietrich et al., *Validation of the Shallow Landslide Model, SHALSTAB, for Forest Management*, in Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas, 195–227 (2 Water Sci. Applications Ser., M. S. Wigmosta & S. J. Burges eds., 2001).

Joseph L. Ebersole et al., *Juvenile Coho Salmon Growth and Survival across Stream Network Seasonal Habitats,* 135 Trans. Am. Fisheries Soc'y, 1681–97 (2006).

Joseph L. Ebersole et al., *Modeling Stream Network–scale Variation in Coho Salmon Overwinter Survival and Smolt Size*, 138 Trans. Am. Fisheries Soc'y, 564–580 (2009).

Fred H. Everest & William R. Meehan, *Forest Management and Anadromous Fish Habitat Productivity, in* Trans. 46th N. Am. Wildlife and Nat. Resources Conf., 521–530 (Wildlife Mgmt. Inst., 1981).

Fred H. Everest & Gordon H. Reeves, *Riparian and Aquatic Habitats of the Pacific Northwest and Southeast Alaska: Ecology, Management History, and Potential Management Strategies* (USDA Forest Serv. Gen. Tech. Rep. No. PNW–GTR–692, 2007).

Julie C. Firman et al., *Landscape Models of Adult Coho Salmon Density Examined at Four Spatial Extents,* 140 Trans. Am. Fisheries Soc'y, 440–455 (2011).

Sam A. Flanagan et al., *Methods for Inventory and Environmental Risk Assessment of Road Drainage Crossings* (USDA Tech. & Dev. Program, Water/Road Interaction Tech. Series No. 9877 1809–SDTDC, 1998)

Rebecca L. Flitcroft et al., *Do Network Relationships Matter? Comparing Network and Instream Habitat Variables to Explain Densities of Juvenile Coho Salmon (Oncorhynchus kisutch) in Mid–Coastal Oregon, USA*, 22 Aquatic Conservation: Marine and Freshwater Ecosystems, 288–302 (2012).

Rebecca L. Flitcroft et al., *Riverscape Patterns Among Years of Juvenile Coho Salmon in Midcoastal Oregon: Implications for Conservation*, 143 Trans. Am. Fisheries Soc'y, 26–38 (2014).

Takashi Gomi et al., *Suspended Sediment Dynamics in Small Forest Streams of the Pacific Northwest*, 41 J. Am. Water Resources Ass'n, 877–898 (2005).

Jeremiah D. Groom, *Response of Western Oregon (USA) Stream Temperatures to Contemporary Forest Management*, 262 Forest Ecology and Mgmt. 1618–1629 (2011).

Hermann Gucinski et al., *Forest Roads: A Synthesis of Scientific Information* (USDA Forest Serv. Gen. Tech. Rep. PNWGTR–509, 2001).

Dalton J. Hance et al., *Basin-Scale Variation in the Spatial Pattern of Fall Movement of Juvenile Coho Salmon in the West Fork Smith River, Oregon*, 145 Trans. Am. Fisheries Soc'y, 1018–1034 (2016).

R. Dennis Harr et al., *Changes in Storm Hydrographs After Road Building and Clear-cutting in the Oregon Coast Range*, 11 Water Resources Res., 436–444 (1975).

C.W. Harrison, *Planting Eyed Salmon and Trout Eggs*, 52 Trans. Am. Fisheries Soc'y, 191–200 (1923).

Jeff A. Hatten et al., *Effects of Contemporary Forest Harvesting on Suspended Sediment in the Oregon Coast Range: Alsea Watershed Study Revisited*, 408 Forest Ecology and Mgmt., 238–248 (2018).

B.J. Hicks et al., *Responses of Salmonids to Habitat Changes*, 19 Am. Fisheries Soc'y Special Publication, 483–518 (1991).

R. Jon Hofmeister, *Slope Failures in Oregon: GIS Inventory for Three 1996/97 Storm Events* (Or. Dep't Geology & Minerals Industry Special Paper No. 34, 2000).

Peter C. Impara, *Spatial and Temporal Patterns of Fire in the Forests of the Central Oregon Coast Range* (June 27, 1997) (Ph.D. dissertation, Oregon State University) (on file with Oregon State University Scholars Archive).

Independent Multidisciplinary Science Team (IMST), *Recovery of Wild Salmonids in Western Oregon Forests: Oregon Forest Practices Act Rules and the Measures in the Oregon Plan for Salmon and Watersheds* (Or. Plan for Salmon and Watersheds Tech. Rep. 1991–1, 1999).

Richard M. Iverson, *Debris–Flow Mobilization from Landslides,* 25 Ann. Rev. Earth and Planetary Sci., 85–138 (1997).

Molly Jackson & Joshua J. Roering, *Post-fire Geomorphic Response in Steep, Forested Landscapes: Oregon Coast Range, USA*, 28 Quaternary Sci. Rev., 1131–1146 (2009).

David W. Jensen et al., *Impact of Fine Sediment on Egg-To-Fry Survival of Pacific Salmon: A Meta–Analysis of Published Studies*, 17 Rev. in Fisheries Sci., 348–359 (2009).

Michael G. Johnson & Robert L. Beschta, *Logging, Infiltration Capacity, and Surface Erodibility in Western Oregon*, 78 J. Forestry, 334–337 (1980).

Julia A. Jones & G.E. Grant, *Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon*, 32 Water Resources Res., 959–974 (1996).

Julia A. Jones et al., *Effects of Roads on Hydrology, Geomorphology, and Disturbance Patches in Stream Networks*, 14 Conservation Biology, 76–85 (2000).

J.I. Jones et al., *The Impact of Fine Sediment on Macro-Invertebrates,* 28 River Res. and Applications, 1055–1071 (2012).

Philip R. Kaufmann & Robert M. Hughes*, Geomorphic and Anthropogenic Influences on Fish and Amphibians in Pacific Northwest Coastal Streams*, in 48 Am. Fisheries Soc'y Symp.: Landscape Influences on Stream Habitats and Biological Assemblages, 429–455 (R.M. Hughes, L. Wang & P.W. Seelbach eds., 2006).

K. Victor Koski, *The Survival of Coho Salmon (Oncorhynchus kisutch) From Egg Deposition to Emergence in Three Oregon Coastal Streams* (unpublished master's thesis, Oregon State University) (1965).

Kathryn Kostow, *The Status of Salmon and Steelhead in Oregon*, in Pacific Salmon and Their Ecosystems: Status and Future Options, 145–178 (D.J. Stouder, P.A. Bisson & R.J Naiman eds., 1997)

Stephen T. Lancaster et al., *Effects of Wood on Debris Flow Runout in Small Mountain Watersheds*, 39 Water Resour. Res., ESG 4 1–17 (2003).

Phillip Lee et al., *Quantitative Review of Riparian Buffer Width Guidelines from Canada and the United States,* 70 J. Envtl. Mgmt., 165–180 (2004).

Danny C. Lee et al., *Broadscale Assessment of Aquatic Species and Habitats, in* An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Vol. 1, 1058–1496 (USDA Forest Serv. Gen. Tech. Rep. No. PNW-GTR-405, T.M. Quigley & S.J Arbelbide eds., 1997).

Peter Leinenbach et al., *Effects of Riparian Management Strategies on Stream Temperature* (Prepared for U.S. Interagency Coordinating Subgroup, 2013).

Michael K. Liquori, *Post-harvest Riparian Buffer Response: Implications for Wood Recruitment Modeling and Buffer Design*, 42 J. Am. Water Resources Ass'n, 177–189 (2006).

Colin J. Long et al., *A 9,000-year Fire History from the Oregon Coast Range, Based on a High–resolution Charcoal Study*, 28 Can. J. Forest Res., 774–787 (1998).

Colin J. Long et al., *Holocene Vegetation and Fire History of the Coast Range, Western Oregon, USA*, 17 The Holocene, 917–926 (2007).

Charles H. Luce & Thomas A. Black, *Sediment Production from Forest Roads in Western Oregon*, 35 Water Resources Res., 2561–2570 (1999).

Charles H. Luce & Thomas A. Black*, Effects of Traffic and Ditch Maintenance on Forest Road Sediment Production*, *in* Proceedings of the Seventh Federal Interagency Sedimentation Conference, V67–V74 (2001).

Lee H. MacDonald, *Evaluating and Managing Cumulative Effects: Process and Constraints*, 26 Envtl. Mgmt., 299–315 (2000).

Lee H. MacDonald & Drew B, Coe, 2008. *Road Sediment Production and Delivery: Processes and Management*, in Proceedings of the First World Landslide Forum, 381–384, 2008).

Christine L. May, *Debris Flows Through Different Forest Age Classes in the Central Oregon Coast Range*, 38 J. Am. Water Resources Ass'n, 1097–1113 (2002).

Christine L. May, *Sediment and Wood Routing in Steep Headwater Streams: An Overview of Geomorphic Processes and Their Topographic Signatures*, 53 Forest Sci., 119–130 (2007).

Christine L. May & Robert E. Gresswell, *Processes and Rates of Sediment and Wood Accumulation in Headwater Streams of the Oregon Coast Range, USA*, 28 Earth Surface Processes and Landforms, 409–424 (2003a).

Christine L. May & Robert E. Gresswell, *Large Wood Recruitment and Redistribution in Headwater Streams in the Southern Oregon Coast Range, U.S.A.*, 33 Can. J. of Forest Research, 1352–1362 (2003b).

Christine L. May & Danny C. Lee, *The Relationships Among In–Channel Sediment Storage, Pool Depth, and Summer Survival of Juvenile Salmonids in Oregon Coast Range Streams*, 24 N. Am. J. Fisheries Mgmt., 761–774 (2004).

Christine May, *Sediment and Wood Routing in Steep Headwater Streams: An Overview of Geomorphic Processes and their Topographic Signatures*, 53 Forest Sci., 119–130 (2007).

Daniel D. Magoulick & Robert M. Kobza, *The Role of Refugia for Fishes During Drought: A Review and Synthesis*, 48 Freshwater Biology, 1186–1198 (2003).

M.H. McDade et al., *Source Distances for Coarse Woody Debris Entering Small Streams in Western Oregon and Washington*, 20 Can. J. Forest Res., 326–330 (1990).

Chad C. Meengs & Robert T. Lackey, *Estimating the Size of Historical Oregon Salmon Runs*, 13 Revs. in Fisheries Sci., 51–66 (2005).

Daniel J. Miller & Kelly M. Burnett, *Effects of Forest Cover, Topography, and Sampling Extent on the Measured Density of Shallow, Translational Landslides*, 43 Water Resour. Res, W03433 (2007).

Daniel J. Miller & Kelly M. Burnett, *A Probabilistic Model of Debris–flow Delivery to Stream Channels, Demonstrated for the Coast Range of Oregon*, USA, 94 Geomorphology, 184–205 (2008).

Rebecca R. Miller, *Is the Past Present? Historical Splash-dam Mapping and Stream Disturbance Detection in the Oregon Coastal Province* (Sept. 23, 2010) (M.S. thesis, Oregon State University) (on file with Oregon State University Scholars Archive).

David R. Montgomery, *Road Surface Drainage, Channel Initiation, and Slope Instability*, 30 Water Resources Res., 1925–1932 (1994).

David R. Montgomery et al., *Pool Spacing in Forest Channels*, 31 Water Resources Res., 1097–1105 (1995).

David R. Montgomery & John M. Buffington, *Channel-Reach Morphology in Mountain Drainage Basins*, 109 GSA Bull., 596–611 (1997).

David R. Montgomery et al., *Stream-bed Scour, Egg Burial Depths, and the Influence of Salmonid Spawning on Bed Surface Mobility and Embryo Survival*, 53 Can. J. Fisheries and Aquatic Sci., 1061–1070 (1996).

David R. Montgomery et al., *Channel Type and Salmonid Spawning Distribution and Abundance,* 56 Can. J. Fisheries and Aquatic Sci., 377–387 (1999).

David R. Montgomery et al., *Forest Clearing and Regional Landsliding*, 28 Geology, 311–314 (2000).

Robert J. Naiman et al., *Fundamental Elements of Ecologically Healthy Watersheds in the Pacific Northwest Coastal Ecoregion*, *in* Watershed Management: Balancing Sustainability and Environmental Change, 127–188 (R.J. Naiman ed., 1992).

Robert J. Naiman et al., *Dead Wood Dynamics in Stream Ecosystems*, *in* Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests, 23–48 (USDA Forest Serv. Gen. Tech. Rep. No. Gen. Tech. Rep. PSW-GTR-181, 2002)

Willa Nehlsen et al., *Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington*, 16 Fisheries, 4–21 (1991).

NMFS (National Marine Fisheries Service), Final ESA Recovery Plan for Oregon Coast Coho Salmon *(Oncorhynchus kisutch),* West Coast Region (2016).

NMFS Environmental and Technical Services Division Habitat Conservation Branch, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (1996).

NOAA & U.S. EPA, *NOAA/EPA Finding That Oregon Has Not Submitted a Fully Approvable Coastal Nonpoint Program* (Jan. 30, 2015), https://coast.noaa.gov/data/czm/pollutioncontrol/media/ORCZARAdecision013015.pdf

National Research Council et al., *Upstream: Salmon and Society in the Pacific Northwest* (1996).

Charles P. Newcombe & Jorgen O.T. Jensen, *Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact*, 16 N. Am. J. Fisheries Mgmt., 693–727 (1996).

Fishes and Forestry: Worldwide Watershed Interactions and Management (T.G. Northcote & G.F. Hartman eds., 2004)

Northwest Fisheries Science Center, *Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest* (Prepared for NMFS, Michael Ford ed., 2015)

Oregon DEQ, Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon, Or. Admin. R. 340-041-0001–340-041-8033 (Ch. 340, Division 41) (2011).

Oregon Department of Fish and Wildlife*, Oregon Coast Coho Conservation Plan for the State of Oregon* (2007), http://www.oregon.gov/OPSW/cohoproject/coho_proj.shtml

Oregon Department of Forestry, *Determination of Rapidly Moving Landslide Impact Rating* (Forest Practices Tech. Note No. 6, 2013).

Oregon Department of Forestry, *Northwest Oregon State Forests Management Plan: Revised Plan April 2010* (2010).

Oregon Department of Forestry, *Current FMP Riparian Strategy – Clarification Regarding Slope Stability and Landslides in the Context of Harvest Revision of 06/25/2018* (2018).

Oregon Department of Forestry, State Forests Division, *Species of Concern Operational Policy*, (2010).

Oregon Department of Forestry, State Forests Division, *Species of Concern Operational Procedures*, (2010).

Oregon Department of Transportation, *Guidance Manual for Writing Biological Assessment Documents* (2008).

Mariska Obedzinski et al., *Effects of Flow-Related Variables on Oversummer Survival of Juvenile Coho Salmon in Intermittent Streams*, 147 Trans. Am. Fisheries Soc'y, 588–605 (2018).

Janet L. Ohmann, *Influence of Environment, Disturbance, and Ownership on Forest Vegetation of Coastal Oregon,* 17 Ecological Applications, 18–33 (2007).

Deanna H. Olson et al., *Biodiversity Management Approaches for Stream-Riparian Areas: Perspectives for Pacific Northwest Headwater Forests, Microclimates, and Amphibians*, 246 Forest Ecology and Mgmt., 81–107 (2007).

Alison M. Pechenick, *A Multi-Scale Statistical Approach to Assess the Effects of Connectivity of Road and Stream Networks on Geomorphic Channel Condition*, 39 Earth Surface Processes and Landforms, 1538–1549 (2014).

Timothy D. Perry & Julia A. Jones, *Summer Streamflow Deficits from Regenerating Douglas-Fir Forest in the Pacific Northwest, USA*, 10 Ecohydrology, e1790 (Special Issue, 2017).

Bradley T. Piehl, *Ditch-relief Culverts and Low-volume Forest Roads in the Oregon Coast Range*, 62 Northwest Sci., 91–98 (1988).

Michael M. Pollock et al., *Stream Temperature Relationships to Forest Harvest in Western Washington*, 45 J. Am. Water Resources Ass'n, 141–156 (2009).

Michael M. Pollock and Timothy J. Beechie, *Does Riparian Forest Restoration Thinning Enhance Biodiversity? The Ecological Importance of Large Wood*, 50 J. Am. Water Resources Ass'n, 543–559 (2014).

Geoffrey C. Poole & Cara H. Berman, *An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation*, 27 Envtl. Mgmt., 787–802 (2001).

Thomas P. Quinn, *The Behavior and Ecology of Pacific Salmon and Trout*, U. of Wash. Press, (2018).

Edward B. Rashin et al., *Effectiveness of Timber Harvest Practices for Controlling Sediment Related Water Quality Impacts,* 42 J. Am. Water Resources Ass'n, 1307–1327 (2006).

Gordon H. Reeves et al., *A Disturbance-Based Ecosystem Approach to Maintaining and Restoring Freshwater Habitats of Evolutionarily Significant Units of Anadromous Salmonids in the Pacific Northwest, in* 17 Am. Fisheries Sci. Symp.: Evolution and The Aquatic Ecosystems: Defining Unique Units in Population Conservation, 334–349 (J. Nielsen ed., 1995).

Gordon H. Reeves et al., *Sources of Large Wood in the Main Stem of a Fourth-Order Watershed in Coastal Oregon*, 33 Can. J. Forest Res., 1363–1370 (2003).

Leslie M. Reid et al., *Application of Sediment Budget Studies to the Evaluation of Logging Road Impact*, 20 J. Hydrology (New Zealand), 49–62 (1981).

Leslie M. Reid & Thomas Dunne, *Sediment Production from Forest Road Surfaces*, 20 Water Resources Res., 1753–1761 (1984).

M.E. Reid et al., Forecasting Inundation from Debris Flows that Grow Volumetrically During Travel, with Application to the Oregon Coast Range, USA, 273 Geomorphology, 396-411 (2016).

Raymond M. Rice et al., *Evaluating Forest Management Effects on Erosion, Sediment, and Runoff: Caspar Creek and Northwestern California*, in: *A Century of Forest and Wildland Watershed Lessons*, Soc'y Am. Foresters, 223–238 (2004).

John S. Richardson et al., *How Did Fixed–Width Buffers Become Standard Practice for Protecting Freshwaters and Their Riparian Areas from Forest Harvest Practices?* 31 Freshwater Sci., 232–238 (2012).

Ann Richter and Steven A. Kolmes, *Maximum Temperature Limits for Chinook, Coho, and Chum Salmon, and Steelhead Trout in the Pacific Northwest*, 13 Rev. Fisheries Sci., 23–49 (2005).

E. George Robison et al., *Storm Impacts and Landslides of 1996: Final Report* (ODF Forest Prac. Monitoring Program Tech. Rep. No. 4, 1996).

Streamside Management: Forestry and Fishery Interactions (Inst. Forest Resources, Contribution No. 57, U. Wash., 1987) (E. O. Salo & T. W. Cundy eds., 1987).

K.M. Schmidt et al., *The Variability of Root Cohesion as an Influence on Shallow Landslide Susceptibility in the Oregon Coast Range*, 38 Can. Geotechnical J., 995–1024 (2001).

Dave Schuett-Hames et al., *Results of the Westside Type N Buffer Characteristics, Integrity and Function Study: Final Report* (Wash. State Dep't Nat. Resources Rep. No. CMER 12-1201, 2012).

Mary Scurlock, *Before the Oregon Board of Forestry: General Public Comment by Mary Scurlock, Oregon Stream Protection Coalition on 1) Debris Torrent Stream Implementation and Effectiveness, and; 2) Alternate Practice Approvals Allowing Tethered Equipment on Steep and Erosion Prone Slopes and High Landslide Hazard Locations* (2019).

J. Sessions, *Road Location and Construction Practices: Effects on Landslide Frequency and Size in the Oregon Coast Range*, 2 W. J. Applied Forestry, 119-124 (1987).

Rishi Sharma & Ray Hilborn, *Empirical Relationships Between Watershed Characteristics and Coho Salmon (Oncorhynchus Kisutch) Smolt Abundance in 14 Western Washington Streams*, 58 Can. J. Fisheries and Aquatic Sci., 1453-1463 (2001).

Brian C. Spence et al., *An Ecosystem Approach to Salmonid Conservation* (ManTech Envtl. Res. Serv. Corp. Rep. No. TR-4501-96-6057, 1996).

Thomas A. Spies et al., *Cumulative Ecological and Socioeconomic Effects of Forest Policies in Coastal Oregon*, 17 Ecological Applications, 5–17 (2007).

Pacific Salmon and Their Ecosystems: Status and Future Options (D.J. Souder, P.A. Bisson & R.J. Naiman eds., 1997).

Heather A. Stout et al, Scientific Conclusions of the Status Review for Oregon Coast Coho Salmon (Oncorhynchus kisutch), U.S. Dept. Commer., NOAA Tech. Memo, NMFS-NWFSC-118, (2012).

Kenwyn B. Suttle et al., *How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids*, 14 Ecological Applications 969-974 (2004).

F.J. Swanson, *Inventory of Mass Erosion in the Mapleton Ranger District, Siuslaw National Forest*, (Unpubl. Rep. on file), For. Sci. Lab., PNW For. & Range Exp. Stn., Corvallis, Or, (1977).

F.J. Swanson et al, *Material Transfer in a Western Oregon Forested Watershed,* in *Analysis of Coniferous Forest Ecosystems in the Western United States,* 14 US/IBP Synthesis Series, 233-266 (1982).

M.E. Swanson et al., *The Forgotten Stage of Forest Succession: Early-Successional Ecosystems on Forest Sites,* 9 Frontiers Ecology & Envmt., 117–125 (2011).

Bernard W. Sweeney & J. Denis Newbold, *Streamside Forest Buffer Width Needed to Protect Stream Water Quality, Habitat, and Organisms: A Literature Review*, 50 J. Am. Water Resources Assn., 560-584 (2014).

P.J. Tschaplinski et al., *Fish Forestry Interaction Research in Coastal British Columbia: The Carnation Creek and Queen Charlotte Islands Studies*, *in* Fishes and Forestry: Worldwide Watershed Interactions and Management, 389–412 (G.F. Hartman & T.G. Northcote eds., 2004).

Stephen C. Trombulak & Christopher A. Frissell, *Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities*, 14 Conservation Biology, 18–30 (2000).

H.J. van Meerveld et al., *Controls on Sediment Production from an Unpaved Forest Road in a Pacific Maritime Watershed*, 50 Water Resources Research, 4803–4820 (2014).

Brooke M. Warrington et al., *Forestry Best Management Practices Relationships With Aquatic And Riparian Fauna: A Review*, 8 Forests, (2017).

Beverly C. Wemple et al., *Channel Network Extension by Logging Roads in Two Basins, Western Cascades, Oregon*, 32 AWRA Water Resources Bull., 1195-1207 (1996).

Beverley C. Wemple et al., *Forest Roads and Geomorphic Process Interactions, Cascade Range, Oregon*, 26 Earth Surface Processes and Landforms, 191–204 (2001).

Beverley C. Wemple & Julia A. Jones, *Runoff Production on Forest Roads in a Steep, Mountain Catchment*, 39 Water Resources Res., No. 8, 1220 (2003).

M.C. Wimberly, *Spatial Simulation of Historical Landscape Patterns in Coastal Forests of the Pacific Northwest*, 32 Can. J. Forest Res., 1316–1328 (2002).

Michael G. Wing & Arne Skaugset, *Relationships of Channel Characteristics, Land Ownership, and Land Use Patterns to Large Woody Debris in Western Oregon Streams*, 59 Can. J. Fisheries and Aquatic Sci., 796–807 (2002).

Mark S. Wipfli et al., *Ecological Linkages Between Headwaters and Downstream Ecosystems: Transport of Organic Matter, Invertebrates, and Wood Down Headwater Channels,* 43 J. Am. Water Resources Ass'n, 72–85 (2007).

Steven M. Wondzell & John G. King, *Post-Fire Erosional Processes in the Pacific Northwest and Rocky Mountain Regions*, 178 Forest Ecology & Mgmt., 75-87 (2003).

CERTIFICATE OF SERVICE

I hereby certify that on February 10, 2020, I caused the foregoing Expert Report of Kelly M. Burnett, Ph.D. and sources cited therein to be served on counsel of record for the State Defendants and Defendant-Intervenors.

Dated this 10th day of February, 2020.

/s Amy R. Atwood
Amy R. Atwood

EXHIBIT A

Kelly M. Burnett, Ph.D.
Fisheries Science Consultant
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Corvallis, OR 97333
541-740-9142; kelly.burnett@gmail.com

I. Education

Degrees

Ph.D. Oregon State University, 2001, Fisheries Science
M.S. Oregon State University, 1987, Fisheries Science
B.S. Berry College, Mount Berry, GA, 1980, Biology & Chemistry

Additional Study (selected)

1. Congressional Briefing Conference for the USDA Forest Service, 36 hours, The Government Affairs Institute, Georgetown University, Washington, DC, 2006
2. Ecological Modeling, 40 hours, Fort Collins, CO, 1998
3. Mediation Training and Certification, 30 hours, University of Oregon, School of Law, Eugene, OR, 1995

II. Professional experience

2013 – present	Consulting Fisheries Scientist, self employed, Corvallis, OR
2013 – present	Emeritus Research Fish Biologist, USFS, PNW Research Station, Corvallis, OR
2007 - 2012	GS-482-13, Research Fish Biologist, USFS, PNW Research Station, Corvallis, OR
2006 – present	Graduate Faculty, Oregon State University, Corvallis, OR
2005	GS-482-12 National Fish and Aquatic Program Leader. Detail USDA Forest Service, Washington Office Research and Development.
2002 - 2006	GS-482-12, Research Fish Biologist, USFS, PNW Research Station, Corvallis, OR
1991 - 2002	GS-482-09,-11 Fish Biologist, USFS, PNW Research Station, Corvallis, OR Corvallis, OR
1988 - 1991	GS-482-05,-06,-07 Fisheries Technician, USFS, PNW Research Station, Corvallis, OR
1987 - 1988	Associate Scientist, Caribbean Marine Research Station, Lee Stocking Island, Bahamas
1986	Fisheries Technician II, Prince William Sound Aquaculture Corporation, Cordova, AK
1985	GS-404-5, Biological Technician, USFS, Region 6, Portland, OR
1983 - 1985	Graduate Research Assistant, Fisheries and Wildlife Department, Oregon State University, Corvallis, OR

1981 - 1982 Faculty Research Assistant, Biology Department, Emory University, Atlanta, GA

Honors and Awards (selected)

1. Alpha Chi. 1980. National Honor Society.
2. Certificate of Merit. 1989. For outstanding achievement in providing technical support for fish habitat research on forest and range lands in the PNW and Alaska. USDA Forest Service, PNW Research Station.
3. Certificate of Merit. 1990. For exceptional sensitivity and professionalism in completing a complex and demanding field-sampling program with sensitive fish stocks. USDA Forest Service, PNW Research Station, Aquatic and Land Interactions Program.
4. Certificate of Merit. 1993. In recognition of and appreciation for service on the President's Forest Ecosystem Management and Assessment Team. USDA Forest Service, Washington Office.
5. Certificate of Appreciation. 1994. In special recognition for your outstanding individual contributions to the "Rise to the Future" fisheries program. USDA Forest Service, Washington Office.
6. Certificate of Merit. 1994. For you dedicated, professional, and expeditious completion of 28 timber sale reviews for the protection of aquatic resources. USDA Forest Service, Region 6.
7. Certificate of Appreciation. 1994. For your vital role on the Watershed Analysis Work Group to lay the groundwork for implementing the President's Forest Plan. Interagency Implementation Team and Regional Ecosystem Office.
8. Certificate of Merit. 1996. For outstanding efforts and contributions to the development of the Pacific Salmon and Aquatic Conservation Strategy (PACFISH). USDA Forest Service, Washington Office.
9. Certificate of Appreciation. 1996. In recognition of and appreciation for you work on the Watershed Analysis Coordination Team to implement the Northwest Forest Plan. The Interagency Regional Ecosystem Office.
10. Science Findings Award. 1997. "Landslides through a fish-eye lens." Jointly awarded with Dr. G. Reeves. USDA Forest Service, PNW Research Station.
11. Science Findings Award. 1998. "Seeing the forest for the trees: applying satellite remote sensing to landscape ecology and management." Group award for the Coastal Landscape Analysis and Modeling Study. USDA Forest Service, PNW Research Station.
12. Certificate of Merit. 2003. For successfully managing the aquatic component of the Coastal Landscape Analysis and Modeling Study. USDA Forest Service, PNW Research Station, Aquatic and Land Interactions Program.
13. Science Findings Award. 2004. "Is it HIP? Identifying streams with high potential to provide habitat for salmon and trout?" USDA Forest Service, PNW Research Station.
14. Science Findings Award. 2004. "Forest biodiversity policies: where are they leading us?" Group award for the Coastal Landscape Analysis and Modeling Study. USDA Forest Service, PNW Research Station.
15. Certificate of Merit. 2005. Outstanding scientific and professional work as the acting National Fish and Aquatic Program Leader. USDA Forest Service, Washington Office Research and Development.

16. Extra Effort Award. 2006. For leadership in the science consistency review of the proposed Aquatic and Riparian Conservation Strategy for National Forest System lands throughout Region 6. USDA Forest Service, PNW Research Station.
17. Science Findings Award. 2008. "A landslide is a landslide, is a landslide… or is it?" USDA Forest Service, PNW Research Station.
18. Science Findings Award. 2010. "Linked in: connecting riparian areas to support forest biodiversity." Jointly awarded with Dr. D. Olson. USDA Forest Service, PNW Research Station.
19. Science Findings Award. 2011. "Thinking big: linking rivers to landscapes." Jointly awarded with Dr. E.A. Steel. USDA Forest Service, PNW Research Station.
20. USFS National Rise to the Future Award. 2011. "For professional excellence in research achievements." USDA Forest Service, Washington Office.

Invited Presentations (selected)

1. Burnett, K.M. 1992. Role of riparian vegetation and importance of planning in protecting aquatic ecosystems from upland activities. Field Seminar, First World Congress on Tourism and the Environment, June 1992, Dangriga, Belize, Central America.
2. Burnett, K.M. 1997. Aquatic ecosystem science principles and concepts. Managing Forest Ecosystems, Sustainable Forestry Partnership, April 1997, Corvallis, OR.
3. Burnett, K.M. and G.H. Reeves. 1998. Riparian and upslope conditions predict juvenile Chinook salmon use and habitat. 127th Annual Meeting, American Fisheries Society, August 1998, Hartford, CT.
4. Burnett, K.M. and G.H. Reeves. 1999. Relationships among juvenile Chinook salmon, their habitat, and landscape conditions in the Elk River basin, Oregon. Forests and streams of the Oregon Coast Range: building a foundation for integrated resource management, Coastal Oregon Productivity Enhancement Program, January 1999, Corvallis, OR.
5. Burnett, K.M. 2001. Basin-level effects of headwater streams. Headwaters Research Symposium, October 2001, Corvallis, OR.
6. Burnett, K.M., G.H. Reeves, S.E. Clarke, D.J. Miller, K.R. Christiansen, and K.Vance-Borland. 2002. Modeling aquatic habitat relationships in the Coastal Landscape Analysis and Modeling Study. Changing the scale of our thinking: a multi-ownership assessment of forests and watersheds of the Oregon Coast Range, College of Forestry, Pacific Northwest Research Station, and Oregon Department of Forestry. June 2002, Corvallis, OR.
7. Burnett, K.M. and S.E Clarke. 2002. Riparian zones and related matters: fish habitat. Field Seminar, Annual Meeting, Northwest Forest Soils Council, July 2002, Florence, OR.
8. Burnett, K.M. and D.J. Miller. 2003. Considering disturbance in restoration planning. Annual Meeting, Northwest and Southwest Chapters, Society of Ecological Restoration, March 2003, Portland, OR.
9. Burnett, K.M. 2003. Effects of land management on anadromous salmonids: a landscape and policy context. Field Seminar, North American Forest Ecology 4th Annual Workshop, July 2003, Corvallis, OR.
10. Burnett, K.M., D.J. Miller, L.E. Benda, and G. H. Reeves. 2003. Factors controlling

physical spawning habitat at the basin scale. 133rd Annual Meeting, American Fisheries Society, August 2003, Quebec City, Quebec, Canada.

11. Burnett, K.M., G.H. Reeves, P.W. Lawson, T.A. Spies, and D.J. Miller. 2004. Dynamic landscape modeling in the Coastal Landscape Analysis and Modeling Study (CLAMS). Meeting of the Center for Science in the Earth System, Climate Impacts Group, April 2004, Seattle, WA.
12. Burnett, K.M., G.H. Reeves, D.J. Miller, S.E. Clarke, and K.R. Christiansen. 2004. Mapping the potential of streams to provide high quality habitat for salmonids. Fourth World Fisheries Congress, May 2004, Vancouver, B.C., Canada.
13. Burnett, K.M., G.H. Reeves, S.E. Clarke, and K.R. Christiansen. 2004. Comparing riparian and catchment-wide influences on salmonid habitat in the Elk River, Oregon. The 134th Annual Meeting, American Fisheries Society, August 2004, Madison, WI.
14. Burnett, K.M. 2005. Characterizing habitat condition and capacity to inform monitoring and salmon management. *Keynote for the Habitat Panel*. Triennial Conference, International State of the Salmon, April 2005, Anchorage, AK.
15. Burnett, K.M. 2005. Aquatic biodiversity in the Coastal Landscape Analysis and Modeling Study. Office of the State Forester, Oregon Department of Forestry, May 9, 2005, Salem, OR.
16. Burnett, K.M., G.H. Reeves, D.J. Miller, S.E. Clarke, K. Vance-Borland, and K.R. Christiansen. 2005. Is it HIP? Identifying stream reaches with high intrinsic potential to develop rearing habitat for Pacific salmonids. Annual Meeting, Society for Conservation Biology, July 2005, Brasilia, Brazil.
17. Burnett, K.M., E.P. Bjorkstedt, D.J. Miller, B.C. Spence, K. Vance-Borland, and R. Schick. 2005. Modeling intrinsic habitat potential for salmonids in Oregon and California. 135th Annual Meeting, American Fisheries Society, September 2005, Anchorage, AK.
18. Burnett, K.M. 2005. Identifying the potential of streams to provide favorable habitat for fish: model development, evaluation, and use. West Coast Regional Meeting, National Council for Air and Stream Improvement, September 2005, Portland, OR.
19. Burnett, K.M. 2005. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Office of the Associate Chief, USDA Forest Service, December 20, 2005, Washington, D.C.
20. Burnett, K.M. 2006. Modeling intrinsic habitat potential for salmonids: examples from the Oregon coast. Salmon Habitat Modeling Workshop, Alaska Department of Fish and Game and The Nature Conservancy, May 2006, Anchorage, AK.
21. Burnett, K.M., D.P. Larsen, P.W. Lawson, D.J. Miller, E.A.Steel, D. Stevens, C. Torgersen, J. Ebersole, Jeff Rodgers. 2007 Modeling tools and data for assessing landscape level determinants of fish production: examples from Western Oregon. Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative Symposium, February 2007, Anchorage, AK.
22. Burnett, K.M. 2007. Intrinsic potential, disturbance, and resilience of streams. Pathways to Resilience, Oregon Sea Grant, April 2007, Portland, OR.
23. Burnett, K.M., G.H. Reeves, and D.J. Miller. 2007. Habitat resilience, disturbance, and intrinsic potential. Annual Meeting, North Pacific International Chapter, American Fisheries Society, June 2007, Tacoma, WA.
24. Burnett, K.M. 2008. Salmonid habitats in the context of changing land use and land

cover. State of Oregon Independent Multidisciplinary Science Team, January 2008, Corvallis, OR.

25. Burnett, K.M., D.H. Olson, and D. Miller. 2008. Evaluating configurations of riparian management areas along headwater streams for conservation of amphibians and salmonids. Advances in freshwater conservation planning: a special symposium of the 22nd Conference for the International Society of Conservation Biology, July 2008, Chattanooga, TN.
26. Burnett, K.M. 2009. Intrinsic potential: concepts, models and applications. *Keynote*. State of Intrinsic Potential Modeling Workshop. NOAA Fisheries and Pacific Northwest Aquatic Monitoring Partnership, November 2008, Portland, OR.
27. Burnett, K.M. 2009. Preliminary results – salmon population response across different intensities of land management in Western Oregon. West Coast Regional Meeting, National Council of Air and Stream Improvement, September 2009, Portland, OR.
28. Burnett, K.M., G. Giannico, J. Behan. 2010. What can clinical medicine teach fisheries science? A systematic review on the effectiveness of placing large wood in streams. Annual Meeting, Oregon Chapter, American Fisheries Society, February 2010, Eugene, OR.
29. Burnett, K.M., and K. Vance-Borland. 2010. Landscape predictors of coho salmon. Progress and Findings Symposium, Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative, March 2010. Nome, AK.
30. Burnett, K.M. 2011. Systematic reviews in natural resources management. Cooperative Monitoring, Research, and Evaluation Committee. Washington Department of Natural Resources, July 2011, Olympia, WA.
31. Burnett, K.M. and R.R. Miller. 2011. Restoring in-stream legacies of log driving and splash damming: a crucial step forward? 141st Annual Meeting, American Fisheries Society, September 2011, Seattle, WA.
32. Burnett, K.M. 2011. Intrinsic potential: models and applications. Density Management in the 21st Century – West Side Story. USDI Bureau of Land Management, October 4-6, 2011, Corvallis, OR.
33. Burnett, K.M. 2012. Anybody heard my voice? I know I left it around here somewhere. Women in Fisheries Science. Oregon Chapter of American Fisheries Association, 48th Annual Meeting, February 2012. Eugene, OR
34. Burnett, K.M. 2012. Intrinsic Potential: Models and Applications. USFS National Rise to the Future Awards Symposium, March 2012, Washington, DC.
35. Burnett, K.M., A.P. Fischer, K. Vance-Borland, S.S. Hummel, J. Creighton, S. Johnson. 2012. Communication and Collaboration: Fish & Fire in the Pacific Northwest. USFS WO National Fish and Hydro Meeting, June 14, 2012, Portland, OR.

Offered Presentations (selected)

1. Reeves, G.H., L. E. Benda, K. M. Burnett, P. A. Bisson, and J. R. Sedell. 1994. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitat for anadromous salmonids. American Fisheries Society, Evolution and the Aquatic Ecosystem, May 1994, Monterey, CA.
2. Sedell, J.R. and K.M. Burnett. 1996. Bringing the aquatic sciences into the National Forest Management Act: do they fit? The National Forest Management Act: How has it

worked? Will it work in the 21st Century? September 1996, National Public Lands Conference, Boulder, CO.

3. Gresswell, R.E., K.M. Burnett, S.E. Clarke. 1997. Relationship among landscape, reach, and habitat-unit scale variables and the distribution of native fishes in Elk River. Annual Meeting, Oregon Chapter, American Fisheries Society, February 1997, Salishan, OR.
4. Clarke, S.E., R.E. Gresswell, and K.M. Burnett. 1997. Development of a landscape classification for use in anadromous salmonid research and management. 12th Annual Meeting, US Chapter, International Association of Landscape Ecology, March 1997, Durham, NC.
5. Reeves, G.H., J.R. Sedell, and K.M. Burnett. 1997. Aquatic assessment for the Northwest Forest Plan: the FEMAT model. Annual Meeting, American Fisheries Society, August 1997, Monterey, CA.
6. Burnett, K.M. and G.H. Reeves. 1998. Using multivariate statistical models to predict salmonid use/density from in-channel and upslope characteristics. Annual Meeting, Oregon Chapter, American Fisheries Society, February 1998, Bend, OR.
7. Spies, T.A., K.M. Burnett, W. McComb, M. Raphael, G.H. Reeves, and R. Vega. 1998. Fish, birds, and old growth: developing measures and models to assess effects of forest policies on biodiversity at landscape and regional scales. Annual Meeting, US Chapter, International Association of Landscape Ecology, March 1998, East Lansing, MI.
8. Reeves, G.H. and K.M. Burnett. 1999. Response of aquatic ecosystems. Forest and streams of the Oregon Coast Range: building a foundation for integrated resource management. Coastal Oregon Productivity Enhancement Program, January 1999, Corvallis, OR.
9. Burnett, K.M. and G.H. Reeves. 1999. Aquatic Component of the Coastal Landscape Analysis and Modeling Study. Annual Meeting, Oregon Chapter, American Fisheries Society, February 1999, Bend, OR.
10. Burnett, K.M., S.E. Clarke, G.H. Reeves, and K.R. Christiansen. 1999. GIS in the Coastal Landscape Analysis and Modeling Study (CLAMS): a prototype application to predict juvenile salmonid summer use and habitat from landform and land use data. First International Symposium, GIS in Fishery Sciences, March 1999, Seattle, WA.
11. Clarke, S.E., K.M. Burnett, and K.R. Christiansen. 1999. Building foundation data layers for aquatic analyses. First International Symposium, GIS in Fishery Sciences, March 1999, Seattle, WA.
12. Clarke, S.E., K.M. Burnett, and K.R. Christiansen.1999. Using 10-m drainage-enforced digital elevation models (DE-DEMs) for aquatic analyses. Annual Conference, American Society of Photogrammetry and Remote Sensing, May 1999, Portland, OR.
13. Reeves, G.H. and K.M. Burnett. 1999. Future condition of Oregon's streams and fish. Oregon's Forests at the Millennium Symposium, September 1999, Corvallis, OR.
14. Burnett, K.M., S.E. Clarke, Z. Rickenbach, J. Rodgers, and C. Rugger. 2000. An approach to assess the regional representativeness of current and future life-cycle monitoring basins (LCMB) for coho salmon in western Oregon. Annual Meeting, Oregon Chapter, American Fisheries Society, February 2000, Eugene, OR.
15. Clarke, S.E., K.M. Burnett, K. Vance-Borland, and K.R. Christiansen. 2000. Aquatic

data development for the Coastal Landscape Analysis and Modeling Study (CLAMS). Annual Northwest ESRI Users Conference, September 2000, Skamania Lodge, WA.

16. Burnett, K.M. 2001. Relationships among juvenile anadromous salmonids, their freshwater habitat, and landscape characteristics over multiple years and spatial scales in the Elk River, Oregon. July 2001, Oregon State University, Corvallis, OR.
17. Reeves, G.H. and K.M. Burnett. 2001. Defining biodiversity in the Oregon Coast Range – aquatic conditions. Landmark Assessment of Oregon's Forest Sustainability Symposium, Oregon Board of Forestry and OSU College of Forestry, October 2001, Corvallis, OR.
18. Miller, D.J., K.M. Burnett, S.E. Clarke, K.R. Christiansen, 2001. Sediment routing in headwater streams. Headwaters Research Symposium, October 2001, Corvallis, OR.
19. Reeves, G.H. and K.M. Burnett. 2002. Developing a recovery strategy for coastal Oregon salmon: what the land tells us. Annual Meeting, Oregon Chapter, American Fisheries Society, March 2002, Sun River, OR.
20. Burnett, K.M., G.H. Reeves, S.E. Clarke, and K.R. Christiansen. 2002. Juvenile ocean-type Chinook salmon, their freshwater habitat, and landscape characteristics in the Elk River. Annual Meeting, Oregon Chapter, American Fisheries Society, March 2002. Sun River, OR.
21. Miller, D.J., K.M. Burnett, K.R. Christiansen, and S.E. Clarke. 2002. Inferring habitat variability in space and time. Annual Meeting, Oregon Chapter, American Fisheries Society, March 2002, Sun River, OR.
22. Burnett, K.M., G.H. Reeves, S.E. Clarke, and K.R. Christiansen. 2002. Comparing riparian and catchment-wide influences on salmon habitat. Annual Meeting, US Chapter, International Association of Landscape Ecology, April 2002, Lincoln, NE.
23. Reeves, G.H. and K.M. Burnett. Aquatic habitat relationships in the Oregon Coast Range. 2002. Changing the scale of our thinking: a multi-ownership assessment of forests and watersheds in the Oregon Coast Range. OSU College of Forestry, Pacific Northwest Research Station, and Oregon Department of Forestry, June 2002, Corvallis, OR.
24. Miller, D.J., K.M. Burnett, S.E. Clarke, K.R. Christiansen, and L.E. Benda. 2002. Broad-scale models of landslides and debris flows. Changing the scale of our thinking: a multi-ownership assessment of forests and watersheds of the Oregon Coast Range. OSU College of Forestry, Pacific Northwest Research Station, and Oregon Department of Forestry, June 2002, Corvallis, OR.
25. Burnett, K.M., G.H. Reeves, D.J. Miller, S.E. Clarke, K.R. Christiansen, K. Vance-Borland. 2002. Prioritizing watersheds to recover Pacific salmon and trout in the Coastal Province of Oregon, USA. World Congress on Aquatic Protected Areas, What works and how do we know? July 2002, Cairns, Australia.
26. Reeves, G.H. and K.M Burnett. 2003. Considerations for establishing recovery plans and goals for endangered salmonids. Annual Meeting, Western Division, American Fisheries Society, April 2003, San Diego, CA.
27. Burnett, K.M., G.H. Reeves, D.J. Miller, S.E. Clarke, K.R. Christiansen, and K Vance-Borland. 2003. Identifying stream reaches with potential to support high-quality habitat for imperiled anadromous salmonids. 17th Annual Meeting, International Society for Conservation Biology, June 2003, Duluth, MN.
28. Clarke, S.E., K.M. Burnett *(presenter)*, K.R. Christiansen, and K. Vance-Borland.

2003. Are the spatial data adequate for your conservation biology project? What your GIS analyst should tell you. 17th Annual Meeting, International Society for Conservation Biology, June 2003. Duluth, MN.

29. Spies, T.A, J.L. Ohmann *(presenter)*, B.C. McComb, K.M. Burnett, and G.H. Reeves. 2003. Assessing changes in forest and aquatic biodiversity for broad-scale ecological assessments: an example from coastal Oregon, USA. World Congress, International Association for Landscape Ecology, July 2003, Darwin, Northern Territory, Australia.
30. Burnett, K.M., D.J. Miller, G.H. Reeves, S.E. Clarke, K. Vance-Borland, and K.R. Christiansen, 2003. Regional mapping of stream reaches with potential to develop high-quality habitat for anadromous salmonids. 133rd Annual Meeting, American Fisheries Society, August 2003, Québec City, Québec, Canada.
31. Miller, D.J., L.E. Benda, K.M. Burnett, and S.E. Clarke. 2003. How to reach across a basin: integrating basin-scale interactions to reach-scale predictions. Annual Meeting, American Geophysical Union, December 2003, San Francisco, CA.
32. Clarke, S.E., K.M. Burnett, D.J. Miller, and K.R. Christiansen. 2004. Combining landscape data and field data to model stream geomorphic attributes. Annual Meeting, Western Division, American Fisheries Society, February 2004, Salt Lake City, Utah.
33. Steel, E.A., B. Sanderson, B. Feist, A. Fullerton, M. Sheer, and K.M. Burnett. 2004. Landscape-scale analysis for understanding and managing freshwater ecosystems. Fourth World Fisheries Congress, May 2004, Vancouver, B.C., Canada.
34. Burnett, K.M., D.J. Miller, G.H. Reeves, T.E. Nickelson, and S.E. Clarke. 2004. Identifying stream reaches with potential to develop high-quality habitat for salmon and trout. Annual Meeting, North American Benthological Society, June 2004, Vancouver, B.C., Canada.
35. Moiana, L., K. M. Burnett, K. Vance-Borland, J. Rodgers, and S.E. Clarke. 2004. Assessing representativeness of life cycle monitoring basins for threatened Oregon coastal coho salmon. Annual Meeting, International Society for Conservation Biology, July 2004, New York City, NY.
36. Burnett, K.M., J.L. Ohmann, M. Gregory, and L. Moiana. 2004. Evaluating Landsat imagery for broad-scale characterization of riparian vegetation to guide regional land management policies. Annual Meeting, Ecological Society of America, August 2004, Portland, OR.
37. Burnett, K.M., G.H. Reeves, T.A. Spies, D.J. Miller *(presenter)*, K.N. Johnson, and T. Larsen. 2005. Evaluating riparian policies for headwater streams in the Oregon Coast Range. Science and Management of Headwater Streams in the Pacific Northwest, Oregon Headwaters Research Cooperative, November 2005, Corvallis, OR.
38. Vance-Borland, K., K.M. Burnett, and S. E. Clarke. 2006. Stream and streamside conditions in coastal Oregon watersheds: comparing three stream data sources. Annual Meeting, Society for Conservation GIS, June 2006, San Jose, CA.
39. Burnett, K.M., J.L. Ohmann, L. Moiana, and K. Vance-Borland. 2006. Regional characterization of riparian and upslope vegetation to guide stream habitat protection and restoration. Annual meeting, International Society for Conservation Biology, June 2006, San Jose, CA.
40. Ebersole, J. L., M. Colvin, P. J. Wigington Jr, S. G. Leibowitz, and K.M. Burnett. 2008. Application of restoration scenarios to basin-scale demographics of coho salmon inferred from pit-tags. International Symposium on Advances in Fish Tagging and

Marking Technology, February 2008, Auckland, New Zealand.

41. Firman, J. and K.M. Burnett. 2008. The good data paradox: lessons in landscape modeling for coho salmon in western Oregon. Annual Meeting, Western Division, American Fisheries Society, May 2008, Portland, OR.
42. Burnett, K.M., G. Giannico, and J. Behan. 2008. What can clinical medicine teach fisheries science? A systematic review on the effectiveness of placing large wood in streams. Presented: 138th Annual Meeting, American Fisheries Society, August 2008, Ottawa, Ontario, Canada.
43. Miewald, T., G.H. Reeves, K.M. Burnett, A.N. McKay, M. Goslin, L.E. Benda, A. Bidlack, and E. McCall. 2009. Intrinsic Potential: A Tool for Identifying Salmon Habitat at the Landscape Scale. Spring Specialty Conference, Managing Water Resources Development in a Changing Climate, American Water Resources Association, May 2009, Anchorage, AK.
44. Anlauf, K.J., D.W. Jensen, E.A. Steel, K.M. Burnett, K. Christiansen, J.C. Firman, B.E. Feist, and D.P. Larsen. 2009. A mechanistic approach to explain the variation in coho salmon (*Oncorhynchus kisutch*) habitat across the landscape. North American Regional Meeting, The International Environmetrics Society (TIES), Measuring, Monitoring, and Modeling Environmental Resources, June 2009, Corvallis, OR.
45. Ebersole, J.L, ME Colvin, P.J. Wigington, Jr., S.G. Leibowitz, K.M. Burnett, and J.C. Firman. 2009. Patterns of coho salmon size and survival within a stream network. North American Regional Meeting, The International Environmetrics Society (TIES), Measuring, Monitoring, and Modeling Environmental Resources, June 2009, Corvallis, OR.
46. Firman, J.C., E.A. Steel, D.W. Jensen, K.M. Burnett, K. Christiansen B.E. Feist, D.P. Larsen and K.J. Anlauf. 2009. How broad the horizon? Landscape models of adult coho salmon density examined at four spatial extents. North American Regional Meeting, The International Environmetrics Society (TIES), Measuring, Monitoring, and Modeling Environmental Resources, June 2009, Corvallis, OR.
47. Larsen, D.P., E.A. Steel, K.J. Anlauf , J.C. Firman, D.W. Jensen, K.M. Burnett, K. Christiansen, B.E. Feist. 2009. Introduction to the Oregon story: linking landscapes to coastal coho and habitat. North American Regional Meeting, The International Environmetrics Society (TIES), Measuring, Monitoring, and Modeling Environmental Resources, June 2009, Corvallis, OR.
48. Steel, E.A., D.W. Jensen, K.M. Burnett, K. Christiansen, J.C. Firman, B.E. Feist, K.J. Anlauf, and D.P. Larsen. 2009. Comparing riverine landscape models across populations and sampling designs to understand spawning distributions of coho salmon (*Oncorhynchus kisutch*). North American Regional Meeting, The International Environmetrics Society (TIES), Measuring, Monitoring, and Modeling Environmental Resources, June 2009, Corvallis, OR.
49. Burnett, K.M., D.H. Olson, and D. Miller. 2009. Evaluating linkage areas on headwater streams to conserve amphibians and salmonids. Annual Meeting, American Society of Ichthyologists and Herpetologists, July 2009, Portland, OR.
50. Guritz, R., D.J. Miller, and K.M. Burnett. 2009. Study of the Nome River Salmon Habitat using PRISM, PALSAR, and TerraSAR-X data. Presented: a. 36th Annual Meeting, Alaska Chapter, American Fisheries Society, November 2009, Fairbanks, AK ; b. 3rd International Symposium Principle Investigators, Advanced Land Observing

Satellite, November 2009, Kona, HI .

51. Olson, D.H. and K.M. Burnett. 2010. Up and over: extending riparian reserves into headwaters and over ridgelines to integrate fish and amphibian conservation in forested landscapes. Annual Meeting, Society for Northwest Vertebrate Biology, February 2010, Medford, OR.
52. Anlauf, K., D. Jensen, E.A. Steel, K.M. Burnett, K.R. Christiansen, J. Firman, B. Feist. 2010. Uncovering landscape controls to explain the variation in coho salmon (*Oncorhynchus kisutch*) habitat. Annual Meeting, Oregon Chapter, American Fisheries Society, February 2010, Eugene, OR.
53. Burnett, K.M., D.H. Olson and D. Miller. 2010. Considering amphibians and salmon: designing headwater linkage areas to conserve multiple taxa. The conservation and management of rivers: 20 years on. University of York, England, UK, 6-9 September 2010.
54. Burnett, K.M., D.H. Olson and D. Miller. Designing headwater linkage areas: landscape connectivity for salmon and amphibians. Annual Symposium US International Association of Landscape Ecology, 3-7April 2011, Portland, OR.
55. Anlauf, K., E.A. Steel, K.M. Burnett, J. Firman, K. Christiansen, D.P. Larsen, and B.E. Feist. 2011. Relationships between landscape characteristics, coho salmon, and their channel habitat: spatial extent, spatial variability, and modeling species occupancy. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
56. Flitcroft, R.L., G. Reeves, and K.M. Burnett. 2011. Juvenile coho salmon distribution in stream networks of the mid-Oregon Coast: Implications for conservation. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
57. Flitcroft, R., K.M. Burnett, A.H. Fullerton, and N. Som. 2011. Toward a framework for characterizing hydrologic connectivity in riverine fishes. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
58. Lawson, P., R. Kennedy, G. Reeves, K.M. Burnett, C. Jordan, and M. Meleason. 2011. Patterns of forest disturbance in the Oregon Coast Range with implications for Oregon coast coho salmon. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
59. Meleason, M., P. Lawson, D. Miller, K.M. Burnett, and G. Reeves. 2011. Estimating coho habitat capacity in a dynamic landscape using GIS-based variables. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
60. Meleason, M., P. Lawson, D. Miller, K.M. Burnett, and G. Reeves. 2011. Modeling Stream Habitat Dynamics and Coho Population Viability in Oregon Coastal Rivers. 141st Annual Meeting, American Fisheries Society, 5-8 September 2011, Seattle, WA.
61. May, C., L.S. Eaton, J. Roering, and K.M. Burnett. 2011. The effects of deep-seated landslides on the width of valleys and salmon habitat. Annual Meeting Geological Society of America, 9-12 October 2011, Minneapolis, MN.
62. Hummel, S., K.M. Burnett, K. Vance-Borland, P. Fischer, S. Johnson, and J. Creighton. 2011. Science Communication Networks: the case of "Fish and Fire." Interior West Fire Ecology Conference. 14-17 November 2011, Snowbird, UT.

Workshops Organized (selected)

1. 1992. First World Congress on Tourism and the Environment. Dangriga, Belize, Central

America. Moderated field seminar.
2. 1996. Tools for appropriate dispute resolution. Annual Meeting, Oregon Chapter, American Fisheries Society. Coordinated.
3. 2003. Understanding wild riverine fish populations: new concepts, tools, and applications. Annual Meeting, American Fisheries Society, Quebec City, Quebec, Canada. Co-coordinated and moderated.
4. 2004. International Monitoring Workshop for North Pacific Rim Salmon. Wild Salmon Center and EcoTrust, March 8-12, 2004, Welches, OR. Steering-committee member and expert panelist.
5. 2004. Innovative approaches for investigating stream networks at multiple spatial scales. Annual Meeting, North American Benthological Society, Vancouver, B.C., Canada. Co-coordinated and moderated.
6. 2005. International State of the Salmon Triennial Conference. Wild Salmon Center and EcoTrust, April 17-20, 2005, Anchorage, AK. Steering-committee member and habitat panel moderator.
7. 2005. New Currents in Conserving Freshwater Systems. American Museum of Natural History, April 2005, New York City, NY. Science steering-committee member.
8. 2005 A new approach to planning the National Forests: the NFMA Planning Rule and Planning Directives. Department of Forest Resources, OSU; USDA Forest Service, Pacific Northwest Research Station; and USDA Forest Service, Willamette and Siuslaw National Forests; April 28-June 2, 2005, Corvallis, OR. Co-organized and moderated.
9. 2008. State of Intrinsic Potential Modeling Workshop. NOAA Fisheries and Pacific Northwest Aquatic Monitoring Partnership. November 19 and 20, 2008. Portland, OR. Invited leader coho salmon work group.
10. 2008. Advances in modeling stream populations and habitats. Annual Meeting, Western Division, American Fisheries Society, Portland, OR. Co-coordinated and moderated.
11. 2010. Environmental Legacies: Understanding the Past – Learning for the Future. Annual Meeting, Oregon Chapter, American Fisheries Society. Co-coordinated and moderated.

Consultations (selected)

1. Forest planning and management.
    a. Effects of forest management policies on aquatic sustainability at species and ecosystem levels. Examples include representing the Research, Development & Applications branch of the US Forest Service through multiple revisions of the biological diversity provisions prior to adoption of the 2005 NFMA Planning Rule; and serving on the Forest Ecosystem Management and Assessment Team and as science liaison in developing the Northwest Forest Plan for federal forest lands in the range of the northern spotted owl.
    b. Consistency of aquatic conservation and restoration with best available science. Examples include co-authoring language for "Science Reviews in the Land Management Process" (USFS Directives System FSH1909.12 Chapter 40 Science and Sustainability) with a colleague from the National Forest Systems branch of the US Forest Service; co-leading the interagency Scientific Consistency Review Panel for the proposed Aquatic and Riparian Conservation Strategy (ARCS) to replace the Aquatic Conservation Strategy of the Northwest Forest Plan; and conducting a prototype

"Systematic Evidence Review," as requested by the Oregon Board of Forestry, to assess the feasibility of adapting methods from clinical medicine to evaluate the state of available science on the effectiveness of placing large wood in streams for restoration.

   c. Potential effects of climate change on aquatic resources. Examples include briefing the US Congressional delegation from Oregon; and appointment to Technical Team for developing the interagency National Fish, Wildlife, and Plants Climate Adaptation Strategy as required in the FY 2010 US Department of Interior and Related Agencies Appropriations Act Conference Report.
   d. Monitoring stream and watershed conditions. Examples include reviewing, at the request of PNW Station leadership, the US Office of Management and Budget mandated federal "Implementation Guide for Assessing and Tracking Changes to Watershed Condition;" and developing statistical approaches for the Aquatic and Riparian Effectiveness Monitoring Program (AREMP) of the Northwest Forest Plan.
   e. Effects on aquatic resources of fire and post-fire management in forested ecosystems. Examples include membership on several interdisciplinary intra- and inter-regional committees as requested by PNW Research Station leadership.
2. Intrinsic potential models.
   a. Developing and evaluating intrinsic potential models. Examples include models for historical coho, Chinook, and steelhead habitat potential in northern CA for the National Marine Fisheries Service Southwest Fisheries Science Center; and spawning habitat for lower Columbia River fall Chinook salmon for National Marine Fisheries Service Northwest Fisheries Science Center.
   b. Application of intrinsic potential models. Examples include reviewing the use of intrinsic potential models by Oregon Department of Fish and Wildlife (ODF&W) to evaluate the amount and quality of coho habitat made accessible by past culvert repairs for the interagency Coastal Coho Assessment of the Oregon Plan for Salmon, which was considered by the National Marine Fisheries Service in the ESA listing decision for coastal coho salmon; and advising the Technical Recovery Team for coastal coho salmon in the use of intrinsic potential models to evaluate population structure throughout Oregon and northern California, to identify rivers and streams thought to have once contained salmon, and to set recovery goals, all required under the federal Endangered Species Act.
3. National and regional research priorities. Examples include service on interdisciplinary panels to develop long-term national research priorities for the Wildlife and Fish Strategic Program Area and the Invasive Species Strategic Program Area of the Research, Development, & Applications branch of the US Forest Service. Informal advisory panels for the Environmental Protection Agency (EPA), National Health and Environmental Effects Research Laboratory, Western Ecology Division to evaluate the draft Hydrologic Landscape Regions of Oregon and the salmon research plan, "Landscape and watershed influences on wild salmon and fish assemblages in Oregon coastal streams."
4. Activities of governmental and non-governmental organizations. I regularly consult on regional to international issues with various entities, including King County, WA, Oregon Water Watch, Pacific Rivers Council, Trout Unlimited, The Nature Conservancy, Wild Salmon Center, and EcoTrust. Issues span assessing effectiveness of stream restoration projects as well as developing aquatic and riparian conservation programs, approaches to

regional monitoring and assessment, and basic aquatic ecosystem processes and functions. I have been invited to present to science and policy staff, review technical documents, advise on project development, serve on steering committees, attend workshops, and provide guidance in other capacities.

Peer Reviewed Publications

1. Burnett, K.M. 1990. Multi-steady-state toxicant fate and effect in laboratory aquatic ecosystems. M.S. thesis, Oregon State University, Corvallis, OR.
2. Watanabe, W.O., K.M. Burnett, B. Olla, and R.I. Wicklund. 1989. The effects of salinity on reproductive performance of Florida red tilapia. Journal of the World Aquaculture Society 20(4): 223-229.
3. Burnett, K.M., and W.J. Liss. 1990. Multi-steady-state toxicant fate and effect in laboratory aquatic ecosystems. Environmental Toxicology and Chemistry 9: 637-647.
4. Forest Ecosystem Management and Assessment Team. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Portland, OR: US Department of Agriculture: US Department of Interior [and others].
5. Sedell, J.R., G.H. Reeves, and K.M. Burnett. 1994. Development and evaluation of aquatic conservation strategies. Journal of Forestry 92: 28-31.
6. Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A disturbance-based ecosystem management approach to maintaining and restoring freshwater habitats of Evolutionarily Significant Units of anadromous salmonids in the Pacific Northwest. pp 334-349 *in* Evolution and the Aquatic System: Defining Unique Units in Population Conservation, American Fisheries Society Symposium Proceedings 17.
7. Ringold, P.L., J. Alegria, R. Czaplewski, B. Mulder, T. Tolle, and K.M. Burnett. 1996. Adaptive monitoring design for ecosystem management. Ecological Applications 6:745-748.
8. Sessions, J., G.H. Reeves, K. N. Johnson, K. M. and Burnett, 1997. Implementing spatial planning in watersheds. pp 271-280 *in* K. Kohm and J. Franklin (eds), Creating a Forestry for the 21st Century: The Science of Ecosystem Management, Island Press, Washington, D.C.
9. Ringold, P.L., J. Alegria., R. Czaplewski, B. Mulder, T. Tolle, and K.M. Burnett. 1999. Ecosystem management: lessons in the design of an ecological monitoring strategy for the Pacific Northwest Forest Plan. Environmental Management 23(2):179-192
10. Burnett, K.M. 2001. Relationships among juvenile anadromous salmonids, their freshwater habitat, and landscape characteristics over multiple years and spatial scales in the Elk River, Oregon. PhD Dissertation, Oregon State University, Corvallis, Oregon. 244p
11. Spies, T. A., K. N. Johnson, G. Reeves, P. Bettinger, M. T. McGrath, R. Pabst, K.M. Burnett, and K. Olsen. 2002. An evaluation of tradeoffs between wood production and ecological integrity in the Oregon Coast Range. pp 111-120 *in* Johnson, A.C., R.W. Haynes, and R.A. Monserud (eds) Congruent Management of Multiple Resources: Proceedings from the Wood Compatibility Workshop. PNW-GTR 563 Pacific Northwest Research Station, Portland, OR.
12. Spies, T.A., G.H Reeves, K.M. Burnett, W. McComb, K.N. Johnson, G.E. Grant, J.L.

Ohmann, S.L. Garman, and P. Bettinger. 2002. Assessing the ecological consequences of forest policies in a multi-ownership province in Oregon. pp 179-207 *in* J. Liu and W. Taylor (eds), Integrating Landscape Ecology into Natural Resources Management, Cambridge University Press, New York City, NY.

13. Reeves, G.H., K.M. Burnett, and S.V. Gregory. 2002. Fish and aquatic ecosystems of the Oregon Coast Range. pp 68-98 *in* S.D. Hobbs, J.P. Hayes, R.L. Johnson, G.H. Reeves, T.A. Spies, J.C. Tappeiner II and G.E. Wells (eds), Forest and Stream Management in the Oregon Coast Range. Oregon State University Press, Corvallis, OR.
14. Ringold, P.L., B. Mulder, J. Alegria, R. Czaplewski, T. Tolle, and K.M. Burnett. 2003. Ecosystem management: Lessons in the design of an ecological monitoring strategy for the Pacific Northwest Forest Plan. pp 73-100 *in* D.E. Busch and J.C. Trexler (eds), Monitoring Ecosystems: Interdisciplinary Approaches for Evaluating Ecoregional Initiatives. Island Press, Washington, D.C.
15. Clarke, S.E. and K.M. Burnett. 2003. Comparison of digital elevation models for aquatic data development. Photogrammetric Engineering and Remote Sensing 69(12):1367-1375.
16. Reeves, G.H., K.M. Burnett, and E. McGarry. 2003. Sources of wood in the mainstem of a fourth-order watershed in Coastal Oregon. Canadian Journal of Forest Research 33:1363-1370.
17. Burnett, K.M., G.H. Reeves, D.J. Miller, S.E. Clarke, K.R. Christiansen, and K. Vance-Borland. 2003. A first step toward broad-scale identification of freshwater protected areas for Pacific salmon and trout. In J. Beumer, ed. Proceedings of the World Congress on Aquatic Protected Areas, Cairns, Australia, August 14-18, 2002, Australian Society for Fish Biology, North Beach, WA, Australia.
18. Agrawal, A., R.S. Schick, E.P. Bjorkstedt, R.G. Szerlong, M.N. Goslin, B.C. Spence, T.H. Williams, and K.M. Burnett. 2005. Predicting the potential for historical coho, Chinook, and steelhead habitat in northern CA. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-379.
19. Reeves, G.H., J.E. Williams, K.M. Burnett, and K. Gallo. 2006. The aquatic conservation strategy of the Northwest Forest Plan. Conservation Biology 13:1220-1223
20. Burnett, K.M., G.H. Reeves, S.E. Clarke, and K.R. Christiansen. 2006. Comparing riparian and catchment-wide influences on salmonid habitat in Elk River, Oregon. Pages 175-196 *in* R.M. Hughes and L. Wang (eds), Influences of Landscapes on Stream Habitat and Biological Communities. American Fisheries Society Symposium 48. Bethesda, MD
21. Spies, T.A., K.N. Johnson, K.M. Burnett, J.L. Ohmann, B.C. McComb, G.H Reeves, P. Bettinger, J.D. Kline, and B. Garber-Yonts. 2007. Cumulative Ecological and Socioeconomic Effects of Forest Policies in Coastal Oregon. Ecological Applications. 17(1):5-17.
22. Burnett, K.M., G.H. Reeves, D.J. Miller, S. Clarke, K. Vance-Borland, and K. Christiansen. 2007. Distribution of Salmon-Habitat Potential Relative to Landscape Characteristics and Implications for Conservation. Ecological Applications. 17(1):66-80.
23. Miller, D. J., and K. M. Burnett. 2007. Effects of forest cover, topography, and sampling extent on the measured density of shallow, translational landslides. Water Resources Research, 43, W03433, doi:10.1029/2005WR004807.
24. Wondzell, S.M., K.M. Burnett, J.D. Kline. 2007. Landscape Analysis: Projecting the effects of management and natural disturbances on forest and watershed resources of the

Blue Mountains, Oregon, USA. Landscape and Urban Planning 80:193–197
25. Bigelow, P., L.E. Benda, D.J. Miller, and K. M. Burnett. 2007. On Debris Flows, River Networks, and the Spatial Structure of Channel Morphology. Forest Science 53: 220-238.
26. Burnett, K.M. and D.J. Miller. 2007. Streamside Policies for Headwater Channels: An Example Considering Debris Flows in the Oregon Coastal Province. Forest Science 53: 239-253.
27. Miller, D.J. and K.M. Burnett. 2008. A probabilistic model of debris-flow delivery to stream channels, demonstrated for the Coast Range of Oregon, USA Geomorphology 94: 184-205.
28. Clarke, S.E., K.M. Burnett, and D.J. Miller. 2008. Modeling streams and hydrogeomorphic attributes in Oregon from field and digital data. Journal of the American Water Resources Association 44: 459-477. DOI: 10.1111/j.1752-1688.2008.00175.x
29. Torgersen, C.E., R.E. Gresswell, D.S. Bateman, and K.M. Burnett. 2008. Spatial identification of tributary impacts in river networks. Pp 159-182 *in* A. Roy, S. Rice, and B. Rhoads (eds), River confluences and the fluvial network.
30. Vance-Borland, K., K.M. Burnett, and S.E. Clarke. 2008. Stream and streamside conditions in coastal Oregon watersheds: comparing three stream data sources. Aquatic Conservation: Marine and Freshwater Ecosystems. DOI: 10.1002/aqc.967
31. Miller, D., Burnett, K.M., Benda, L. 2008. Factors controlling availability of spawning habitat for salmonids at the basin scale. Pages 103-120 in D. A. Sear and P. DeVries, editors. Salmonid spawning habitat in rivers: physical controls, biological responses, and approaches to remediation. American Fisheries Society, Symposium 65, Bethesda, Maryland
32. Burnett, K.M., C. E. Torgersen, E.A. Steel, D.P. Larsen, J.L. Ebersole, R.E. Gresswell, P.W. Lawson, D.J. Miller, J.D. Rodgers, and D.L. Stevens. 2009. pp 873-902 *in* C.C. Krueger and C.E. Zimmerman eds. Data and Modeling Tools for Assessing Landscape-Level Influences on Salmonid Populations: Examples from Western Oregon. American Fisheries Society, Symposium 70, Bethesda, Maryland
33. Olson, D.H. and K.M. Burnett. 2009. Design and management of linkage areas across headwater drainages to conserve biodiversity in forest ecosystems. Forest Ecology and Management. doi:10.1016/j.foreco.2009.04.018
34. Adams, S.B., K.M. Burnett, P. Bisson, B. Harvey, K.H. Nislow, B.E. Rieman, John Rinne. 2010. The Role of the Forest Service in Aquatic Invasive Species Research. General Technical Report, USDA Forest Service, Southern Research Station
35. Fullerton, A.H., K.M. Burnett, E.A. Steel, R.L. Flitcroft, B.E. Feist, C.E. Torgersen, D.J. Miller, and B.L. Sanderson. 2010. Connectivity in Riverine Ecosystems: Measurement Challenges and Research Opportunities. Journal of Freshwater Biology.
36. Firman, J. C., E. A. Steel, D.W. Jensen, K.M. Burnett, K. Christiansen, B.E. Feist, D.P. Larsen, and K. Anlauf. 2011. Landscape models of adult coho salmon density examined at four spatial extents. Transactions of the American Fisheries Society 140: 440-455 DOI:10.1080/00028487.2011.567854
37. Lucero, Y., E. A. Steel, K.M. Burnett, and K. Christiansen. 2011. Untangling human development and natural gradients: Implications of underlying correlation structure for linking landscapes and riverine ecosystems. River Systems 19: 207-224, DOI:

10.1127/1868-5749/2011/019-0024
38. Anlauf, K. J., D.W. Jensen, K.M. Burnett, E.A. Steel, K. Christiansen, J.C. Firman, B.E. Feist, D.P. Larsen. 2011. Explaining spatial variability in stream habitats using both natural and management-influenced landscape predictors. Aquatic Conservation: Marine and Freshwater Ecosystems 21:704-714, DOI: 10.1002/aqc.1221
39. Steel, E. A., D.W. Jensen, K.M. Burnett, K. Christiansen, J.C. Firman, B.E. Feist, K. Anlauf, and D.P. Larsen. 2012. Landscape characteristics and coho salmon (*Oncorhynchus kisutch*) distributions: Explaining abundance versus occupancy. Canadian Journal of Fisheries and Aquatic Sciences 69: 457-468, 10.1139/f2011-161
40. Flitcroft, R. L., K. M. Burnett, G. H. Reeves, and L. M. Ganio. 2012. Do network relationships matter? Comparing network and instream habitat variables to explain densities of juvenile coho salmon (*Oncorhynchus kisutch*) in mid-coastal Oregon, USA. Aquatic Conservation: Marine and Freshwater Ecosystems 22: 288–302. doi: 10.1002/aqc.2228
41. Busch, S.D., M. Sheer, K.M. Burnett, P. McElhany, and T. Cooney. 2013. Landscape-level model to predict spawning habitat for Lower Columbia River fall Chinook (*Oncorhynchus tshawytscha*). River Research and Applications 29: 297–312. doi: 10.1002/rra.1597
42. Flitcroft R.L., K.M Burnett, and K.R. Christiansen. 2013. A simple model that identifies potential effects of sea-level rise on estuarine and estuary-ecotone habitat locations for salmonids in Oregon, USA. Environmental Management 52:196-208. DOI 10.1007/s00267-013-0074-0
43. C. May, J. Roering, L.S. Eaton and K.M. Burnett. 2013. Controls on valley width in mountainous landscapes: The role of landsliding and implications for salmonid habitat Geology doi: 10.1130/G33979.1
44. Fischer, A.P., K. Vance-Borland, K.M. Burnett, S.S. Hummel, J. Creighton, S. Johnson. 2014. Does the social capital in networks of "fish and fire" scientists and managers suggest learning? Society and Natural Resources 27: 671-688 doi:10.1080/08941920.2014.901463
45. Flitcroft, R., K. Burnett, J. Snyder, G. Reeves, and L. Ganio. 2014. Riverscape patterns among years of juvenile Coho Salmon in midcoastal Oregon: implications for conservation. Transactions of the American Fisheries Society 143: 26-38
46. Hance, D.J, L.M. Ganio, K.M. Burnett, and J.L. Ebersole. 2016. Basin-scale variation in the spatial pattern of fall movement of juvenile Coho salmon in the West Fork Smith River, Oregon. Transactions of the American Fisheries Society 145:1018-1034
47. Steel, E.A., A. Muldoon, A., R.L. Flitcroft, J.C. Firman, K.J. Anlauf-Dunn, K.M. Burnett, and R.J. Danehy. 2016. Current landscapes and legacies of land-use past: understanding the distribution of juvenile coho salmon (Oncorhynchus kisutch) and their habitats along the Oregon Coast, USA. Canadian Journal of Fisheries and Aquatic Sciences 999:1-16.
48. Petro, V.M., J.D. Taylor, D.M. Sanchez, and K.M. Burnett. 2018. Methods to Predict Beaver Dam Occurrence in Coastal Oregon, Northwest Science 92(4) https://doi.org/10.3955/046.092.0405

Reports

1. Dunham, J.D, K. Burnett, and G. Wenz. 1990. Birds of Lee Stocking Island, Bahamas.

Observations from the unpublished report were subsequently published in Buden, D.W. 1992. Birds of the Exumas, Bahama Islands. Wilson Bulletin 104 (4):674-898.

2. Regional Ecosystem Office. 1995. Federal Guide to Watershed Analysis. Version 1.1. Portland, OR.
3. Science Consistency Review Panel. 2006. Science consistency review of the USDA Forest Service, Region 6, Aquatic and Riparian Conservation Strategy for contributing to species sustainability. PNW Research Station. Portland, OR.
4. Burnett, K.M., G. Giannico, and J. Behan. 2008. A pilot test of systematic review techniques: evaluating whether wood placements in streams of the Pacific Northwest affect salmonid abundance, growth, survival or habitat complexity. February 4, 2008, Report to the Oregon Board of Forestry, Salem, Oregon.
5. Sheer, M.B., D.S. Busch, E. Gilbert, J.M. Bayer, S. Lanigan, J.L Schei, K.M. Burnett, and D. Miller. 2009. Development and management of fish intrinsic potential data and methodologies: State of the IP 2008 summary report: Pacific Northwest Aquatic Monitoring Partnership Series 2009-004, 56 p.
6. Furniss, M.J., B.P. Staab, S. Hazelhurst, C.F. Clifton, K.B. Roby, B.L. Ilhadrt, E.B. Larry, A.H. Todd, L.M. Reid, S.J. Hines, K.A. Bennett, C.H. Luce, P.J. Edwards. 2010. Water, climate change, and forests: watershed stewardship for a changing climate. Gen. Tech. Rep. PNW-GTR-812. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 75 p.
7. Burnett, K. M., D.J. Miller, R. Guritz, M.A. Meleason, K. Vance-Borland, R.L. Flitcroft, M.J. Nemeth, J. Priest, N.A. Som, and C. Zimmerman. 2013 Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative 2011 Project Final Product. Landscape Predictors of Coho Salmon.
8. D.H. Olson, K.M. Burnett. 2013. Geometry of forest landscape connectivity: pathways for persistence. P.D. Anderson, K.L. Ronnenberg (Eds.), Density Management in the 21st Century: West-side Story. PNW-GTR-880, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR

Archived databases

1. Z. Rickenbach, S.E. Clarke and K.M. Burnett. 1999. Nested 6th and 7th code Hydrologic Units (HU) for the Coastal Province of Oregon derived from 10-m digital elevation data. (http://www.fsl.orst.edu/CLAMS).
2. Miller, D.J., K.M. Burnett, K.R. Christiansen, S.E. Clarke, and G.H. Reeves. 2006. A high-resolution stream layer modeled from 10-m digital elevation data for the Coastal Province of Oregon. Modeled streams (drainage areas greater than 0.75 ha) and modeled hydrogeomorphic attributes, including intrinsic habitat potential for steelhead and coho salmon as well as other modeled hydrogeomorphic attributes.(http://www.fsl.orst.edu/CLAMS).
3. Miller, R.R. and K.M. Burnett. 2010. A high-resolution geodatabase of 232 splash dams and 213 log drives that were operated from the 1880s through the 1950s in rivers of western Oregon. Splash damming and log driving, among the earliest reported management disturbances in rivers of the Pacific Northwest, were used to transport timber to downstream mills before extensive logging roads were constructed. (http://www.fs.fed.us/pnw/lwm/aem/people/burnett#splashdams).

Demonstrations and Courses (selected)

1. Basin Survey Techniques. Habitat Rehabilitation and Enhancement Workshop, Oregon Chapter of the American Fisheries Society, February 1990, Bend, OR.
2. The Statistical Basis of and Field Methods for Stream Survey Procedures. USDA Forest Service, Fish Habitat Relationships Program, Basin Surveys and Applications Short Course, April 1992, Utah State University, Logan, UT.
3. The Coastal Landscape Analysis and Modeling Study: freshwater emphasis. Research and Monitoring Committee, 27 January 1998, Regional Ecosystem Office, Portland, OR.
4. Analyzing policy implications of the Oregon Coastal Salmon Restoration Initiative. 9-week graduate course, OSU Department of Forest Resources, FOR 561, Winter term 1997. Co-taught.
5. Modeling current and future effects of alternative forest policies on aquatic biodiversity in the Coastal Landscape Analysis and Modeling Study. Coast Range Provincial Advisory Committee, 18 July 2002, Corvallis, OR.
6. Using intrinsic potential models to identify historical coho salmon habitat conditions and production. Meeting of the Southern Oregon and Northern California Technical Recovery Team for coho salmon, 24 September 2003, Corvallis, OR.
7. Identifying streams with high intrinsic potential for aquatic habitat and management applications. USFS Region 6, Aquatic Program Managers Meeting, 21 April 2004, Hood River, OR.
8. Modeling fish habitat potential. Aquatic Habitat Restoration and Enhancement, Bureau of Land Management National Training Course (NTC 1730-25), Spring 2005, Eugene, OR.
9. Aquatic biodiversity in the Coastal Landscape Analysis and Modeling Study. Office of the State Forester, Oregon Department of Forestry, 9 May 2005, Salem, OR.
10. Models for planning to conserve and restore native fish habitat. Bureau of Land Management, Western Oregon Land and Resource Management Planning team, 12 May 2005, Eugene, OR.
11. Models to evaluate riparian management alternatives. National Commission on Science for Sustainable Forestry, 20 May 2005, Corvallis, OR.
12. Landscape influences on streams. 9-week graduate course, OSU Department of Fisheries and Wildlife, FW 599 Fall term, 2010, 2011, and 2012. Co-taught.
13. “Fish and Fire” Science Network Communication Study. Meeting of the Station Management Team, PNW Research Station, 26 October 2011, Portland, OR.

Editorships

2005- 2007: Based on my experience with bioregional assessments, I was invited to be a guest editor for a special issue of the refereed journal Landscape and Urban Planning on the Interior Northwest Landscape Analysis System (INLAS). Editorial responsibilities were shared with Dr. S. Wondzell and Dr. J. Kline. I coordinated peer reviews for five of the twelve articles in the special issue.

Grants and Agreements

1. 1994 - 2000 USFS PNW Research Station, NW Forest Plan competitive funding. To G.H. Reeves and K.M. Burnett. Dynamic ecology of aquatic ecosystems in Oregon ($350,000).
2. 2001 USFS National Resource Information System, Water. To K.M. Burnett. Comparing available stream layers for aquatic analysis ($20,000).
3. 2004 Oregon Watershed Enhancement Board. To K.M. Burnett. Mapping intrinsic potential for the Oregon Coast Range ($7,000).
4. 2004 USFS Region 6, Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan. To K.M. Burnett. Developing and applying landslide models for the Northwest Forest Plan area ($20,000).
5. 2006-2008 BLM State Office. To G.H. Reeves, K.M. Burnett, L. Benda, and D.J. Miller. Developing criteria to assess alternatives for the Western Oregon Plan Revision ($68,000).
6. 2006-2009 USFS Region 6, Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan. To K.M. Burnett. Developing landscape models to estimate stream conditions ($108,000).
7. 2007-2010 Oregon Headwaters Research Cooperative. To K.M. Burnett (PI), G.H. Reeves, J. Dunham, D.J. Miller, and L. Benda. A Disturbance-Based Approach for Predicting and Evaluating Cumulative Watershed Effects in Headwaters and Downstream in Larger Fish-Bearing Channels ($44,400).
8. 2007-2011 Oregon Watershed Enhancement Board. To K.M. Burnett. Integrated Dynamic Landscape and Coho Salmon Model ($88,000).
9. 2008-2011 Arctic Yukon Kuskokwim Sustainable Salmon Initiative. To K.M. Burnett (PI), D.J. Miller, R. Guritz, M. Nemeth, K. Vance-Borland, and C. Zimmerman. Landscape indicators of coho salmon abundance ($425,000).
10. 2008-2013 National Council of Air and Stream Improvement. To K.M. Burnett. Evaluation of Coho Salmon across a Range of Management Intensities and Habitat Potentials ($110,000).
11. 2009-2011 American Reinvestment and Recovery Act. To K.M. Burnett. Spatial Patterns of Habitats and Salmonids ($335,000).
12. 2010-2012 PNW Research Station. To K.M. Burnett (PI), K. Vance-Borland, S. Hummel, J. Creighton, P. Fischer, M. Furniss, and S. Johnson. Social Network Analysis: Fish and fire ($170,000).

AMENDED EXPERT REPORT OF KELLY M. BURNETT, PH.D.
Appendix A (Table of Timber Sales)

ODF Sale Name	AOP year	New Road Miles	Acres Clearcut	Acres Partial Cut	Landslide Prone Landscape	Debris Flow Runout from Harvest Unit to Coho Stream	Debris Flow Runout from Harvest Unit to Any Stream	Expected Buffer Effectiveness (Low, Medium, High, O-no buffer)	Haul Route Available	Debris Flow Runout from Haul Route to Coho Stream	Debris Flow Runout from Haul Route to Any Stream	Hydrologically Connected Haul Route	Aquatic Anchor	Primary Location in Aquatic Anchor	Secondary Location in Aquatic Anchor 2	Named Streams on map
Ax Ridge	2015	5.3	237	65	H	Rearing	Y	L	Y	Spawning	N	Y	N			Jordan Creek
BD7	2019	0.74	150		M	Spawning	N	L	Y	N	N	Y	N			SF Wilson River
Big Louie	2019	0.37	90		L	Spawning	N	L	Y	N	N	Y	Y	Lousignont/U Nehalem		Lousignont Creek
Brimstone	2017	0.98	27		L	N	Y	M	Y	Spawning/Rearin	N	Y	N			Bark Shanty Creek/ NF Trask River
Broken Arrow	2018	2.11	405		H	Spawning	Y	L	Y	Spawning	N	Y	N			Jordan Creek
Buck Shot	2020	0	177		L	Spawning	Y	M	Y	N	N	Y	N			Deep Creek
Clean Slate	2020	0	226		M	N	Y	H	Y	N	N	Y	Y	Northrup		Northrup Creek / Cow Creek
Coast Bill	2021	2.25	331		H	Spawning	Y	M	Y	Spawning	Y	Y	N			Joyce Creek / Bill Creek / SF Trask
Cruisin Murphy	2020	0.46	194		L	Spawning	Y	L	Y	N	Y	Y	Y	Elkhorn		Cruiser Creek
Daisy Chain	2018	0.2	77		L	Spawning	Y	M	Y	N	N	Y	Y	Northrup		Cow Creek
Devil Ray	2021	0.84	189		L	Spawning	N	M	Y	N	Y	Y	Y	Devils Lake Fork		Devils Lake Fork
Dragon's Roost	2020	0.1	202		L	N	N	H	Y	N	N	Y	Y	Buster		Buster Creek
Duchess and the Duke	2019	0.52	83		M	Spawning	N	L	Y	N	N	Y	N			SF Wilson River
East Foley	2019		226		H	Spawning	Y	L	Y	Spawning	N	N	Y	Foley		East Foley/ Anderson Creek
Fireworks	2016	0	330		M	Spawning	Y	L	Y	N	Y	Y	Y	Elkhorn		Elkhorn Creek / Cruiser Creek
Flinstone	2019		49		L	Spawning	Y	M	Y	N	N	Y	Y	Northrup		Northrup Creek
Forgotten Shorts	2020	0	67		H	Rearing	Y	L	Y	N	N	Y	N			Nehalem River
Franken Fir	2018	1.54	313		H	N	Y	L	Y	N	Y	Y	Y	Cedar	Little NF Wilson	Wilson River
General Lee	2018	0.94	157		M	Rearing	Y	M	Y	Spawning	N	Y	Y	Ben Smith		Wilson River / Ben Smith Creek
Gold Rush	2019	2.17	180		H	Spawning/Rearing	Y	L	Y	Spawning	Y	Y	N			SF Trask River
Ground Round	2018		43		L	N	N	H	Y	N	N	Y	Y	Lousignont/U Nehalem		Nehalem River
Hanns Down	2019		104		M	Spawning	Y	L	Y	N	N	Y	Y	Lousignont/U Nehalem		Nehalem River
Hembre Falls	2021	0.51	181		H	Spawning	N	L	Y	Spawning	Y	Y	N			Fall Creek
High Standards	2017	1.96	110		H	Spawning	Y	L	Y	Spawning	N	Y	N			Rogers Creek
Hind Sight	2020		104		L	N	N	H	Y	N	N	Y	Y	Lousignont/U Nehalem		Lousignont Creek
Homesteader	2016	1.1	203	234	L	N	Y	O	N				N			Nehalem River / Buster Creek
Hopscotch	2018	0.9	0		H	Spawning	Y	L	Y	N	N	Y	Y	EF SF Trask		Scotch Creek / EF SF Trask River
Jethro Toll	2019	1.75	333		M	Spawning/Rearing	Y	M	Y	N	Y	Y	N			Bark Shanty Creek/ NF Trask River
Jordan Ridge	2021	0.63	176		H	Spawning	Y	L	Y	N	Y	N	N			Jordan Creek
Kilchis Saddle	2020	2.16	220		M	Spawning	Y	L	Y	Spawning	N	Y	Y	Middle Kilchis		Sam Downs Creek / Little SF Kilchis
Knot Berry	2017	1.67	193		H	Spawning/Rearing	Y	M	Y	Spawning	Y	N	Y	Little NF Wilson		Little NF Wilson River / Berry Creek
Lobo Canyon	2022	0.99	194		H	Spawning/Rearing	Y	O	Y	Spawning	Y	Y	Y	Cedar		Cedar Creek / Wolf Creek
Long Walker	2018	1.6	190	34	L	Spawning	N	H	Y	N	N	Y	Y	Buster		Strum Creek / Walker Creek
Lost Hills	2018	1.9	236		H	Spawning	Y	L	Y	N	Y	N	N			Lost Creek
Lost Overlook	2019		76		M	Spawning	N	M	Y	N	N	Y	N			Lost Creek
Lost Pony	2016	0.2	159		L	Spawning	Y	L	N				N			Lousignont Creek
Lou's Leftovers	2019	0.3	123		L	N	N	H	Y	N	N	Y	Y	Lousignont/U Nehalem		NF Lousignont Creek
Mor Nor Wolf	2019	1.42	189		L	Spawning	Y	M	N				N			NF Wolf Creek
More Cow Bell	2015	1.14	96		M	Spawning	N	M	Y	N	N	Y	Y	Lousignont/U Nehalem		Reliance Creek
My Mulligan	2017	0	108		L	N	N	H	N				Y	Lousignont/U Nehalem		Lousignont Creek
Nehalem Breaks	2016	1.04	145		M	Spawning/Rearing	Y	L	N				Y	Lousignont/U Nehalem		Nehalem River / Derby Creek
Nowhere Land	2016	0.4	137		L	Rearing	Y	M	N				Y	Northrup		Northrup Creek
Old Bungee	2020	0.91	225		H	Spawning	Y	L	Y	Spawning	Y	Y	Y	Cedar		NF Kilchis River / Cedar Creek
Packy	2015	0.6	213		M	Spawning	Y	L	Y	N	N	Y	N			Walker Creek
Power Trip	2020	0.14	70		H	Spawning	Y	L	Y	N	Y	Y	N			SF Wilson River
Quarter Mile	2016	1.9	68		L	Rearing	Y	M	Y	N	N	Y	N			Nehalem River
Razorback	2020		113		L	Spawning	N	L	Y	N	N	N	N			Devils Lake Fork
Rocky 2	2020	1.48	178		M	Spawning	Y	M	Y	Spawning	Y	N	Y	EF SF Trask		EF SF Trask River
Rocky Road	2017	6.25	298	315	M	Spawning	Y	M	Y	Spawning	Y	Y	Y	EF SF Trask		EF SF Trask River / Rock Creek
Round House	2015	2.45	157	140	M	N	N	M	N				Y	Lousignont/U Nehalem		Nehalem River
Sloopy	2020		69		L	Spawning	N	M	Y	Spawning	Y	Y	N			Wolf Creek / Salmonberry River
Smith and Archers	2020	1.97	205		M	Spawning	N	M	Y	Spawning	N	Y	Y	Ben Smith		Ben Smith Creek
South Bushong	2019	0.81	222		M	Spawning	N	L	Y	N	Y	Y	N			SF Trask River
South Minich	2018	0.06	119		M	Spawning	Y	M	Y	N	N	N	Y	Miami		Minich Creek
Southern Steamer	2021	3.25	209		H	Spawning	Y	L	Y	Spawning	Y	Y	N			Jordan Creek / SF Jordan Creek
Spruce Run Ridge	2018	0.6	3	220	M	N	Y	M	Y	Spawning	Y	Y	N			Spruce Run Creek
The Simms	2016	3.36	949		L	Spawning	Y	M	Y	N	Y	Y	Y	Elkhorn		Cruiser Creek / Elkhorn Creek
Thor's Summit	2018	2.4	107		M	Spawning	Y	M	Y	Spawning	Y	Y	Y	EF SF Trask		South Creek / Summit Creek
Three Little Ridges	2016	3	348		H	Spawning	Y	L	Y	Spawning	Y	Y	Y	Little NF Wilson		Little NF Wilson River
Upper Horse Hawk	2019	0.6	92		M	Spawning	Y	M	Y	N	Y	Y	N			Warner Creek
Voltaire's Flair	2017	0		363	L	N	Y	H	N				Y	Lousignont/U Nehalem		Nehalem River / Derby Creek
Wild Bill	2019	0.3	56		M	N	Y	M	Y	N	Y	Y	N			Walker Creek
Willy-nilly	2020	0.59	189		M	Spawning	Y	L	Y	Spawning	N	Y	N			NF NF Trask River / MF NF Trask
Woods Way	2017	0.87	110		M	Spawning	N	L	N				N			SF Wilson River
Woody Woodpecker	2019		100	197	M	Spawning/Rearing	Y	M	Y	N	N	Y	Y	Upper NF Nehalem		Nehalem River / Sweet Home Creek
Wooley Grade	2020	0	102		H	Spawning	Y	M	Y	N	Y	N	N			Helloff Creek
ZZ Tops	2021	1.38	126		H	Spawning/Rearing	Y	L	Y	N	N	Y	N			NF Trask River / Hembre Creek

November 9, 2020

To:

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CC: Oregon Congressional Delegation

Dear Federal Forest Managers:

Oregon has experienced an unprecedented fire season that will be remembered for decades to come. The confluence of drought and east winds was a set up for tragedy. The costs in terms of human life and property are significant and irreplaceable. We share the pain and anguish of those who lost loved ones or lost homes.

As the fall rains arrive and the embers are cooling, we are writing to offer our initial recommendations for post-fire management of our public lands. Significant economic recovery of fire-killed trees can be expected from private lands, leaving a different role for public forests. Namely, natural forest recovery. Salvage logging on public lands can set back natural recovery and harm water quality by damaging soils and significantly increasing sediment flows and remove biologically diverse habitat that wildlife depend on and accelerate carbon emissions. Rather, we urge public land managers to focus on stabilizing watersheds and emphasize natural recovery of complex early seral forests and retention of abundant snags and dead wood.

The new paradigm for post-fire management is well articulated in this excerpt from respected scientists in one of the world's leading science journals:

> … [N]atural disturbances are key ecosystem processes rather than ecological disasters that require human repair. Recent ecological paradigms emphasize the dynamic, nonequilibrial nature of ecological systems in which disturbance is a normal feature and how natural disturbance regimes and the maintenance of biodiversity and productivity are interrelated … Salvage harvesting activities undermine many of the ecosystem benefits of major disturbances. … [R]emoval of large quantities of biological legacies can have negative impacts on many taxa. For example, salvage harvesting removes critical habitat for species, such as cavity-nesting mammals, [and] woodpeckers, … Large-scale salvage harvesting is often begun soon after a wildfire, when resource managers make decisions rapidly, with long lasting ecological consequences….

Lindenmayer, Franklin et al (2004). Federal forest managers should follow the best available science and avoid reliance on outdated provisions of existing resource management plans.

From an ecological perspective fire represents ecological change, neither good nor bad. Before old-growth forests became severely depleted by logging, on average approximately two-thirds of Oregon's forests were complex mature & old forests that supported high water quality, high biodiversity, climate stability, and other values. When fire burned through some of these forests (which was a regular occurrence) unburned and unlogged forests remained in abundance across a diverse landscape, available to support those values. The natural redundancy of old forests represented an important form of resiliency that has now been lost as old forests have become rare.

Owners of private lands currently have no incentive to manage for the values associated with ecologically complex forests, young or old. This leaves federal lands with the vital role of restoring mature & old-growth forest ecosystems as envisioned by the Northwest Forest Plan, the Spotted Owl Recovery Plan, and even BLM's Revised RMPs. Science tells us that the best path to restoring complex *old* forest is by conserving complex *young* forest, not through salvage and replanting. Importantly, the role of complex post-disturbance forest types is not well recognized in current management plans. It is crucial that your agencies act accordingly to close the gap between outdated management practices and current science.

Advancing the goal of conserving ecologically complex forest requires a cautious approach to post-fire management. In recent decades, voluminous and compelling science has emerged showing that natural forest recovery after fire is more likely to maintain and develop long-lasting complex forest attributes, while salvage logging and traditional replanting schemes are certain to simplify forests and retard or prevent development of desired complex forests. See key science resources listed below, especially Swanson et al (2010), and Donato et al (2012).

After a fire, the powerful dynamics of PNW forest ecosystems rapidly emerge. This ecosystem is dominated by large wood legacies carried over from the previous stand, plus a profusion of diverse plants that produce nuts, berries, nectar, pollen, and palatable foliage. These rich plant communities provide food and habitat for a diversity of foraging wildlife, and those wildlife support diverse predators - helping to support a robust forest food chain. The importance of the complex early seral stage has been vastly under-appreciated until recently, and your respective agencies' approaches to post-fire management need to reflect the best (and most recent) available science.

As your agencies know well, fire as a disturbance provides the ideal conditions for this complex early seral ecosystem to emerge and flourish at least until conifer regeneration develops and dominates the site. In a forest experiencing natural recovery, the heterogeneous early seral ecosystem stage can persist for decades. However, this biodiverse condition can be brought to a screeching halt with salvage logging and conifer replanting that removes complex legacy structures, damages regenerating vegetation diversity, and accelerates conifer dominance. In fact, forests with structurally complex beginnings due to fire can develop desired old growth forest characteristics twice as fast as forests simplified by salvage logging and replanting.

The new science regarding post-fire forest management is fairly well represented in the 2011 Revised Recovery Plan for the Northern Spotted Owl which recognizes the natural role of fire in developing and maintaining complex habitat supporting spotted owls and diverse prey species. Relevant parts of the recovery plan state:

- “There is evidence of spotted owls occupying territories that have been burned by fires of all severities. The limited data on spotted owl use of burned areas seems to indicate that different fire severities may provide for different functions.” (p III-31).
- “… [S]upport is lacking for the contention that reduction of fuels from post-fire harvest reduces the intensity of subsequent fires (McIver and Starr 2000), and planting of trees after post-fire harvest can have the opposite effect.” (p III-47).
- “Detrimental ecological effects of post-fire timber harvest include: increased erosion and sedimentation, especially due to construction of new roads; damage to soils and nutrient-cycling processes due to compaction and displacement of soils; reduction in soil-nutrient levels; removal of snags and, in many cases, live trees (both of which are habitat for spotted owls and their prey); decreased regeneration of trees; shortening in duration of early-successional ecosystems; increased spread of weeds from vehicles; damage to recolonizing vegetation; reduction in hiding

cover and downed woody material used by spotted owl prey; altered composition of plant species; increased short-term fire risk when harvest generated slash is not treated and medium-term fire risk due to creation of conifer plantations; reduction in shading; increase in soil and stream temperatures; and alterations of patterns of landscape heterogeneity …" (p III-48).

- "Consistent with restoration goals, post-fire management … should promote the development of habitat elements that support spotted owls and their prey, especially those which require the most time to develop or recover (e.g., large trees, snags, downed wood). Such management should include retention of large trees and defective trees, rehabilitation of roads and firelines, and planting of native species (Beschta et al. 2004, Hutto 2006, Peterson et al. 2009). We anticipate many cases where the best approach to retain these features involves few or no management activities. Forests affected by medium- and low-severity fires are still often used by spotted owls and should be managed accordingly. Many researchers supported the need to maintain habitat for spotted owl prey. For example, Lemkuhl et al. (2006) confirmed the importance of maintaining snags, downed wood, canopy cover, and mistletoe to support populations of spotted owl prey species. Gomez et al. (2005) noted the importance of fungal sporocarps which were positively associated with large, downed wood retained on site post-harvest. Carey et al. (1991) and Carey (1995) noted the importance of at least 10 to 15 percent cover of downed wood to benefit prey." (p III-49).

We would like to highlight the recovery plan's recommendation to conserve large trees and snags because they are "habitat elements that support spotted owls and their prey, especially those which require the most time to develop or recover..." Given the dire condition of spotted owl populations, and the fact that spotted owl habitat is limiting, these post-fire recommendations should be followed on all federal lands. At a minimum they must be followed in all areas with a conservation emphasis, e.g., LSRs, critical habitat, riparian reserves, Administratively Withdrawn Areas, roadless areas, ACECs, etc.

A high percentage of the wildfires in Oregon this year were in drinking water source areas exhibiting steep mountainous terrain with significant potential for erosion. Watersheds affected by wildfire are already at increased risk of erosion and water quality degradation. Salvage logging (and associated road building) will reduce the sediment holding and soil building services of dead wood and makes a bad situation worse with regard to water quality, including drinking water, and other watershed values. See key science resources listed below, especially Emelko et al (2011).

Climate change is not only a primary driver of the increasing wildfires that threaten our communities and our forests, but climate change also adds significant uncertainty to our ability to conserve and restore old growth forests. After fire, agencies should manage to retain as much old forest structure and function as possible, this includes all large trees and snags. Converting burned forests to plantations lacking significant dead wood structure promotes a homogenous forest type that is already vastly over-represented in western Oregon, and one that poses a significant fire hazard for communities and remaining mature & old-growth forests. Complex early seral forests are also a hedge against climate uncertainty. Species diverse forests are expected to be better able to tolerate and adapt to climate extremes and disturbance, and better able to store carbon more securely. See key science resources listed below, especially IPCC AR5 2014, and Osuri et al (2020).

Given this science and evidence, our post-fire recommendations for public lands include:

- Focus on stabilizing watersheds, by mitigating damage caused by fire suppression, limiting erosion using native fibers and native plants, treating weeds, disconnecting roads from streams, and closing and storing unneeded roads.
- Focus danger tree felling on imminent hazards located within 150 feet of high use areas, such as developed sites, parking lots, and paved roads. Do not remove felled danger trees from reserves, including the full extent of riparian reserves. If danger trees are removed, use them for restoration of streams and old clearcuts that lack large wood.
- Avoid salvage logging. Salvage logging has potentially significant impacts on water quality, fish & wildlife habitat, and forest successional trajectories and salvage should not be approved using Categorical Exclusions from the National Environmental Policy Act. If salvage logging is deemed necessary, focus on partial removal of small trees from plantation stands less than 80 years old.
- Retain all large wood to mitigate the shortage of snag habitat and for long-term ecological benefits and carbon storage. Fires create an apparent abundance of snags, but that is misleading because snags are ephemeral; the abundance of snags is short-lived and hides the fact that after those snags fall down, there will be a long-term shortage of snags that lasts until large trees regrow. Salvage logging will exacerbate the expected shortage of snags.
- Avoid road construction, including temporary roads, as they have long-term impacts on watersheds, soil, and vegetation, can introduce invasive weeds, and fragment habitat. Watersheds are already damaged by hundreds of miles of hastily constructed firelines. New roads will make a bad situation worse.
- Don't cut any live, green trees, because all surviving trees are helping to rebuild the below-ground ecosystem and serve a valuable role as legacy structure and a recruitment pool for future large trees and snags. All trees presumed to be dying should be treated as live until they are dead, because we do not want to lose the ecological benefits of those trees that may unexpectedly survive.
- Avoid replanting because it will create hazardous fuel conditions and truncate development of a desired complex early seral forest. If replanting is deemed necessary, replant diverse species in patches, at low density, far from existing seed sources.
- Encourage fire-affected local communities to rebuild in a responsible way that is more resilient to wildfire, which is an unavoidable part of our climate future.

Thank you for considering these comments and recommendations in decisions about post-fire management activities and include this letter as official public comments on all proposed post-fire logging and other post-fire management proposals.

Sincerely,

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Key science resources regarding complex early seral forests, dead wood habitat, and post-fire management:

Lindenmayer, Franklin, Hunter, Noss, et al., 2004. ECOLOGY: Salvage Harvesting Policies After Natural Disturbance, Science 303: 1303.
http://www.eebweb.arizona.edu/courses/ecol406r_506r/lindenmayer&noss-2005-effectslogging4.pdf

Mark E Swanson, Jerry F Franklin, Robert L Beschta, Charles M Crisafulli, Dominick A DellaSala, Richard L Hutto, David B Lindenmayer, and Frederick J Swanson 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Front Ecol Environ 2010; doi:10.1890/090157
https://www.fs.fed.us/pnw/pubs/journals/pnw_2010_swanson001.pdf

Daniel C. Donato, John L. Campbell & Jerry F. Franklin 2012. FORUM Multiple successional pathways and precocity in forest development: can some forests be born complex? Journal of Vegetation Science 23 (2012) 576–584 http://people.forestry.oregonstate.edu/john-campbell/sites/people.forestry.oregonstate.edu.john-campbell/files/Donato_2012_JVS.pdf

Beschta R.L., J.J. Rhodes, J.B. Kauffman, R.E. Gresswell, G.W. Minshall, J.R. Karr, D.A. Perry, F.R. Hauer, and C.A.Frissell, 2004. Postfire management on forested public lands of the western USA. Cons. Bio., http://pacificrivers.org/files/post-fire-management-and-sound-science/Beschta-etal2004.pdf

Franklin, J.F., Lindenmayer, D., MacMahon, J.A., McKee, A., Magnuson, J., Perry, D.A., Waide, R., and Foster, D. 2000. Threads of Continuity. Conservation Biology in Practice. [Malden, MA] Blackwell Science, Inc. 1(1) pp9-16.
https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub2815.pdf

Monica B. Emelko, Uldis Silins, Kevin D. Bladon, Micheal Stone 2011. Implications of land disturbance on drinking water treatability in a changing climate: Demonstrating the need for "source water supply and protection" strategies. Water Research, Volume 45, Issue 2, 2011, Pages 461-472.
http://staticweb.fsl.orst.edu/bladon/publications/Emelko_WaterResearch_2011.pdf

Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 *in Wildlife-Habitat Relationships in Oregon and Washington* (Johnson, D. H. and T. A.

O'Neil. OSU Press. 2001)
http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf

USFWS 2011. Revised Recovery Plan for the Northern Spotted Owl. https://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/RevisedNSORecPlan2011.pdf

IPCC AR5, Working Group III, Mitigation of Climate Change, Chapter 11 Agriculture, Forestry and Other Land Use (AFOLU) (Final Draft 2014) pp 46-47. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf;

Anand M Osuri, Abhishek Gopal, T R Shankar Raman, Ruth S DeFries, Susan C Cook-Patton and Shahid Naeem. 2020. Greater stability of carbon capture in species-rich natural forests compared to species-poor plantations. Environmental Research Letters. Accepted Manuscript online 6 December 2019. https://doi.org/10.1088/1748-9326/ab5f75; https://iopscience.iop.org/article/10.1088/1748-9326/ab5f75/pdf.

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The Case for Protecting Both Old Growth and Mature Forests

by Doug Heiken | Oregon Wild | dh@oregonwild.org

This paper presents an argument against two propositions: first, that the current level of old-growth forest is adequate, and second, that *if* we need to grow more old growth, we can wait for young forests to grow into old growth. The thesis of this paper is that there is a severe shortage of old-growth forests and to address this short-fall in a timely way, it is necessary to protect mature forests and trees because (a) they are already provide some values associated with old-growth forests and b) they are poised to become old growth more quickly. This paper also urges recognition that old-growth forests are part of a forest development continuum, and sound forest policy requires conservation of not just existing old growth but also the ecological processes that sustain and continuously recruit old growth.

> As recognized by [Forest Ecosystem Management Assessment Team], a conservation strategy for the Pacific Northwest must consider mature forests as well as [old growth]. Forests are considered to enter maturity when … they begin developing the characteristics that ultimately produce [old growth]. Mature forests serve various important ecologic functions. They serve as future replacements for old growth, help protect existing [old growth] by reducing the starkness of age-class boundaries, and provide landscape connectivity and transitional habitat that compensate to some degree for the low levels of [old growth]. Moreover, they are almost certainly more resistant to crown fires than younger forests, and hence contribute to buffering the landscape.[1]

David Perry, Emeritus Professor, Oregon State University, School of Forestry.

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[1] Perry, D. 2008. Late-Successional and Old-Growth Forests in the Pacific Northwest. Statement of David A. Perry, Professor Emeritus. Department of Forest Science, Oregon State University, before the Subcommittee on Public Lands and Forests of the Committee on Energy and Natural Resources, United States Senate. March 13, 2008

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Instead of focusing on the fire-prone thicket in the back-ground, the Forest Service planned to log the fire-resistant mature trees marked in blue.

Executive Summary

1. “Save the Old Growth” is the banner under which people rally, but the real issue is to conserve old growth within the context of *healthy forest ecosystems*. This principle underlies thousands of pages of scientific reports that support the Northwest Forest Plan and Interior Columbia Basin Ecosystem Management Project. A political solution cannot succeed unless it is informed by and respects the complexity of ecosystems. Success requires protecting not just the old growth structures themselves, but also the ecological processes that create and maintain old growth. For example, forests must be allowed to grow, recruit new old growth trees, and die, thus recruiting new large snags and dead wood, and opportunities for new trees, all of which are just as essential to old growth ecosystems as are the big green trees.

2. It is clear there is not enough old growth; the surest and quickest way we can have more is to let mature forests grow old. Logging mature forests while relying on younger forests to replace old growth presents two risks. First, young forests will take decades longer to become old growth compared to mature forests. Second, we cannot be certain that young forests resulting from clearcutting will ever function as old growth because restoration methods are unverified. This uncertainty increases in the face of climate change.

3. The call for protection of mature forests and trees is not a radical new position. This is really just a more effective manifestation of the prime directive of the Northwest Forest Plan to grow more old growth and the Eastside Screens’ directive to protect all large trees. The only inconsistency with the NWFP is to reject the compromise that left one million acres of mature & old-growth forests unprotected. This compromise perpetuates conflict and delays ecosystem recovery that is ever more essential.

4. There is new urgency to protect mature forests to store carbon to mitigate climate change and to provide additional habitat as soon as possible to increase the chances that the spotted owls can co-exist with the invading barred owl.

5. While mature forests are growing into old-growth forests they'll provide important public values: habitat, watershed, carbon storage, recreation, and beauty. All the reasons for protecting old-growth forests also apply to mature forests because mature forests already provide some old-growth characteristics, and because they *are* future old growth.

6. Science tells us that while some degraded forests may benefit from logging, most natural forests will not benefit from logging. Developing policy that focuses and refines this distinction is a good way to help decide which forests need protection and which need active management.

7. Main point for the Westside: Don’t sacrifice the mature stands that are needed as recruitment as future old growth. Main point for the eastside: Don’t sacrifice co-dominant or medium-sized trees of fire-resilient species that are needed for recruitment of old forests and as habitat for species that depend on canopy cover and/or dead wood.

8. Recognize that any logging, even thinning mature stands or removing mature trees, will reduce the quality of habitat and delay attainment of old-growth characteristics such as snags and dead wood, which are defining characteristics of old growth and provide essential

ecological services, including fish & wildlife habitat, carbon storage, slope stability, and capture-storage-release of water and nutrients.

9. We should no longer tolerate "sacrifice areas" on public lands where commodity production overrides other important public values. Recognizing that non-federal lands provide all the wood fiber that society needs, the highest and best use of federal forests is to meet objectives that complement each other — biodiversity conservation, watershed protection, carbon sequestration, and compatible forms of recreation, instead of logging and other activities that are incompatible with these public values. This will require managing the *entire federal forest landscape* for ecological purposes — no more sacrifice areas.

10. Another aim is to temper unrealistic expectations about commercial timber production. There are a lot of dense forests, but many of them will not support commercially viable timber sales, especially in low productivity areas of the eastside. Public subsidies for low-impact equipment that can handle small diameter trees might be helpful, but subsidies must be very carefully targeted to ensure they lead to activities that do more good than harm.

11. Leaving mature forests unprotected will inhibit collaboration and perpetuate conflict over federal forest management.

Old-growth characteristics are degraded rather than enhanced by the logging of mature forests.

What is a "Mature" Forest?

After a major disturbance, forests develop through a sequence of many stages.[2] Maturity is the stage when forests start to develop the complexity that eventually manifests as classic old growth. According to the report of the Forest Ecosystem Management Assessment Team (FEMAT), the *mature seral stage* is "a time of gradually increasing stand diversity. Hiding cover, thermal cover, and some forage may be present."[3] The Northwest Forest Plan explained that "80 years is the age when many forest stands begin to develop late-successional characteristics, such as the formation of heavy limbs and an accumulation of coarse woody debris on the forest floor."[4] FEMAT and the Northwest Forest Plan did not distinguish old growth forests from mature forests. They used the term "late-successional forest" to describe the combined mature and old-growth seral stages.[5] These late successional forests collectively became the target of conservation and restoration.

> Structural characteristics of late-successional and old-growth forests vary with vegetation type, disturbance regime, and developmental stage. For example, in many Douglas-fir stands in western Oregon and Washington, the mature phase of stand development begins around 80 years and is characterized by relatively large live and dead trees, although multiple canopy layers may not yet be well developed.[6]

Mature trees are also developing characteristics that make them relatively resistant and resilient to fire compared to younger stands. These characteristics include: thick bark, high crowns, and high canopy cover that creates a cool, moist microclimate and provides shade to suppress the growth of ladder fuels.[7]

Mature seral stage begins with the "culmination of the mean annual increment" of growth (CMAI),[8] which means the age at which the average growth rate of a tree or stand first

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[2] Franklin J.F., Spies T.A., Van Pelt R., Carey A.B., Thornburgh D.A., Rae Berg D., Lindenmayer D.B., Harmon M.E., Keeton W.S., Shaw D.C., Bible K., Chen J., Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example, For. Ecol. Manage. 155 (2002) 399-423. Van Pelt, R. 2007. Identifying Old trees and Forests in Washington. Washington DNR. http://www.dnr.wa.gov/ResearchScience/Topics/ForestResearch/Pages/lm_oldgrowth_guides.aspx

[3] USDA/USDI/NOAA/NPS/EPA. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Forest Ecosystem Management Assessment Team (FEMAT), Team Leader, Jack Ward Thomas. July 1993. Glossary, page IX-31.

[4] 1994 NWFP FSEIS, Appendix F-12. See also 1994 FSEIS Appendix B2, Ecological Principles for Management of Late-Successional Forest.

[5] 1994 NWFP FSEIS, Glossary p 9.

[6] 1994 NWFP FSEIS, Appendix B-44 (citations omitted).

[7] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf

[8] FEMAT Glossary, p IX-31.

peaks (not the current growth rate, but the average growth rate), i.e., current increment of growth equals total growth divided by age.[9]

For Douglas-fir, the average age of (CMAI) is 85 years old. This varies depending on species, genetics, climate, soils, etc., but on *average* it's 85 years old.[10]

A note on terminology:

"Mature and old-growth" is the same thing as "late-successional old-growth" or "LS/OG."[11] In this paper, the term "older forests" is also used to mean the same thing. "Large trees" are generally ≥20" diameter at breast height, however the ICBEMP team offers an important reminder that:

> Large trees is a relative term dependent on species and site. Large trees are a future source of large snags, and large snags are a future source of coarse woody debris, another important habitat component for many species. It is important to have present and **future sources of large trees** and snags at adequate levels though time.[12]

Conservation in Moist and Dry Forests

It is generally recognized among scientists and conservationists that forests with different disturbance regimes may need different forms of management.

In moist forests, with long periods between fires, management should focus on conserving entire stands of mature & old-growth forest because these forests are naturally dense.. Many species, including the spotted owl, marten, and fisher, depend on these dense forest conditions. Intervention is generally not needed to reduce drought stress or fire hazard in such stands. Because big and old trees are relatively rare and ecologically valuable wherever they occur, individual legacy trees should also be protected outside of older stands.

Dry forest ecosystems like those east of the Cascade crest differ significantly from moist forests to the west. Eastside forests grow in a more extreme climate—hotter and drier in summer and colder in winter—and often on less productive soils.[13] These forests are often less productive,

[9] Tree Increment and Growth. http://sres-associated.anu.edu.au/mensuration/BrackandWood1998/T_GROWTH.HTM

[10] Curtis, Robert O. 1994. Some Simulation Estimates of Mean Annual Increment of Douglas-Fir: Results, Limitations and Implications for Management. USDA Forest Service PNW Research Station Research Paper PNW-RP-471.

[11] 1994 NWFP FSEIS p 3&4-13.

[12] USDA/USDI 2000. Interior Columbia Basin Ecosystem Management Project (ICBEMP) SDEIS p 3-66 – 3-68.

[13] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

more prone to drought stress, and were historically less dense due to the occurrence of frequent fires. Many species, like white-headed woodpecker, depend on these conditions. So, in dry forests with frequent fire return intervals, management should focus more on conserving individual mature and old trees, especially those that are fire-tolerant, early-seral species, like ponderosa pine, sugar pine, larch, white pine, and Douglas fir.

Though fire hazard is frequently overstated,[14] old forests in dry environments can suffer from the effects of fire suppression and may benefit from the removal of *small* fuels in order to protect rare large and old trees from fire and drought stress. This *exception* to the general principle that logging is inadvisable in older *stands* must be very cautiously implemented because research has shown that removal of commercial size logs can conflict with both fire hazard objectives and habitat objectives. Scientists have found that "treating more area of young, noncomplex forest reduced fire threat more effectively … than did treating structurally complex old-forest patches," and "requiring landscape treatments to earn a profit negatively impacted both habitat and fire objectives."[15] In some cases, forests may need to be maintained at higher than normal density levels in order to provide habitat for species like the northern spotted owl. For instance, the Final Recovery Plan for the Northern Spotted Owl states that recovery "may call for higher levels of dense late-successional and old forest than historically occurred in many dry forest landscapes."[16]

Fire resistant mature trees marked for cutting on the Fremont National Forest, Oregon

[14] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's Forest Resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf

[15] PNW Research Station. 2006. Seeing The Bigger Picture: Landscape Silviculture May Offer Compatible Solutions To Conflicting Objectives. Science Findings. July 2006. http://www.fs.fed.us/pnw/sciencef/scifi85.pdf

[16] FWS 2008. Final Recovery Plan for the Northern Spotted Owl, Appendix E: Managing for Sustainable Spotted Owl Habitat in Dry Eastern Cascades Forests of the Inland Northwest (from SEI 2008). p 111.

Mature forests logged under the Northwest Forest Plan. This is not restoration. It's just exploitation, slightly mitigated.

Here is a forest that could benefit from thinning and produce wood products.

Sensible thinning of young stands near existing roads on the Siuslaw National Forest.

Ecological Reasons to Protect Mature Trees and Forests

Our Guidepost: The Natural Range of Variability

> [M]anaging an ecosystem within its range of variability is appropriate to maintain diverse, resilient, productive, and healthy ecosystems for viable populations of native species. Using the historical range of variability ... is the most scientifically defensible way to meet society's objective of sustaining habitat.[17]

Recognizing the expected influence of climate change, many scientists now use the term "natural range of variability" instead of "historic range of variability" (HRV).[18]

[17] Patrick Daigle and Rick Dawson. 1996. Extension Note 07 - Management Concepts for Landscape Ecology (Part 1 of 7). October 1996. http://www.for.gov.bc.ca/hfd/pubs/docs/en/en07.pdf; citing Swanson, F. J.; Jones, J. A.; Wallin, D. O.; Cissel, J. H. 1994. Natural variability--implications for ecosystem management. In: Jensen, M. E.; Bourgeron, P. S., tech. eds. Eastside Forest Ecosystem Health Assessment--Volume II: Ecosystem management: principles and applications. Gen. Tech. Rep. PNW-GTR-318. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station: pp 89-106.

[18] Johnson, K.N., Duncan, S. 2007. THE FUTURE RANGE OF VARIABILITY: PROJECT SUMMARY. National Commission on Science for Sustainable Forestry. June 15, 2007.

Using the natural range of variability as a guide, current and future management should clearly emphasize efforts to restore and increase under-represented old forest types and should avoid creating more young forest types that are already over-represented. The Eastside Screens require protection of old-growth elements and movement toward the historic range of variability. When conducting activities in stands that are not considered old growth, "the intent is still to maintain and/or enhance LOS [late old structure] components in stands subject to timber harvest … [and to] manipulate vegetative structure that does not meet late and old structural (LOS) conditions … in a manner that moves it towards these conditions as appropriate to meet HRV."[19]

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) "found that the areas with the highest levels of traditional management [i.e., logging and grazing] had the highest departure in these characteristics [i.e., historic range of variability] and the highest probability of severe events."[20]

There is a severe region-wide deficit of mature and old-growth forest habitat in the Pacific Northwest.

Obtaining consistent estimates of the extent of old forests is always confounded by methodological differences in terms of time periods of interest, geographic scope, and definitions of old forest. Nevertheless, it remains undisputed that the northwest forest landscape was historically dominated by old forests, and that today the landscape is dominated by young forests.

The forest age-class distribution across the landscape was historically approximately one-third young forest and two-thirds mature and old-growth forest.[21] Today, after decades of intensive logging, the proportions of young and old forests across the landscape have been reversed - the current forest landscape is more than three-quarters young forest and less than one-fifth mature & old-growth forest.[22] (See figures below.[23]) The National Research Council (2000) discussed

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http://ncseonline.org/00/Batch/NCSSF/project_reports/NCSSF%20D3%20Johnson%20FRV%20Final%20Report%2006.16.07.pdf

[19] USDA Forest Service 1995. "Eastside Screens." Revised Interim Management Direction Establishing Riparian, Ecosystem And Wildlife Standards For Timber Sales. PNW Regional Forester's Forest Plan Amendment #2. 6/12/95.
http://www.fs.fed.us/r6/uma/projects/readroom/pomeroy/school/seis/Appendix%20N%20Eastside%20Screens.pdf

[20] Quigley, T.M., and S.J. Arbelbide, *Technical Editors*. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins. PNW-GTR-405. vol I, p 47.

[21] FEMAT 1993. p IV-51 ("65% provides an estimate of the long term average percentage of the regional landscape covered by late successional forests."). See generally, NRC 2000 pp 67-72. Strittholt, J.R., D.A. DellaSala, and H. Jiang. 2006. Status of mature and old-growth forests in the Pacific Northwest, USA. Conservation Biology 20:363-374, and Appendix A of Randi Spivak's March 13, 2008 Congressional Testimony.
http://www.americanlands.org/assets/docs/1205426522_Randi%20Spivak%20Senate%20Hearing%203%2013%202008%20Statement%20on%20Old%20Growth%20Final.pdf.

[22] NRC 2000, p 71; and Bolsinger, CL; Waddell, KL.1993. Area of old-growth forest in California, Oregon, and Washington. PNW-RB-197. USDA Forest Service. 1993.

the historic vs. current extent of "late-successional" (i.e., mature and old-growth) forests at some length and concluded that "regardless of the extent that old-growth forests might have increased or decreased naturally over thousands of years, the reduction of old-growth over the past century is a more abrupt change than the forests have undergone since the last ice age."[24]

Similar estimates have been made for both the dry eastside and moist westside forests. Cowlin (1942) estimated that in 1936 73% of eastern Washington and eastern Oregon was covered by older forests (after some logging had already occurred). Before logging began, old growth may have covered 86-90% of the landscape.[25] In the Oregon Coast Range, the mean percentage of old growth (>200 years old) was estimated at between 39 and 55 percent. The mean percentage of mature and old-growth forest combined showed less variation at between 66 to 76 percent.

Especially hard hit have been certain forest types like ponderosa pine and the oldest forest on the westside, as well as certain provinces like the Oregon Coast Range and the Puget Lowlands. Wimberly et al. (2000) noted that currently "the entire Coast Range province contains approximately 5% old growth and 11% late successional forests. These estimates fall far below the 5% quantiles for percent old growth and percent late successional forest modeled at the province scale."[26] Even with reduced logging levels, the Oregon Coast Range is not expected to recover from the effects of logging for more than a century. Nonaka and Spies (2005) conducted one of the most thorough province-level analyses ever and demonstrated that:

> a large number of landscape characteristics [in the Oregon Coast Range Province] are outside of HRV [historic range of variability]. Currently, forests <80 years old cover >75% of the landscape, whereas they historically occupied 21%, on average. The total core area of mature and older forests has decreased to about one twenty-seventh of the mean historical level. … The simulations indicated that 100 years was not long enough to return the overall condition of the landscape to the HRV under either scenario. First, the 100-year period was too short for old forests to reach the HRV. On the current landscape, the amount of forest older than 80 years is well below the historical level especially because old-growth forests (>200 years) are very rare.[27]

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[23] Graphs created with data from: McShane, C., T. Hamer, H. Carter, G. Swartzman, V. Friesen, D. Ainley, R. Tressler, K. Nelson, A. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished report. EDAW, Inc. Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, Oregon. (p 4-77).

[24] NRC 2000. p 67-72.

[25] Cowlin, R.W., Briegleb, P.A., and Moravets, F.L. 1942. Forest Resources of the Ponderosa Pine Region of Washington and Oregon. Misc. Publ. 490. Washington, DC: U.S. Department of Agriculture, Forest Service.

[26] Michael C. Wimberly, Thomas A. Spies, Colin J. Long, and Cathy Whitlock. 2000. "Simulating Historical Variability in the Amount of Old Forests in the Oregon Coast Range," Conservation Biology, Pages 167-180, Volume 14, No. 1, February 2000; http://www.fs.fed.us/pnw/pubs/journals/0010.pdf

[27] Nonaka, E., Thomas A. Spies. 2005. Historical Range Of Variability In Landscape Structure: A Simulation Study In Oregon, USA. Ecological Applications, 15(5), 2005, pp. 1727–1746.

Dry forests are also depleted. The report of the Eastside Scientific Societies estimates “that 15% of the original Ponderosa pine forest remains on the Eastside and less than 5% in the eastern Cascades and on Oregon’s Klamath plateau. Continued logging of now unprotected LS/OG [late-successional old-growth] would further reduce the area occupied by these unique ecosystems …”[28] They also reported that:

> Log production from national forests in eastern Oregon and Washington increased nearly fourfold between 1949 and 1968. By the late 1960s, harvest from all lands, regardless of ownership, stood at 50% higher than the most optimistic estimate of sustained yield from eastside forests (Cowlin et al. 1942). … In summary, the forest landscapes of eastern Washington and Oregon have been transformed during the past century. Continued logging in unprotected areas could reduce LS/OG to less than 10% of the total forest area in the region, raising concerns about risks to species and ecological processes.[29]

The oldest forests are almost gone. “Current estimates of the extent of old-growth place it at less than half the lowest prelogging estimate. … Approximately 12 percent (3.6 million acres) of forest stands across Oregon are older than 160 years; and slightly fewer than 7 percent (1.9 million acres) are older than 200 years.”[30] The National Commission on Science for Sustainable Forestry reported, “As of the mid-1990s, older forest in the Pacific Northwest dominated by trees more than 30 inches in diameter with complex forest canopies was estimated to comprise approximately 6 percent of forestland on all ownerships in western Washington, Oregon, and northern California - 3.5 million acres out of a total of 56.8 million. If the definition is broadened to include older forest with a mix of medium- and large-diameter trees and simple as well as complex canopies, that figure increases to about 21 percent.”[31]

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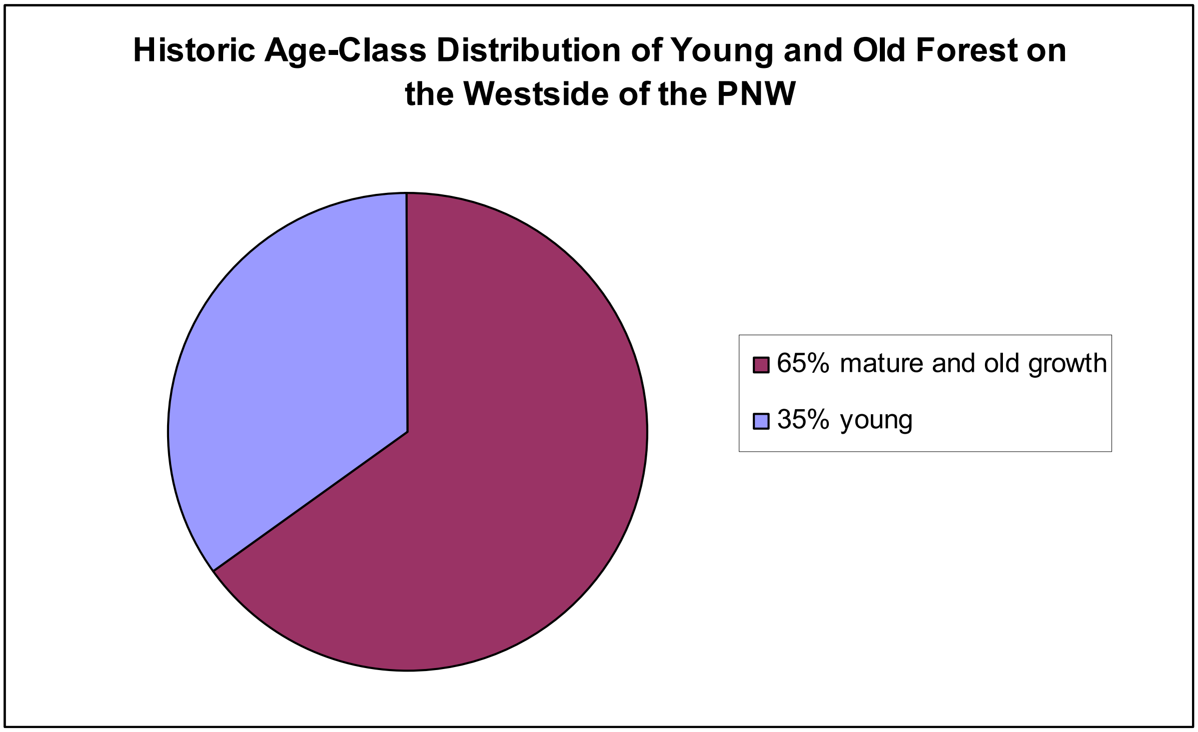
[28] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

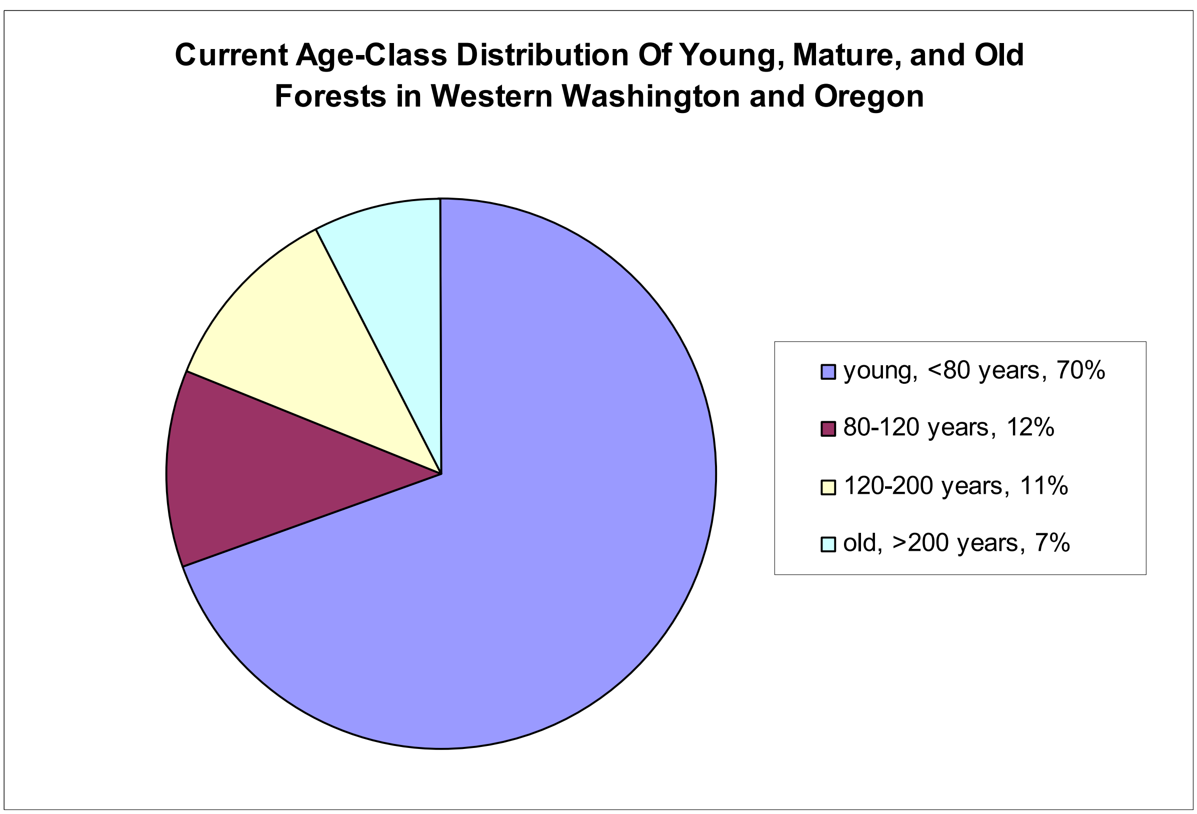
[29] Henjum (1994).

[30] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon’s forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf. pp 36, 38.

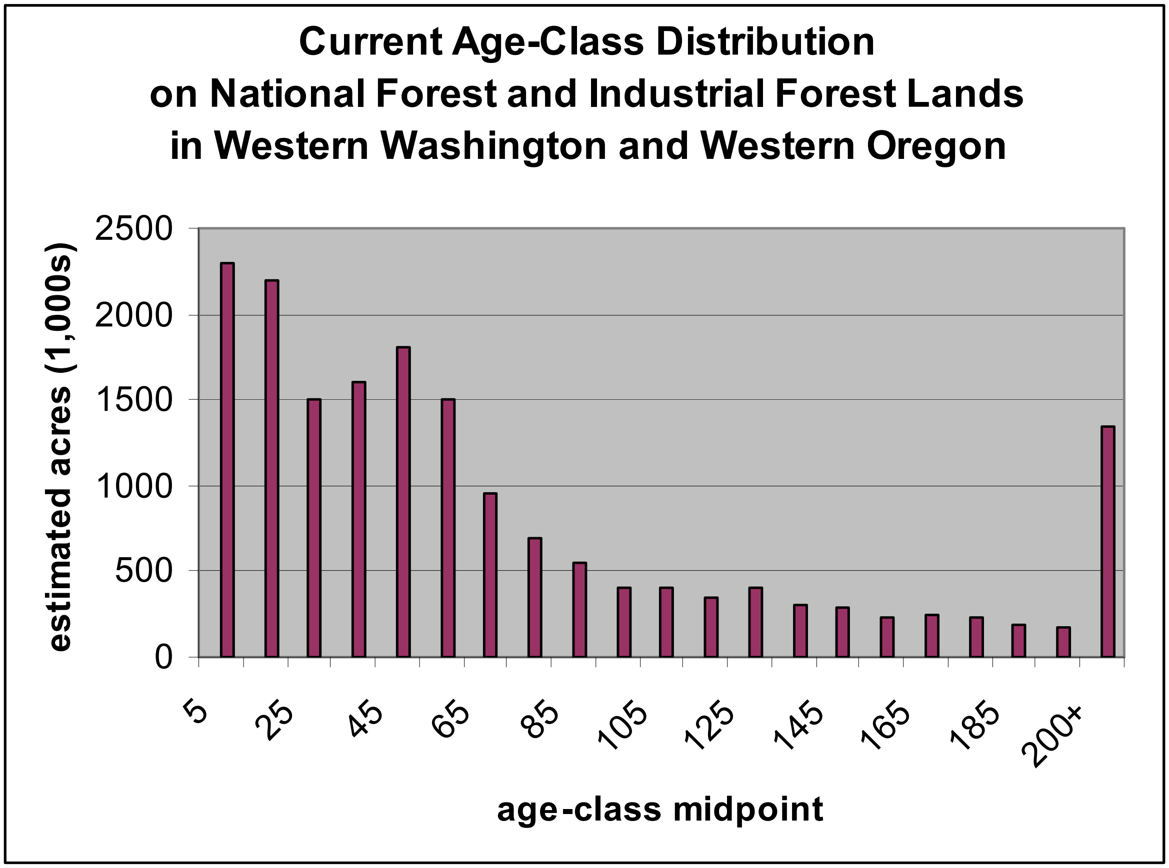
[31] NCSSF 2008. Beyond Old Growth Older Forests in a Changing World - A synthesis of findings from five regional workshops. National Commission on Science for Sustainable Forestry. http://ncseonline.org/00/Batch/NCSSF/BOG/OldGrowth_final%203.10.08.pdf



[Source: FEMAT 1993. p IV-51 ("65% provides an estimate of the long term average percentage of the regional landscape covered by late successional forests." (Late successional is defined as ≥80 years old).]



[Source: McShane et al. 2004. Evaluation report for the 5-year status review of the marbled murrelet.]



[Source: Evaluation report for the 5-year status review of the marbled murrelet. McShane et al. (2004.)]

If old-growth forests are to be restored and maintained, there must be continual recruitment into the pool of older forests.

There is widespread recognition among scientists, conservationists, and policy-makers that there is too little old growth and there needs to be more, but where will it come from? OSU's Gordon Reeves, who, as co-leader of FEMAT's Aquatics/Watershed Group, helped develop the NWFP Aquatic Conservation Strategy, asks "Where is the next generation of old-growth going to be and how will it develop? These questions are critical but they are not brought up in the current debate."[32] Jack Ward Thomas, Former Chief of the Forest Service and one of the chief authors of the Northwest Forest Plan writes that "plans must be developed and followed that will assure that new late successional forest habitats are 'on line' to replace the extant stands .… "[33]

Science no longer views late-successional forest ecosystems as static equilibrium systems. The old-growth seral stages are part of a dynamic continuum of forest development. A recent set of

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[32] NCSSF/PNW Old Growth Workshop. Bonneville Hot Springs Resort. May 2005. http://www.fsl.orst.edu/Oldgrowthworkshop/statements/Reeves.pdf

[33] NCSSF/PNW Old Growth Workshop. Bonneville Hot Springs Resort. May 2005. http://www.fsl.orst.edu/Oldgrowthworkshop/statements/Thomas.pdf

scientific workshops on old-growth forest conservation conducted by the National Commission on Science for Sustainable Forestry concluded that:

> Mature stands that are nearly old growth also deserve protection. … To have old growth in the future, it's necessary to identify and protect or restore older forests that are nearing old-growth conditions… If the nation is serious about preserving biodiversity, older forest area must be increased. Such efforts must begin with the existing base of older forests, but it ultimately will be necessary to go well beyond this base to effectively meet biodiversity and human values goals. In every region, the full forest growth and development cycle needs to be integrated into old-growth restoration plans.[34]

"Using pre-settlement conditions as the reference point, eastern Oregon and Washington old forests currently are inadequately represented on the landscape. An old-forest conservation strategy could require that sufficient mature late-seral stands be developing into old-forest patches to meet this deficit." Given that all old forests will eventually be lost to stand replacing disturbance at some point in the future "conservation of the remaining old forests is the cornerstone of any management scheme … . [A]dditional old-forest stands need to continually be created to maintain a dynamic balance. … Any plan to sustain old forests must first sustain the landscape of which they are a part."[35]

> Sites that already have significant populations of old and/or mature trees provide the best opportunity for restoring sites to an approximation of historic old-growth forest structure, including dominance by old trees and spatially heterogeneous stands. … Managers intending to create sustainable old forest conditions should consider not only the conservation of existing large, old trees but also the need to provide for a flow of mature trees that can provide replacements for the old trees as they die.[36]

Mature forests often function as old growth.

It is important to recognize that old-growth characteristics "begin to develop" in mature stands, but more importantly that mature stands are more likely to contain some of the individual features such as big trees, snags, canopy layers, watershed protection, slope stability, and carbon storage that are already providing important values to wildlife and society. "Sites that do not have the full complement of old-forest characteristics can partially function as old forests for

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[34] NCSSF 2008. Beyond Old Growth Older Forests in a Changing World - A synthesis of findings from five regional workshops. National Commission on Science for Sustainable Forestry. http://ncseonline.org/00/Batch/NCSSF/BOG/OldGrowth_final%203.10.08.pdf

[35] Everett, R., P. Hessburg, J. Lehmkuhl, M. Jensen, and P. Bourgeron. 1994. Old Forests in Dynamic Landscapes: Dry-Site Forests of Eastern Oregon and Washington. Journal of Forestry 92: 22-25.

[36] Jerry F. Franklin, Miles A. Hemstrom, Robert Van Pelt, Joseph B. Buchanan. 2008. The Case for Active Management of Dry Forest Types in Eastern Washington: Perpetuating and Creating Old Forest Structures and Functions. Washington DNR. September 2008. http://www.dnr.wa.gov/Publications/lm_ess_eog_mgmt.pdf

those attributes that are present."[37] When old forests are in such short supply, these mature stands represent important "life boats" that will carry imperiled wildlife through the habitat bottleneck created by decades of overcutting.

The Northwest Forest Plan recognizes that "many mixed-age stands that include only scattered individuals or patches of old trees in a matrix of mature trees probably function ecologically much like classical 'old-growth' stands that have large numbers of old trees. ... [T]he terms 'late successional' and 'old growth' used in this Final SEIS include the successional stages defined as mature and old growth, both of which function as old growth. ..."[38] There is a significant risk that these mature-but-functionally-old-growth stands will be misidentified by the agencies and logged in pursuit of short-term economic goals.

Scientists urge protection of mature forests.

There have been several intensive and comprehensive scientific assessments concerning Pacific Northwest forests. Most notable were the Forest Ecosystem Management Assessment Team ("FEMAT" Report)[39] and the Interior Columbia Basin Ecosystem Management Project (ICBEMP),[40] both chartered by President Clinton after his 1993 Forest Summit. Other important reports were "Environmental Issues in Pacific Northwest Forest Management," prepared in 2000 by a distinguished committee of the National Research Council (NRC),[41] and the Report of the "Eastside Scientific Societies,"[42] which included the Society for Conservation Biology, the Ecological Society of America, and the Wildlife Society. All these reports recognize the importance of protecting mature, as well as old-growth, trees and stands. Dr. David Perry was a member of the NRC scientific panel, and has explained the differences between the FEMAT and NRC recommendations:

> The biological importance of mature forests (roughly 80-150 years old) was recognized by FEMAT, and the NRC panel agreed with their assessment. Basically, these are the next generation of old growth, and many are probably already developing aspects of OG [old growth] habitat. With remaining OG at

[37] Everett, R., P. Hessburg, J. Lehmkuhl, M. Jensen, and P. Bourgeron. 1994. Old Forests in Dynamic Landscapes: Dry-Site Forests of Eastern Oregon and Washington. Journal of Forestry 92: 22-25.

[38] 1994 NWFP FSEIS p 3&4-13.

[39] USDA/USDI/NOAA/NPS/EPA. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Forest Ecosystem Management Assessment Team (FEMAT), Team Leader, Jack Ward Thomas. July 1993.

[40] Integrated Scientific Assessment for the Interior Columbia Basin…. Thomas Quigley, ed., PNW-GTR-382, Sept 1996.

[41] National Research Council. 2000. Environmental Issues in Pacific Northwest Forest Management. Committee on Environmental Issues in Pacific Northwest Forest Management, Board on Biology, Commission on Life Sciences. Washington, DC: National Academy Press. http://books.nap.edu/openbook.php?isbn=0309053285

[42] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

> such low levels, the NRC panel felt that including forests on the cusp could make a significant difference in survival of some species over the next 100 years, and I would imagine that was the reasoning of FEMAT biologists as well.
>
> The NRC panel departed from FEMAT in our beliefs that: from a conservation standpoint, all [old growth] and mature needed protection; and from an economic standpoint the region could afford to do that by reorienting harvests to younger forests. …
>
> Protecting remaining OG is a big step in the direction of strengthening conservation. Protecting remaining mature is another one. Suppose the mature outside of reserves is logged. We then have two very distinct age classes in the region, old and young--nothing in between (outside of mature in reserves). From a demographic standpoint we run the risk of losing OG (to fire, wind, senescence) before enough young forests have reached OG stage to balance those losses. If that should happen, habitat that's already at the lowest level in history (so far as we know) becomes even lower. If it doesn't happen there's no problem. With the stresses that are going to be coming from climate change, the chances of it happening go up.
>
> In the end I can only speak for myself, but I imagine many conservation ecologists would agree. The issue is risk, and how much insurance we can afford to buy to reduce risk. Protecting additional mature forests is buying insurance. Some argue that soft-touch logging such as green retention will effectively protect habitat for late-successional species (or create the conditions which allow that habitat to recover quickly). I think it would be great if it does, but the jury is out on that, and will be for some time to come.
>
> On the other hand, there is an abundance of younger forest badly in need of thinning, and most of it could be commercial thinning that send logs to mills. I strongly believe the health of the [Pacific Northwest] forested landscape would benefit if those were the areas prioritized for logging.[43]

There is a similar need to protect and restore old forests and trees on the eastside of the Cascades. The ICBEMP scientists said:

> We had not anticipated the data indicating the extensive loss of large trees in the landscape over much of the Basin. The harvest legacy has been more extensive than we thought. … To maintain 'old growth' forests … timber harvesting practices will target smaller-diameter trees … and increase recruitment into old growth forests by accelerating growth rates of middle aged stands … through mechanically thinning the understory and using prescribed fires.[44]

[43] David Perry (Professor [emeritus], Oregon State University School of Forestry) correspondence to David Dreher (Legislative Assistant to U.S. Rep. Peter DeFazio), 15 June 2002.

[44] Integrated Scientific Assessment for the Interior Columbia Basin…. Thomas Quigley, ed., PNW-GTR-382, Sept 1996. pp 180, 168, 169.

The report of the Eastside Scientific Societies made the following recommendation:

> **Prohibit logging of dominant or co-dominant Ponderosa pine from any forest, regardless of whether the stand meets the criteria for LS/OG.** Protecting eastside forest ecosystems in the long term requires restoring ponderosa pine to its former dominance throughout much of the eastern Oregon and Washington. Remaining mature ponderosa pines, both inside and outside LS/OG areas, constitute important focal points for any recovery, serving as seed sources, reservoirs of genetic diversity, and refugia for other species. Species from mycorrhizal fungi to vertebrates like bald eagles and white-headed woodpeckers depend on old-growth ponderosa pine. Protecting ponderosa pine must be a high priority independent of the size of the patch where the trees are located.[45]

The Eastside Screens' 21" diameter limit leaves some ecologically valuable trees unprotected such as these blue-painted mature trees.

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[45] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf (emphasis in original).

If mature forests are sacrificed, then ecosystem recovery will be delayed.

Too little old growth remains to ensure attainment of important policy objectives related to water quality improvement, recovery of threatened and endangered species, and carbon storage to mitigate climate change. Even if both mature and old-growth forests are protected, there will still be a significant shortage of old growth.

Nonaka & Spies (2005) suggested that "policy makers could use the relative rate and direction of the trend toward [historic range of variability] as one indicator for evaluating the differences between alternative biodiversity policies."[46] If we protect both mature and old growth, it will allow us to meet restoration goals sooner rather than later, and if we fail to protect mature forests, it will delay attainment of important policy objectives. When so many species are imperiled, with so many streams listed as water-quality limited, and carbon building in the atmosphere, we can't afford delay. Protecting mature stands helps achieve recovery sooner.

The reason that logging mature forest delays recovery of old growth is that once a mature forest or a mature tree is removed from the pipeline of stands on their way to becoming old growth, we have to wait for an even younger stand to grow and take its place. An effective solution must also include protection of recruitment habitat. We must protect both old growth and mature forests to solve the ecological problems we face.

The Northwest Forest Plan recognized the severe deficit of late-successional forests and called for extensive restoration of old forests over time[47], but the Northwest Forest Plan also involved an unfortunate political compromise that left one million acres of older forests unprotected, which delays recovery of the ecosystem and guarantees continuing conflict and controversy. If a timely recovery from the old growth deficit is to occur, all mature forests and trees must be protected so that they can become old-growth forests or be recruited to the dead wood pool, which serves other valuable functions in the forests.

Conservation of mature forest is needed as a hedge against the increased risk of disturbances caused by climate change.

Forest disturbance is closely correlated with large-scale climate patterns such as the El Niño/Southern Oscillation that will be modified by climate change. Climate change is expected to increase climate extremes such as winter storm events and droughts and thereby increase disturbances such as floods, wind, fire, and insects. Stand-replacing disturbances will truncate forest succession resulting in reduced average tree ages and reduced abundance of complex older forests— important ecological features that take a long time to replace. Therefore, conserving existing mature forests makes sense from two perspectives. First, mature forests are relatively

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[46] Nonaka, E., Thomas A. Spies. 2005. Historical Range Of Variability In Landscape Structure: A Simulation Study In Oregon, USA. Ecological Applications, 15(5), 2005, pp. 1727–1746.

[47] USDA FS. 1998. Old Growth Forest Vegetation http://web.archive.org/web/20030402090844/http://www.fs.fed.us/land/fm/oldgrow/oldgrow.htm ("Of the land that is considered forested (16.4 million acres), 52 percent is currently in a large-tree or old-growth condition. The plan projects an increase to 73 percent over the long-term.")

resilient to disturbance,[48] so we can mitigate climate stress by increasing the fraction of the landscape covered by resistant/resilient older forests. Second, retaining "extra" mature forests in the current time period can help mitigate the expected future loss of forests due to climate stress. Because we are starting with a larger baseline of older forests, it will take longer to erode the baseline, giving us more time to address the climate problem.

As pointed out by OSU's Tom Spies, "Where stand-replacement disturbances occur at frequencies that are less than about half the age at which tree species of a forest reach maturity, old-growth conditions will be uncommon or rare in the landscape (Spies and Turner 1999). For example, taking the fire frequency– age class model of Van Wagner (1978), old-growth would be less than 10 percent, on average, in a landscape with a disturbance frequency of 50 years and forests that require 150 years to develop into old-growth."[49] We don't yet know the location or extent of the landscape that will be affected by climate-driven disturbance, but the consequences of increased climate-driven disturbance are alarming and support a call for greater conservation of existing mature forests.

In addition to stand-level and landscape-level disturbance, there may be smaller-scale climate effects at work. Recent research indicates a disturbing trend toward increased mortality in individual trees in older forests across the west. In the Pacific Northwest, tree mortality rates in older forests have increased from 0.3% in the 1970s to 1.3% today.[50] This study was not based on a random sample of sites, so extrapolation is difficult, but if this trend holds true and continues, older forests will need to be replaced by mature forests even sooner. Retaining populations of mature forests and larger trees that are well distributed across the landscape will increase the likelihood that the late-successional forest deficit doesn't worsen.

Mature forests are needed to store carbon to mitigate global warming.

Mature forests and fire-tolerant large trees are a secure and robust form of carbon storage that can help mitigate climate change. Maximizing our forests' capacity to sustainably store carbon to reduce and mitigate climate change must be a primary motivation for forest conservation and restoration. Fortuitously, forest carbon storage is highly complementary with societal objectives for clean water, wildlife, and recreation.

If protected, mature forests will continue growing and removing carbon from the atmosphere for decades.[51] Mature forests have not yet reached their full potential for carbon storage, because

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[48] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf

[49] Spies, T.A. 2004. Ecological Concepts and Diversity of Old-Growth Forests. Journal of Forestry. April/May 2004.

[50] van Mantgem, P. J., Stephenson, N.L., et al. Widespread Increase of Tree Mortality Rates in the Western United States. Science 323, 521-524 (2009).

[51] Oregon Wild. 2008. "The Straight Facts on Forests, Carbon, and Global Warming" http://tinyurl.com/2n96m5. Luyssaert, et al. 2008. Old-growth forests as global carbon sinks. Nature Vol 455. 11 September 2008. Smithwick EAH, Harmon ME, Acker SA, Remillard SM. 2002. Potential upper bounds of carbon stores in the Pacific Northwest. Ecological Applications 12(5): 1303-1317. Harmon, M., Ferrell, W., and J. Franklin. 1990. Effects on Carbon Storage of Conversion of Old-Growth to Young Forests. Science. 9 February 1990. Harmon, Harmon,

they still have a lot of growing to do, and they will continue to sequester additional carbon in both wood and soil for a long time. Old-growth forests in the moist "westside" portions of the Pacific Northwest apparently store more carbon per-acre than any other forests in the world.[52]

A report recently released by The Wilderness Society stated:

> "Mature and old growth forests can store or sequester extraordinary amounts of carbon, such as in the forests of the Pacific Northwest," said Dr. Jerry F. Franklin, a Professor with the University of Washington's College of Forest Resources. "An analogy would be that older forests can be viewed as having very large capital reserves, whereas younger forests have high cash flow, or carbon uptake, but contain very little capital, such as sequestered carbon. There's also a high 'transaction cost' when you 'liquidate' this stored carbon by harvesting the forest. The harvested sites are significant carbon sources leaking carbon dioxide to the atmosphere for many years to decades following the harvest."[53]

Logging mature forests will exacerbate global warming because mature forests already store substantial amounts of carbon, a large fraction of which would be transferred to the atmosphere if logged. Mature forests cannot be converted to young forests or wood products without losing the vast majority of carbon to the atmosphere. In the century preceding 1990, converting vast areas from old growth to plantations on the westside of Oregon and Washington caused 100 times more carbon emissions from land-use activities compared to the global average for similar sized areas.[54] Of the vast amount of carbon removed from forests via timber harvest in Oregon and Washington from 1900 to 1992, only 23% is contained in forest products (including landfills); the other 77% has been released to the atmosphere; so, for every ton of wood-based carbon in our houses and landfills, there is another 3 tons in the atmosphere.[55]

Ferrell and Brooks. Modeling Carbon Stores in Oregon and Washington Forest Products 1900-1992. Climate Change 33:521-550 (1996).). Law, B.E., Turner, D., et al 2004. Disturbance and climate effects on carbon stocks and fluxes across Western Oregon USA. Global Change Biology (2004) 10, 1429-1444.

[52] Smithwick EAH, Harmon ME, Acker SA, Remillard SM. 2002. Potential upper bounds of carbon stores in the Pacific Northwest. Ecological Applications 12(5): 1303-1317. "The C densities we measured in old-growth forests of the PNW are higher than C density values reported for any other type of vegetation, anywhere in the world. … Results showed that coastal Oregon stands stored, on average, 1127 Mg C/ha, which was the highest for the study area, while stands in eastern Oregon stored the least, 195 Mg C/ha. … the highest C density was at stand CH04 at Cascade Head, ORCOAST, with 1245 Mg C/ha."

[53] Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. The Wilderness Society. Washington, D.C. http://wilderness.org/files/ForestCarbonReport_0.pdf

[54] Harmon, M., Ferrell, W., and J. Franklin. 1990. Effects on Carbon Storage of Conversion of Old-Growth to Young Forests. Science. 9 February 1990.

[55] Harmon, Harmon, Ferrell and Brooks. Modeling Carbon Stores in Oregon and Washington Forest Products 1900-1992. Climate Change 33:521-550 (1996).

In fact, logging virtually always results in a net loss of carbon to the atmosphere.[56] Contrary to popular belief, even fuel-reduction logging comes with a cost in terms of net carbon emissions, because, the cumulative effects of logging across the landscape to reduce fire hazard ends up removing more carbon from the forest than fire does.[57]

It is time to draft northwest forestlands in the effort to save the climate. Forests in Washington, Oregon, and California store a disproportionate share of the nation's carbon stocks. West coast forests represent only about 20% of U.S. forested landscape, but they hold about 40% of the United States' total stock of forest carbon. It is estimated that if these forests were allowed to grow and return to historical levels of old-growth across the landscape, Pacific Northwest forests could store two to three times more carbon than they currently store. Considering that the net carbon sink provided by the nation's forests already offsets over 10% of all annual U.S. CO_2 emissions, allowing forests in the Pacific Northwest to return to old-growth conditions could play a significant role in helping to mitigate climate change.

A carbon-rich mature forest in SW Oregon on BLM lands slated for logging. Logging such stands will terminate carbon accumulation and accelerate carbon emissions.

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[56] Oregon Wild. 2008. Climate Control – How NW Old Growth Forests Can Help Fight Global Warming. http://www.oregonwild.org/oregon_forests/global-warming-and-northwest-forests, and see this slideshow which clarifies the relationships between forests, carbon and climate: http://www.slideshare.net/dougoh/forest-carbon-climate-myths-presentation/

[57] Mitchell, S., Harmon, M., and O'Connell, K. (in Review) Forest fuel reduction alters fire severity and long-term carbon storage in three Pacific Northwest ecosystems. Ecological Applications. http://ecoinformatics.oregonstate.edu/new/FuelRedux_FS_CStorage_Revision2.pdf

Mature forests are needed for climate change adaptation.

Global warming is expected to force significant changes in western forest ecosystems, and in order to continue to receive the tremendous ecosystem services that we enjoy from forests, our forests must be able to respond.[58] Mature and old-growth forests are critical components of an effective adaptation strategy for climate disruption. "Diversity is essential to adaptability"[59] and mature and old-growth forests are reservoirs of biodiversity and core habitat for countless species. Each species and each biotic community is a record of successful adaptation to past changes. Mature and old-growth forests are relatively more resilient than younger forests and are able to resist and recover from disturbances. Logging and road building increase fragmentation, which in turn will harm the ability of wildlife to move into more suitable habitat in a warming climate.

Mature forests may be among the last ecosystems to succumb to climate change, because mature forests exhibit "ecological inertia"— creating conditions suitable for their own persistence, like thick bark, deep roots, high canopies, moist microclimate, and complex soil foodweb and nutrient cycles. Younger forests (on both federal and non-federal lands) are more vulnerable to climate change, because young forests have shallow roots that can't reach deep soil water reservoirs; they have relatively thin bark and interlocking branches close to the ground which makes them vulnerable to fire; they lack the deep multi-layered canopies that create cool-moist microclimate; and the soil foodweb is less tightly coupled so the system is more likely to leach nutrients.

Also, most northwestern tree species are at least somewhat tolerant of extremes because forests in this region generally experience wet winters and dry summers on an annual basis. Trees that live for many hundreds of years persist through a lot of climate variations, including wet decades and dry decades driven by ocean conditions and numerous hundred-year floods and hundred-year droughts. These long-lived trees seem able to tolerate extremes at many scales. Trees that have survived several extreme events may be able to survive a few more.

A recent OSU study lends further support to the resiliency of old trees. It found that slower-growing older trees tend to channel relatively more of their energy into structural support and defense compounds to "maximize durability while minimizing … damage".[60]

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[58] Oregon Wild. 2008. "The Straight Facts on Forests, Carbon, and Global Warming" http://tinyurl.com/2n96m5.

[59] Bormann, Bernard T.; Brookes, Martha H.; Ford, E. David; Kiester, A. Ross; Oliver, Chadwick D.; Weigand, James F. 1994. Volume V: a framework for sustainable-ecosystem management. Gen. Tech. Rep. PNW-GTR-331. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 61 p. *in* Everett, Richard L., Assessment Team Leader; Eastside Forest Ecosystem Health Assessment. http://www.fs.fed.us/pnw/publications/pnw_gtr331/pnw_gtr331b.pdf

[60] Colbert, & Pederson. 2008. Relationship between radial growth rates and lifespan within North American tree species. Ecoscience 15(3), 349-357 (2008). http://www.ecoscience.ulaval.ca/catalogue/FA3149-black.pdf

Mature forests provide essential habitat for imperiled species that society is most concerned about.

One of the primary bases for the National Research Council recommendation to protect "most or all of the remaining late successional and old-growth forests" was their recognition that "further cutting of the remaining late successional and old growth forests of the Pacific Northwest is expected to cause rapidly accelerating threats to the biological diversity of the region. … To prevent extinction, viable populations must be managed."[61] Such species include threatened northern spotted owls, marbled murrelets, Pacific salmon, as well as many "survey and manage"[62] species that perform essential ecosystem services like nitrogen fixation and nutrient cycling.

Modeling by OSU's Gordie Reeves "indicates that intermediate-aged forests (120-160 years old), not very old or very young forests, may provide the most productive and diverse fish habitat."[63] Presumably this model describes a system that cycles through all age classes and retains the legacy structural features of older stands.

Spotted owls rely on mature as well as old-growth forests. "Nesting, roosting, and foraging functions [for northern spotted owl] are provided by sub-mature, mature, and old-growth forest types in eastern Washington."[64] Recent range-wide data analysis by Carlos Carroll and Devin Johnson attempts to control for survey bias caused by spatial autocorrelation of owl sites (e.g., juveniles owls are not randomly distributed by tend to live near their parents). Their findings corroborate the long-standing relationship between spotted owls and old growth forests, and shows that the models that best explain the abundance of spotted owl sites include both mature (50-150 y/o) and old growth (>150 y/o) forests.

> A quadratic model based on the combined proportion of old-growth and mature forest … showed the lowest DIC [deviance information criterion] in the southern subregion (northwestern California and southwestern Oregon) (Fig. 1). In the central (northern Oregon) and northern (Washington) sub-regions, the best model contained a pseudo-threshold relationship between owl site abundance and the proportion of old-growth and mature forest… In all subregions the coefficient for old-growth was greater than that for mature forest, and this contrast increased from the southern to northern subregion … [T]he quadratic inflection in the model for the southern subregion occurred in landscapes with 95% old-growth and mature forest, it effectively portrays a threshold relationship at levels of greater than 80% old-growth and mature forest … Within the central and northern subregions, no such threshold is evident from our results because owl abundance was

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[61] NRC 2000, pp 5, 6, 104.

[62] http://www.blm.gov/or/plans/surveyandmanage/index.htm

[63] INR 2008. Nonequilibrium Ecosystem Dynamics: Management Implications for Oregon. Institute for Natural Resources, October 13, 2008. http://www.oregon.gov/ODF/RESOURCE_PLANNING/docs/NonequilibriumEcosystemDynamics.pdf

[64] Jerry F. Franklin, Miles A. Hemstrom, Robert Van Pelt, Joseph B. Buchanan. 2008. The Case for Active Management of Dry Forest Types in Eastern Washington: Perpetuating and Creating Old Forest Structures and Functions. Washington DNR. September 2008. http://www.dnr.wa.gov/Publications/lm_ess_eog_mgmt.pdf

> predicted to continuously increase with increasing proportion of old-growth and mature forest."[65]

The lesson seems to be, "mature forests are good for spotted owls and as it grows older it will get better." If policy encourages harmful logging of mature forest, then conflicts with the Endangered Species Act (ESA) become likely.

Several ESA-listed species rely on mature forests in the Oregon Coast Range Province where "many of the remaining natural forests consist of a mosaic of mature stands and remnant patches of old-growth trees. Because it is isolated and large areas have been harvested, the Oregon Coast Range Province is of concern for northern spotted owls, marbled murrelets, and anadromous fish."[66]

Spotted owls subsist on a diet of mostly small mammals, many of which live in mature forests. While mature forests may not provide ideal spotted owl *nesting* habitat, they do provide excellent *foraging* opportunities and provide *thermal refugia* during hot and cold periods. If we protect old-growth and not mature, it will be like saving the owls' bedroom but destroying their pantry. "Mature forest fragments provide truffles and other food for small mammals such as red-backed voles during the dry summer months when such food is unavailable in plantations."[67] "Coarse woody debris is essential for many species of vascular plants, fungi, liverworts, mosses, and lichens. Truffle production is associated with coarse woody debris in mature forests in southwestern Oregon. This is probably related to the moisture-holding capacity of decayed wood in comparison to surrounding soil that dries and suppresses fruiting of fungi."[68]

Threatened marbled murrelets also rely on mature forests. "Suitable murrelet nesting habitat has been tentatively defined as old-growth forests, and mature forests with an old-growth component ...."[69]

The 1997 Final Recovery Plan for the Threatened marbled murrelet urges protection of both old-growth and mature forests:

> Consistent with the Forest Plan Record of Decision, thinning within Late-Successional Reserves should be restricted to stands younger than 80 years. ... [Recovery Action 3.2.1.2] **Protect 'recruitment' nesting habitat** to buffer and enlarge existing stands, reduce fragmentation, and **provide replacement habitat** for current suitable nesting habitat lost to disturbance events. Stands (currently 80 years old or older) that will produce suitable habitat within the next few decades are the most immediate source of new habitat and may be the only replacement

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[65] Carlos Carroll and Devin S. Johnson. (In press) The Importance of Being Spatial (and Reserved): Assessing Northern Spotted Owl Habitat Relationships with Hierarchical Bayesian Models. Conservation Biology.

[66] 1994 NWFP FSEIS p 3&4-21.

[67] 1994 NWFP FSEIS p 3&4-31.

[68] 1994 NWFP FSEIS p 3&4-32.

[69] 1994 NWFP FSEIS p 3&4-236.

> for existing habitat lost to disturbance (e.g., timber harvest, fires, etc.) over the next century. Such stands are **particularly important because of the vulnerability of many existing habitat fragments to fire and wind and the possibility that climate change will increase the effects of the frequency and severity of natural disturbances**. Such stands should not be subjected to any silvicultural treatment that diminishes their capacity to provide quality nesting habitat in the future. Within secured areas, these "recruitment" stands should not be harvested or thinned.[70]

In the summer of 2008 the Bush Administration issued a Final Recovery Plan (FRP) for the Threatened Northern Spotted Owl.[71] Although this plan is scientifically and legally flawed in some respects,[72] the FRP nonetheless recognizes the value of conserving and restoring *mature*—not just old-growth—forests:

- "Scientific research and monitoring indicate that spotted owls generally rely on **mature** and old-growth forests because these habitats contain the structures and characteristics required for nesting, roosting, and foraging." [73] (emphasis added)
- "In the Western Washington Cascades, spotted owls roosted in **mature forests** ... . In the Coast Ranges, Western Oregon Cascades and the Olympic Peninsula, radio-marked spotted owls selected for old-growth and **mature forests** for foraging and roosting and used young forests less than predicted based on availability..." (FRP p 52, emphasis added).

In regard to dry forest types, the Final Recovery Plan for the northern spotted owl recognizes the value of conserving and restoring mature trees (and smaller size classes) in order to provide recruitment and canopy cover:

- "Active management in dry forests primarily concerns restoring sustainable ecological conditions, with significant populations of **intermediate-sized** and large trees throughout. **Mature** and old trees will provide the framework for **replacement spotted owl habitat when suitable habitat patches are lost to fire**. ..." (FRP p 22, emphasis added).
- "**Smaller size classes** of fire tolerant species **provide the recruitment resource** for future large and very large fire tolerant trees." (FRP pp 23, 109, emphasis added).
- "**Decreasing crown density is the least important of all other [fire resilience] principles are applied**. This principle may be applied variably across the landscape and

[70] FWS. 1997. Recovery Plan For The Threatened Marbled Murrelet (*Brachyramphus Marmoratus*) In Washington, Oregon, And California. http://ecos.fws.gov/docs/recovery_plans/1997/970924.pdf (emphasis added).

[71] USDI Fish & Wildlife Service. 2008. Final Recovery Plan for the Northern Spotted Owl. http://www.fws.gov/pacific/ecoservices/endangered/recovery/NSORecoveryplanning.htm.

[72] A coalition of conservation organizations is challenging the recovery plan and revised critical habitat in court.

[73] USDI/FWS 2008. Final Recovery Plan for the Northern Spotted Owl, page VII (emphasis added) (hereinafter FRP).

would appropriately be ignored in owl habitat to **maintain prey habitat and provide closed canopy owl habitat**.” (FRP p 109, emphasis added).

- "[S]tand restoration and fuel treatment principles: …

  > Retain the **large** and very large fire tolerant trees—existing old trees of fire tolerant species (ponderosa pine, western larch, Douglas-fir, sugar pine, incense-cedar, Jeffrey pine, and a few others depending on location) should be **retained throughout the landscape** managed for Northern Spotted Owl habitat. These trees take 150 or more years to grow and are **not easily replaced**. They are key habitat features that can persist for centuries. Large trees of other species (e.g., grand fir and white fir) and younger, smaller trees (e.g., <20” DBH) of fire tolerant species may be removed outside critical owl habitat to reduce canopy fuels. The panel recommends … recognition of **old trees regardless of diameter** (FRP p 110, emphasis added).

- "[C]onsiderations to aid in landscape planning for sustainable Northern Spotted Owl habitat … High quality habitat should be identified and fuels management and other restoration treatments should be applied adjacent to high quality habitat to reduce fire risks while maintaining **medium** and large tree structure and favoring fire tolerant tree species." (FRP pp 111-112, emphasis added).
- In Eastern Cascades and California Cascades Provinces, "In moist forests within spotted owl habitat capable areas, management should **focus on thinning stands created by past harvest** or fire in order to accelerate the development of large tree structures." (FRP p 23, emphasis added).
- "The key ingredients in all management to produce, conserve, or protect dry east-side old forest is the **retention or generation of sufficient numbers of large and** very large, old ponderosa pine, western larch, and (in some cases) Douglas-fir and the maintenance of both meso- and fine-scale patchiness among and within stands." (FRP p 107); and
- Outside of high quality owl habitat patches "maintain structural conditions supporting prey occurrence and abundance in current or potential [nesting, roosting and foraging] habitat, maintain structural conditions conducive to Northern Spotted Owl foraging, and allow for rapid development of replacement [nesting, roosting and foraging] habitat." (FRP pp 112-113). Spotted owls and their prey benefit from abundant dead wood, but thinning removes significant amounts of wood from the dead wood recruitment pool, so thinning in mature forests is inconsistent with this element of the recovery plan.

The main point here is that any effort to encourage potentially harmful logging in mature forests could place imperiled species at greater risk. In the exceptional circumstances where dry mature forest may need to be treated to improve resilience, the focus must be on the surface and ladder fuels. The canopy trees must remain intact.

There is an urgent need to increase owl habitat to increase the chances that spotted owls can co-exist with invading barred owls.

Barred owl competition and displacement are significant concerns emerging in the status review for the northern spotted owl. The 2004 spotted owl status review panel unanimously identified barred owls as a future threat to the spotted owl.[74] A well-known axiom from island biogeography holds that as habitat area increases, the number of cohabiting species also increases.[75]

> The major causes of population and species extinction worldwide are habitat loss and interactions among species. … The most robust generalization that we can make about population extinction is that small populations face a particularly high risk of extinction. … [E]mpirical support for the extinction-proneness of small populations has been found practically wherever this issue has been examined. … The loss of habitat reduced population size …. Larger habitat patches have larger expected population sizes than smaller patches. Therefore, other things being equal, we could expect large habitat patches to have populations with a lower risk of extinction than populations in small patches. …[76]

From these ecological foundations, one can see that the barred owl, by invading and occupying suitable habitat and excluding spotted owls, has reduced the effective size of the reserves that were established by the Northwest Forest Plan. This effectively reduces the potential population of spotted owls. Extinction risk is increased by this loss of available habitat and smaller population. If we provide more suitable habitat by protecting mature forests, the population potential increases, and the risk of extinction decreases. The most rational way to respond to the invasion of the barred owl is to protect all remaining suitable habitat, and expand and restore the reserve system to provide more suitable habitat, which will increase the likelihood that the two owl species can co-exist.

This view is corroborated by owl biologist David Wiens who was interviewed on the Lehrer NewsHour and said: "The more habitat you protect, the more you're going to alleviate the competitive pressure between the species. Rather than reducing it and increasing the competitive pressure between these two species, we need to *provide as much habitat as possible* for them."[77] Biologist Robert Anthony agrees: "If you start cutting habitat for either bird, you just increase competitive pressure." And in the same news story Eric Forsman added: "You could shoot barred owls until you're blue in the face," he said, "but unless you're willing to do it forever, it's just not going to work."[78] Mature forests provide suitable habitat for spotted owls and is urgently needed to help the owl persist in the face of this new threat.

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[74] Gutierrez. R. 2004. THREATS: Past, Present, and Future, slide presentation. http://www.sei.org/owl/meetings/Presentations/June/Gutierrez-Threats.pdf

[75] Tilman, D. and P. Karieva, Eds. 1997. Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions. Monographs in Population Biology, Princeton University Press. 368 pp. See especially, Part III – "Competition in a Spatial World."

[76] Oscar E. Gaggiotti and Ilkka Hanski. 2004. Chapter 14 - Mechanisms of Population Extinction. In Ecology, Genetics, and Evolution of Metapopulations. Elsevier. 2004. http://www.eeb.cornell.edu/sdv2/Readings/Gaggiotti&Hanski.pdf

[77] WIENS, D. 2007. NewsHour interview. "Biologists Struggle to Save the Spotted Owl." December 18, 2007. http://www.pbs.org/newshour/bb/science/july-dec07/owl_12-18.html

[78] Welch, Craig. 2009. The Spotted Owl's New Nemesis. Smithsonian Magazine. January 2009. http://www.smithsonianmag.com/science-nature/The-Spotted-Owls-New-Nemesis.html?c=y&page=2

The 2008 Final Recovery Plan (FRP) for the Northern Spotted Owl has partially addressed the barred owl issue by adopting Recovery Action 32, which urges the FS and BLM to "Maintain substantially all of the older and more structurally complex multi-layered conifer forests on Federal lands outside of MOCAs…" based on the idea that "protecting these forests will not further exacerbate competitive interactions between spotted owls and barred owls as would occur if the amount of shared resources were decreased."[79] FWS failed to consider the full benefits of protecting all suitable habitat, including mature, not just old growth.

Logging mature forests will impair development of important features of old-growth forests, especially snags and dead wood.

Cutting mature forests and trees is generally not needed for ecological reasons. In fact, commercial logging will most often degrade rather than improve mature forest habitat. Foresters can make an argument that thinning helps grow big trees faster, but that's a tree-farmer's argument that is focused on growing a crop of big trees instead growing complex habitat.

Healthy late-successional forests are so much more than just big trees. Managers of public forests must strive to enhance other important aspects of healthy old forests, including large dead trees called snags, down wood, and multiple canopy layers. Of the six main attributes of old-growth forests, two involve dead trees (i.e., large accumulations of snags and dead wood). Looking at forest development once again as a continuum, restoration of complex old forests will require a reliable flow of material from the live-tree pool into the snag and down-wood pool, but logging interrupts that flow.

Restoring complex old forests requires that extra trees be retained to provide continuous recruitment of large snags and down wood. The latest Forest Inventory and Analysis report for Oregon states, "The presence of dead wood in a forest improves wildlife habitat, enhances soil fertility through nutrient cycling and moisture retention, adds to fuel loads, provides substrates for fungi and invertebrates, and serves as a defining element in old-growth forest. Because of this, the dead wood resource is often analyzed from a variety of perspectives— too much can be viewed as a fire hazard and too little can be viewed as a loss of habitat."[80]

The Scientific Panel on Ecosystem Based Forest Management explained:

> The fact that dead trees and logs are as important to ecosystem function as living trees challenges traditional forestry models that treat such materials as waste, fire hazards, and mechanical impediments. To move away from ecologically simplistic models, new forest management regimes must address questions such

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[79] FWS 2008. Final Recovery Plan for the Spotted Owl, p 34.

[80] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf (citations omitted). It is important to note that large wood that is most valuable for wildlife and does not present a significant fire hazard and small hazardous fuels do not provide as much habitat value as large wood, so compatibility can be achieved if managers focus on removing small hazardous fuels while retaining medium and large trees.

> as: How much coarse woody debris is needed? and: How many snags in various stages of decay are required? to fulfill important ecological functions."[81]

Unfortunately, the agencies continue to rely on scientifically outdated methods that perpetuate the deficit of large snags and down wood,[82] and they continue to remove medium-sized trees that should be allowed to continue to grow and become ecologically valuable snags and dead wood. Heavy thinning of maturing forest has been shown to significantly delay attainment of snag objectives.[83] Which means that commercial thinning may be preventing or delaying development of essential features of old forest ecosystems, features that are important to spotted owls, salmon, and their prey.

The Eastside Scientific Societies Panel explained the keystone role of woodpeckers and the critical importance of snags and dead wood to the overall functioning of the forest. "The predatory impact of woodpeckers on pest insects is only part of the total predatory impact of the entire avian community. Many bird species continually feed on insect populations, and many depend on woodpeckers to construct the cavities they use. Therefore, maintenance of natural densities of woodpeckers may be crucial to the natural ecological response systems to insect irruptions."[84]

> A few scattered snags retained by forest management are not sufficient to provide nesting and roosting habitat into the future. Snags and logs in harvested areas and logs in streams remain only a finite time; the next generation of snags and large woody debris—in other words, live old trees—must be protected. Saving the remaining old-growth is thus a critical first step in conserving old-growth-

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[81] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf (citations omitted).

[82] PNW Research Station, "Dead and Dying Trees: Essential for Life in the Forest," Science Findings, Nov. 1999 (http://www.fs.fed.us/pnw/sciencef/scifi20.pdf) ("Management implications: Current direction for providing wildlife habitat on public forest lands does not reflect findings from research since 1979; more snags and dead wood structures are required for foraging, denning, nesting, and roosting than previously thought."). Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf. Steve Zack, T. Luke George, and William F. Laudenslayer, Jr. 2002. Are There Snags in the System? Comparing Cavity Use among Nesting Birds in "Snag-rich" and "Snag-poor" Eastside Pine Forests. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/017_Zack.pdf.

[83] USDA Forest Service. 2007. Curran Junetta Thin Environmental Assessment. Cottage Grove Ranger District, Umpqua National Forest. June 2007. Using data from stand exams modeled through FVS-FFE (West Cascades variant) the Umpqua NF found that the actual effect of heavy thinning is to capture mortality and delay recruitment of desired levels of large snag habitat for 60 years or more.

[84] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

dependent species, but preservation must be supplemented with plans for generating future old growth.

Forest management that preserves selected snags does not adequately meet the foraging needs of LS/OG-associated species. Eliminating foraging habitat by extensive salvaging or selective cutting will have adverse consequences for pileated woodpeckers and other forest species dependent on cavities excavated by woodpeckers. Continual recruitment of standing dead and downed coarse woody material is absolutely necessary to support the diversity of organisms, including fungi and insects, that in turn provide a productive forest system for woodpeckers and other sensitive wildlife species.

Elimination of deadwood habitat from the forest thus has adverse consequences on bird populations and seriously skews natural predator-prey relationships that may have a major influence on insect populations.[85]

In response to the significant loss of large and old trees on the eastside, ICBEMP proposed the following standards and objectives:

Maintain and/or restore large shade-intolerant trees and snags in densities that are consistent with the range of historical conditions. … *Large trees* is a relative term dependent on species and site. Large trees are a future source of large snags, and large snags are a future source of coarse woody debris, another important habitat component for many species. It is important to have present and **future sources of large trees** and snags at adequate levels though time. Larger snags are generally better than smaller snags because they exist longer. Large trees and/or snags are essential habitat components for many species …

…

Maintain and/or recruit adequate numbers, species, and sizes of snags and levels of downed wood to meet the needs of wildlife, invertebrates, fungi, bryophytes, saprophytes, lichens, other organisms, long-term soil productivity, nutrient cycling, carbon cycles, and other ecosystem processes.[86]

Meeting these goals will require retention of plenty of recruitment trees in the mature age class. Unfortunately, ICBEMP science has not yet been implemented or incorporated into existing forest plans.

After Congressman Charles Taylor commissioned Oliver et al. (1997)[87] to prepare a report urging more logging to make our National Forests healthier, the Ecological Society of America responded with a report confidently concluding that "there is no scientific basis for asserting that

[85] Henjum (1994) (citations omitted).

[86] USDA/USDI 2000. ICBEMP SDEIS p 3-66 – 3-68.

[87] Oliver, C., D. Adams, T. Bonnicksen, J. Bowyer, F. Cubbage, N. Sampson, S. Schlarbaum, R. Whaley, and H. Wiant. 1997. Report on forest health of the United States by the Forest Health Science Panel. A panel chartered by Charles Taylor, Member, U.S. Congress. Washington, D.C.

silvicultural practices can create forests that are ecologically equivalent to natural old-growth forests, although we can certainly use our understanding of forest ecology to help restore managed forests to more natural conditions."[88] The NRC Report (2000) concurred, explaining that "proponents of active timber harvest on all or most of the landscape argue their approach reflects current ecological thinking, which recognizes nature is inherently dynamic. … This view recently was critiqued by a panel of the Ecological Society of America (ESA) which disagreed strongly with the conclusions of Oliver and colleagues (Aber 2000). This committee concurs with the ESA panel ..."[89] The authors point out that reserves are not static, rather reserves should be extensive enough to subsume the natural disturbance processes that create and maintain complex forests, and "there is little evidence that managed stands are healthier than unmanaged stands. In fact, quite the contrary …"

[88] Aber, J., N. Christensen, I. Fernandez, J. Franklin, L. Hidinger, M. Hunter, J. MacMahon, D. Mladenoff, J. Pastor, D. Perry, R. Slangen, H. van Miegroet. 2000. Applying ecological principles to management of the U.S. National Forests. Issues in Ecology, No.6, 20pp. http://esa.org/science_resources/issues/FileEnglish/issue6.pdf

[89] NRC 2000. pp 189-190. The heavy-handed silvicultural approach was also roundly criticized by The Scientific Panel on Ecosystem Based Forest Management: Jerry Franklin, David Perry, Reed Noss, David Montgomery, and Christopher Frissell. See Franklin et al. (2000).

Snags like this are an essential element of old growth forests.
A forest without dead trees like this is not a healthy forest.

Logging in mature forests like this just removes trees that are needed for future recruitment of snags that enrich old growth habitat over time.

In all forest types, recognize that logging has trade-offs.

There's no free lunch. All logging—including thinning stands of any age—involves adverse impacts and trade-offs. Some impacts of logging are unavoidable, so there is no such thing as a logging operation that is 100% beneficial to ecological restoration. Depending on how it is done thinning can have adverse impacts such as:

- soil compaction and disturbance;
- habitat disturbance and wildlife displacement;
- carbon emissions to the atmosphere;
- introducing and spreading weeds;
- removal and reduced recruitment of snags and large wood;
- road-related erosion and hydrologic modification, and opening access for fire ignition and OHV trespass;
- moving flammable small fuels from the canopy to the ground; and
- creating a hotter-dryer-windier microclimate that is favorable to greater flame lengths and rate of fire spread.

Some of these negative effects are fundamentally unavoidable. Therefore, all thinning has negative effects that may be partially compensated by beneficial effects such as:

- reducing competition between trees so that some can grow larger faster;
- increased resistance to drought stress and insects;
- increasing species diversity; and
- possible (but by no means certain) fire hazard reduction.

It is generally accepted that when thinning occurs in very young stands, net benefits are more likely to arise because the benefits outweigh the adverse impacts. Conversely, when thinning occurs in older stands, net benefits are unlikely because negative impacts on soil, water, weeds, carbon, and dead wood recruitment will tend to outweigh the benefits, resulting in a negative ecological balance sheet. The ICBEMP Team said that "there are instances where long-term benefits may not exceed short-term environmental costs or adverse ecosystem impacts, making passive restoration approach more appropriate."[90] As we move along the continuum from thinning young forests to logging older forests, net benefits very often turn into net negative impacts, but where is that line? Within the range of the owl, the Northwest Forest Plan found 80 years to be a good place to draw the line. In dry forests being managed to reduce fire hazard, the Scientific Panel on Ecosystem Based Forest Management concluded that thinning mature stands would likely lead to problems that exceed any benefits, so thinning programs should be limited to younger stands. "Thinning only small and intermediate trees less than 100 years old could decrease fire risk, depending on how much new risk is introduced by logging slash (or its

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[90] Thomas Quigley, ed., Integrated Scientific Assessment for the Interior Columbia Basin. PNW-GTR-382, Sept 1996. p 177.

disposal). … The challenge is to alleviate one problem without exacerbating others or creating new ones (Perry 1995). Therefore, each project requires careful thought and analysis."[91]

In moist provinces, mature forests just need time, not logging.

Mature forests are already starting to exhibit complex forest characteristics and they will continue to develop and improve without human intervention. As recognized in the Northwest Forest Plan standards and guidelines for Late Successional Reserves, stands over 80 years old in the moist westside provinces are most likely to become old growth in the absence of silvicultural manipulation.[92] The transition from mature forest to old growth is a process that takes time and varies depending on factors such as location, species, and disturbance events. In a mature forest, all the ingredients are there to make old growth (e.g., large and growing trees, material for recruitment of snags and logs, mortality processes that create canopy gaps, etc.). These forests don't need logging; they need time to develop.

In moist areas, young forests are most likely to benefit from thinning. The most appropriate use of logging technology is to thin dense young stands that developed following clearcutting. The Northwest Forest Plan prohibits logging of stands 80 years or older in the Late Successional Reserves for several reasons: (a) such stands are beginning to acquire late successional characteristics and provide valuable habitat for spotted owls and other wildlife; (b) there is a lack of evidence to support the hypothesis that logging in stands >80 years old is beneficial to habitat development; and (c) logging will likely do more harm than good.

This reasoning is articulated in several scientific reports, including the 1990 Interagency Scientific Committee (ISC) Report, the 1993 SAT Report, and various reports to Congress where the scientists were being asked to explain to a skeptical committee in Congress why logging old forests could not be compatible with conserving late-successional forest ecosystems. The ISC report said "no consensus exists about whether any silvicultural systems would produce the desired results. The ability to harvest timber in currently suitable owl habitat and have that habitat remain suitable has not been clearly demonstrated."[93]

The SAT noted that "considerable additional research is likely required" before we will know whether silviculture can be compatible with spotted owls, and while the spotted owl is relatively well studied, the risks and uncertainty are even more pronounced for the hundreds of other

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[91] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf

[92] USDA/USDI 1994. Northwest Forest Plan ROD, Attachment A, pages B-6, C-11, C-12. April 1994. *and* Pers. Comm. David Perry (Professor [emeritus], Oregon State University School of Forestry) to David Dreher (Legislative Assistant to U.S. Rep. Peter DeFazio), 15 June 2002.

[93] Thomas, J.W., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A Conservation Strategy for the Northern Spotted Owl. A report by the Interagency Scientific Committee to address the conservation of the northern spotted owl. USDA, Forest Service, and U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Land Management, and National Park Service. Portland, OR (*herein* ISC Report), 1990, p 104.

species associated with old-growth.[94] It should also be recognized that President Clinton's Mission Statement directed the FEMAT team to ensure that "tests of silviculture should be judged in an ecosystem context and not solely on the basis of single species or several species response."[95]

The 1993 Report of the Scientific Analysis Team (SAT) specifically highlighted the risks associated with logging in suitable owl habitat, saying "intentions to selectively cut forest stands to create conditions favorable for spotted owls, represents increased risks to the viability of the spotted owl."[96] The Scientific Analysis Team said there are several factors that support this conclusion and affirm the Interagency Scientific Committee's decision to exclude logging in old growth reserves and rely on natural processes to maintain and restore habitat:

a. "Lacking experience with selective cutting designed to create spotted owl habitat, such practices must be considered as untested hypotheses requiring testing to determine their likelihood of success. ... Given the uncertainty of achieving such expectations, it is likely that some silvicultural treatments, which have been characterized as largely experimental, may well have an opposite effect from that expected. Consequently, such treatments may hinder the development of suitable habitat or they may only partially succeed, resulting in development of marginal habitat that may not fully provide for the needs of spotted owls. Results which fall short of the expected conditions could occur because of delay or failure to regenerate stands that have been cut, increased levels of windthrow of remaining trees, mechanical damage during logging to trees remaining in the logging unit, the spread of root rot and other diseases. Increased risk of wildfires associated with logging operations that increase fuels and usually employ broadcast burning to reduce the fuels also increase the risk of not attaining expected results. Such events may spread to areas adjacent to stands that are logged, thereby affecting even more acreage than those acres directly treated." [SAT p 147-148] The SAT indicates that these comments apply equally to density management and patch cutting, both of which are being promoted as tools to enhance owl habitat. The SAT also cited concerns about the effect of logging on snags and down woody debris which are essential features of owl habitat.

b. "Planning produces a description of desired future conditions [and] culminates in a final plan for a project which, for timber sales, involves legal contracts obligating the purchaser and the seller to specific provisions. … Our experience is that commonly not all provisions of the plan are thoroughly incorporated into such contracts, nor are all contract provisions thoroughly administered to ensure compliance." [SAT p 148-149].

c. "There are also probabilities associated with how well monitoring will identify 'trigger points' that indicate a management plan may need modification. The more complex the plan (i.e., the more variables there are to monitor) the less likely the monitoring plan will

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[94] Thomas, JW, Raphael, MG, Anthony, RG, Forsman ED, Gunderson, AG, Holthausen, RS, Marcot, BG, Reeves, GH, Sedell, JR, and DM Solis. 1993. Viability Assessments and Management Considerations for Species Associated with Late-Successional Old-Growth Forests of the Pacific Northwest. The Report of the Scientific Analysis Team (*herein* SAT Report), 1993, p 147.

[95] FEMAT Report, p iii.

[96] SAT Report p 145.

successfully detect problems. Manipulation of forest stands to accelerate development of spotted owl habitat on a landscape scale, as prescribed in the Bureau of Land Management Preferred Alternative, is an extremely complex issue involving a myriad of variables over a very long timeframe. Development of a monitoring plan intensive enough to isolate the causes of observed variations for wide-scale implementation of the Bureau of Land Management Preferred Alternative seems unlikely to us. … [I]nadequate monitoring will increase, perhaps dramatically, the risk of failure of a plan that relies heavily on adaptive management." [SAT p 149].

d. "A basic requirement for a viable adaptive management strategy is the existence of resources necessary to make the required adjustments. Adaptive management can only be expected to reduce risk if options to adjust management to fit new circumstances are not eliminated. Adaptive management, therefore, can be considered a means to reduce risk associated with a Resource Management Plan commensurate with the options for adjustment which remain during the time the plan is in effect." [SAT p 149-150] In other words, silvicultural manipulation of mature forests has long-term consequences and is likely to foreclose some future options in those stands, thus reducing the utility of adaptive management. A prime example is the fact that logging "captures mortality," yet mortality is an essential feature of old-growth habitat used by both spotted owls and their prey.

e. SAT then noted the cumulative effects of all these uncertainties: "The combined risks associated with treatment of spotted owl habitat or stands expected to develop into suitable habitat for spotted owls, as discussed above, will likely result in situations where either habitat development is inhibited or only marginal habitat for spotted owls is developed. The exact frequency of these partial successes or failures is unknown. Given the likely cumulative relationship among the risks for each factor, it appears to us that the overall risk of not meeting habitat objectives is high. … Members of the Interagency Scientific Committee indicated that, because a plan (the Interagency Scientific Committee's Strategy) was put forth which proposes to reduce the population of a threatened species by as much as 50 percent, providing the survivors with only marginal habitat would be extremely risky and certainly in their minds not 'scientifically credible' (USDA 1991:45)." [SAT p 151].

f. The SAT concluded, "The transition period (1-50 years) between implementation of the Interagency Scientific Committee's Strategy and achievement of an equilibrium of habitat and spotted owls is a critical consideration. … Given the existing risks that face owl populations and the sensitivity of the transition period, the short-term effect of these actions on habitat loss may be much more significant than the long-term predicted habitat gains. We further conclude that, although research and monitoring studies are presently being initiated, no significant new data exist which suggest that the degree of certainty that is expressed in the Bureau of Land Management Draft Resource Management Plans for developing owl habitat silvicultural treatments is justified. Therefore, it is our opinion that the course prescribed in the Interagency Scientific Committee's Strategy, pertaining to timber harvest in Habitat Conservation Areas, remains the most likely course to result in superior habitat conditions within reserves (i.e., Old-Growth Emphasis Areas). The approach prescribed by the Interagency

> Scientific Committee's Strategy preserves options for adjustments in the course of management under a philosophy of adaptive management." [SAT p 151-152].

The authors of the Northwest Forest Plan took all this into account and determined that 80 years is a useful place to draw the line between younger forests that are likely to benefit from careful thinning and older forests that are likely to experience net negative consequences.[97] There is no new science to change that conclusion. In fact, new information developed since 1994 shows that dead wood is probably more valuable than previously thought. It is important for a wide variety of ecological functions, not least of which is providing complex habitat to support owl prey species. Thinning stands over 80 years will remove many large trees and prevent them from ever becoming snags and dead wood. The long-term loss of recruitment of dead wood habitat in older stands is a very strong argument against logging in stands over 80 years old.[98]

Structure-based management (SBM) is often suggested as a way to produce logs and habitat from the same forests, but this is not a well-supported approach to managing older forests. There are well-founded critiques which point out that structure-based management is untested, uncertain, high risk, and unlikely to result in desired outcomes. Consider the well-developed critique of structure based management set forth by the Scientific Panel on Ecosystem Based Forest Management:

> The concept that all forests must be silviculturally manipulated (logged) and eventually replaced in order to provide desired goods and services, including the continued health of forest landscapes, is an old and honored tradition. … The proposition that forest values are protected with more, rather than less logging, and that forest reserves are not only unnecessary, but undesirable, has great appeal to many with a vested interest in maximizing timber harvest. … Our interpretation of the scientific literature, combined with our professional experience, leads us to some very different conclusions about appropriate approaches. Scientifically based strategies for the conservation of forest ecosystems, with a sound theoretical basis in conservation biology—including biodiversity and critical ecological services—have inevitably incorporated reserves along with ecologically sensitive management of unreserved areas (e.g., FEMAT 1993). … In our view, the assumptions underpinning simplified structure-based management (SSBM) are not supported by the published scientific literature on structural development of natural forests, disturbance ecology, landscape ecology and conservation biology, or by the relationships between ecosystem structures

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[97] See 1993 SAT Report pp 146-152. AND February 1991 Questions and Answers on A Conservation Strategy for the Northern Spotted Owl (prepared in response to written questions from the Senate Energy and Natural Resources Committee to the Interagency Scientific Committee on the May 1990 ISC Report. AND Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. Simplified Forest Management To Achieve Watershed And Forest Health: A Critique. National Wildlife Federation. http://www.coastrange.org/documents/forestreport.pdf

[98] USDA Forest Service. 2007. Curran Junetta Thin Environmental Assessment. Cottage Grove Ranger District, Umpqua National Forest. June 2007. http://www.fs.fed.us/r6/umpqua/projects/projectdocs/curran-junetta-thin/index.shtml This EA revealed that heavy thinning in young stands would delay attainment of objectives for recruitment of dead wood for 6 decades or more.

> and processes. … We do not believe, however, that scientific literature or forestry experience supports the notions that intensively managed forests can duplicate the role of natural forests, or that sufficient knowledge and ability exist to create even an approximation of a natural old-growth forest stand.[99]

Allowing logging in stands up to 80 years old may be too generous. Trees that still have a lot of growing to do are far more likely to respond well to thinning because they can put more growth into their still-developing crowns. Older trees that are not expected to grow much taller have much less responsive crowns and will not respond as well to thinning.[100] Some studies indicate that stands over 50 years old may be less amenable to thinning. Recent research indicates that a substantial portion of a tree's size and character at several hundred years of age can be explained by the tree's rate of growth at age 50, and recent modeling "found it difficult to alter the development trajectories of well-established young stands that were first managed at age class 50," and concluded that earlier intervention would have promoted deeper crowns and greater diameter class differentiation.[101] This leads to a tentative conclusion that thinning stands younger than 50 years old should be a higher priority than thinning stands older than 50 years.

In dry provinces, fire hazard is over-stated. Logging mature trees will just make things worse.

The ICBEMP investigations show that fire hazard in northwest forests is not as bad as some are claiming.

> About 6 percent of the FS/BLM administered lands in the ICBEMP management region experience at least moderate levels of uncharacteristic wildfire probability. These are broadly scattered across the landscape. Much of this occurs in dry forest where the interaction of fire suppression, insects and disease, and succession has produced uncharacteristically high fuel levels. … The great majority (80 percent or more) of lands administered by the FS/BLM in the ICBEMP management region currently experience low probabilities of uncharacteristic wildfire. … Fire disturbances are about equally split between low, moderate and high classes at present.[102]

The US Forest Service program on Forest Inventory and Analysis (FIA) recently analyzed forest fire hazard across the state of Oregon and found similar results.

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[99] Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. Simplified Forest Management To Achieve Watershed And Forest Health: A Critique. National Wildlife Federation. http://www.coastrange.org/documents/forestreport.pdf

[100] Tappeiner, J.C., II, Emmingham, W.H., and D.E. Hibbs 2002. Silviculture of Oregon Coast Range Forests. Chapter 7 in Forest and Stream Management in the Oregon Coast Range. Edited by Stephen D. Hobbs, John P. Hayes, Rebecca L. Johnson, Gordon H. Reeves, Thomas A. Spies, John C. Tappeiner II, and Gail E. Wells, 2002.

[101] Andrews, Perkins, Thrailkill, Poage, Tappeiner. 2005. Silvicultural Approaches to Develop Northern Spotted Owl Nesting Sites, Central Coast Ranges, Oregon. West. J. Appl. For. 20(1):13-27. (emphasis added).

[102] Miles A. Hemstrom, Wendel J. Hann, Rebecca A. Gravenmier, Jerome J. Korol. 2000. [SAG] Landscape Effects Analysis of the [ICBEMP] SDEIS Alternatives. USDA/USDI, *draft* March 2000.

> These [forest inventory and analysis] data paint a different picture of fire hazard and fuel treatment opportunity than do certain commonly used maps of fire regime condition class (Hardy et al. 1999; Schmidt et al. 2002). … Under the fire weather assumed for this analysis, less than half the forested lands are predicted to develop crown fires, and an even smaller fraction, 5 to 15 percent, can be expected to develop active crown fire. … From the standpoint of implementing fuel treatments, these results suggest that only a fraction of the forested landscape is likely to benefit from fuel treatment if the objective is to reduce crown fire hazard. Given that spatial analyses of fuel treatments has demonstrated that treating a small percentage of the landscape can reduce landscape-scale fire hazard significantly and sometimes cost-effectively (Finney 2001), these results suggest that the fuels management challenge may be more tractable than has been assumed.[103]

Hanson et al (*in press*) reviewed 2 decades of fire records in conifer forests in dry provinces of the Northwest Forest Plan and found that the proportion of area burned and the severity of fire has not changed significantly.[104] These findings, along with the evidence that logging has unavoidable adverse impacts, indicates that caution is warranted. We should not encourage excessive and unwarranted logging in mature forests. PNW Research Station recently reported that profit-driven fuel reduction logging can conflict with both habitat objectives and fire risk reduction objectives.[105]

If there is a new push for timber volume from mature forests and trees, it will cause fire hazard to increase. Commercial logging can increase fire hazard by making forest stands hotter and windier, and fuels dryer. "Thinning opens stands to greater solar radiation and wind movement, resulting in warmer temperatures and drier fuels throughout the fire season. [T]his openness can encourage a surface fire to spread. …"[106] Opening the canopy also stimulates the growth of new surface and ladder fuels, and logging moves fine fuels from the canopy to the ground where they are more available for combustion.

BLM's Western Oregon Plan Revision EIS confirms that fire hazard will increase in areas managed for timber production, and that retaining more canopy cover would help reduce fire hazard. "The more canopy that would remain, the less effect wind would have on drying fuels and surface fires. This reduction in mid-flame wind speed would reduce flame length, which can

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[103] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf (emphasis added).

[104] Hanson, C.T., Odion, D.C., DellaSala, D.A., and W.L. Baker. *in press.* Overestimation of fire risk in Northern Spotted Owl Recovery Plan. Conservation Biology.

[105] PNW Research Station. 2006. Seeing The Bigger Picture: Landscape Silviculture May Offer Compatible Solutions To Conflicting Objectives. Science Findings. July 2006. http://www.fs.fed.us/pnw/sciencef/scifi85.pdf

[106] USDA Forest Service; Influence of Forest Structure on Wildfire Behavior and the Severity of Its Effects, November 2003. http://www.fs.fed.us/projects/hfi/2003/november/documents/forest-structure-wildfire.pdf

lead to a reduction in tree mortality. … A lower probability of mortality equates to greater fire resiliency."[107]

Current project planning methods do not fully integrate all the complex ways that logging can influence both fuel structure and microclimate over time. Effective fuel reduction must strive for the "sweet spot" by removing just enough of the small surface and ladder fuels, while retaining enough of the medium and large trees to maintain canopy cover and microclimate, suppression of in-growth, hydrology, as well as current and future habitat, etc. This balance requires retention of all mature trees and many medium-sized trees.

Consider these words from Mike Dombeck, former Chief of the Forest Service:

> Some argue that more commercial timber harvest is needed to remove small-diameter trees and brush that are fueling our worst wildlands fires in the interior West. However, small-diameter trees and brush typically have little or no commercial value. To offset losses from their removal, a commercial operator would have to remove large, merchantable trees in the overstory. Overstory removal lets more light reach the forest floor, promoting vigorous forest regeneration … precisely the small diameter materials that are causing our worst fire problems. In fact, many large fires in 2000 burned in previously logged areas laced with roads. It seems unlikely that commercial timber harvest can solve our forest health problems.[108]

The Eastside Scientific Societies were also skeptical about the value of commercial logging in stands other than plantations. "Managing eastside forests within NRV [natural range of variability] dictates that the area of ponderosa pine old growth be increased from 4 to 20 times in areas where it once dominated. … To attain this goal, existing second-growth pine and isolated individuals must provide the cornerstones around which to rebuild the landscape. Any logging of remaining pine, except for thinning in overstocked stands, moves the landscape further from NRV. (Even thinning may better be left to natural processes if it threatens resident biotic components.)"[109]

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[107] BLM. 2008. Western Oregon Plan Revision FEIS, pp 810-811.

[108] Dombeck, M. 2001. How Can We Reduce the Fire Danger in the Interior West. Fire Management Today, Winter 2001. Vol 61(1). http://www.fs.fed.us/fire/fmt/fmt_pdfs/fmn61-1.pdf

[109] Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds: National forests east of the Cascade crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

Logging like this on the Fremont National Forest can sometimes just add to the fuel problems.

Logging is but one tool. Timber sales won't solve all our problems.

There is a mismatch between the restoration requirement and the agencies' preferred management tool – the timber sale. Our degraded forests and watersheds certainly need restoration, but how will it be accomplished? Two of the most important restoration activities include rescaling the road system and reducing the density of small trees, but both of these activities cost money. If we try to subsidize these activities by removing too many commercial trees, we can no longer legitimately call it restoration; it would just be commodity production, with associated adverse impacts, under a new name.

Most conservation groups are not opposed to the use of logging as a management tool in appropriate circumstances. There are instances where there may be commercial-sized trees in excess of ecological needs, and restoration logging might generate some revenue, but these circumstances are far rarer than most people recognize. If we focus our efforts on this small subset of the problem, we will be neglecting the vast majority of the restoration need.

We cannot base public policy on another false hope that restoration will be facilitated by plenty of big trees and commercial logging opportunities, especially in areas with relatively low productivity. A recent report from Oregon's Blue Mountains confirms what conservationists have known for years, that past management has taken too many of the big trees and left current managers with limited options.

> Hoping to boost their economies and also restore these forests, local leaders are interested in the economic value of timber that might be available from thinning treatments on these lands. … [W]e found that on lands where active forestry is allowable, thinning of most densely stocked stands would not be economically viable. … Commercial thinning would only be possible where the value of the timber harvested exceeds the cost of the harvesting, hauling, road maintenance, and contractual requirements (i.e., a positive net revenue exists). Because most simulated thinnings harvested low volumes of small trees, commercial removal was possible on … less than 10 percent of the densely stocked acres … [E]ven when considered under the most favorable of assumptions, most densely stocked stands would not be treatable without significant investments.[110]

Commercial logging is not a very useful tool for restoration because it can only address a small fraction of the restoration needs in degraded forests. In the past the most productive sites were disproportionately affected by clearcutting and high-grading, and now there are few large trees left. Most over-stocked stands will not support a viable timber sale that sustains the other important values in the forest such as fish & wildlife, water quality, and carbon storage.

Restoration forestry requires retention of far more legacies and recruitment trees than traditional forestry and this has a consequences in terms of timber sale viability. The abundance and distribution of snags and large dead wood is one of the key differences between harvested and unharvested stands.[111] Jerry Franklin urges us to:

> incorporate current knowledge of … the role of disturbances in creating structural legacies that become key elements of the post disturbance stands. … [P]rinciples from disturbance ecology and natural stand development [can be used] to create silvicultural approaches that are more aligned with natural processes. Such approaches provide for a greater abundance of standing dead and down wood and large old trees, perhaps reducing short term commercial productivity but ultimately enhancing wildlife habitat, biodiversity, and ecosystem function, including soil protection and nutrient retention.[112]

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[110] Rainville, Robert; White, Rachel; Barbour, Jamie, tech. eds. 2008. Assessment of timber availability from forest restoration within the Blue Mountains of Oregon. Gen. Tech. Rep. PNW-GTR-752. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr752.pdf

[111] Aber 2000.

[112] NCSSF/PNW Old Growth Workshop. Bonneville Hot Springs Resort. May 2005. http://www.fsl.orst.edu/Oldgrowthworkshop/statements/Franklin.pdf

But this is a far cry from traditional commercial forestry. "Restoration of an old-forest network carries with it long-term management costs with little commodity production."[113]

Another problem with timber sales as a restoration tool is that they require roads. Mature forests often lack road access because they have not been actively managed for a long time, if ever. When these forests are targeted for logging, construction of harmful logging roads is often required.[114] ICBEMP found that:

> From an intensive review of the literature, we conclude that increases in sedimentation are unavoidable even using the most cautious roading methods. … [T]wo analyses examining the correlation of roads to habitat and fish population status … support the general conclusion that increasing road density correlates with declining aquatic habitat conditions and aquatic integrity. … The ability of the Forest Service and Bureau of Land Management to conduct road maintenance has been sharply reduced because of declining budgets. This is resulting in progressive degradation of road drainage structures and a potential increase in erosion. …[115]

The BLM's Western Oregon Plan Revision anticipated the need to construct 1300 miles of new roads in an already heavily roaded landscape mainly to facilitate the removal of non-deferred forests 80-159 years old. Since the agencies lack the funds to maintain the existing over-built road system, it is unwise to add to the problem by building more roads.

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113 Everett, R., P. Hessburg, J. Lehmkuhl, M. Jensen, and P. Bourgeron. 1994. Old Forests in Dynamic Landscapes: Dry-Site Forests of Eastern Oregon and Washington. Journal of Forestry 92: 22-25.

114 USDA Forest Service, "Forest Roads: A Synthesis of Scientific Information," Pacific Northwest Research Station, General Technical Report PNW-GTR-509. May, 2001. Noss, Reed; The Ecological Effects of Roads. http://www.wildlandscpr.org/ecological-effects-roads. NRDC Report: "End of the Road: The Adverse Ecological Impacts of Roads and Logging: A Compilation of Independently Reviewed Research" (1999) http://www.nrdc.org/land/forests/roads/eotrinx.asp

115 Quigley, Thomas M.; Arbelbide, Sylvia J., tech. eds. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: volume 1. Gen. Tech. Rep. PNW-GTR-405. Portland, OR. http://www.fs.fed.us/pnw/publications/pnw_gtr405/pnw_gtr405_07.pdf

The need for restoration must be weighed against the adverse effects of road building on soil, water, wildlife, and weeds.

Temporary roads are a misnomer. Their use may be temporary, but adverse effects of road building are often long-lasting.

The architects of the Northwest Forest Plan found that many of the best, large, contiguous forest landscapes are mature, not old-growth, forests.

Some large forest fires burned west of the Cascades between 1840 and 1910, and many such areas were skipped over during "harvest scheduling" because there was a higher priority on converting the very old forests to tree plantations. These former fire areas, now mature forests, offer some of our best hopes of recreating large blocks of unfragmented, contiguous old-growth forest, which is an important goal of the Northwest Forest Plan, and critical to the recovery of old-growth associated wildlife.

Leaving mature forests unprotected would leave substantial areas of roadless forests subject to future conflict. Many westside roadless areas may not qualify as old growth, but still provide important values as roadless and mature forests.[116] Examples of roadless areas with significant stands of mature forest include Moose Creek, Mount Hagen, and Hardesty Mountain on the Willamette National Forest, Mt Hebo on the Siuslaw National Forest, Roaring River and Olallie Lakes on the Mt. Hood National Forest, Twin Lakes on the Umpqua National Forest, and Zane Grey on the Medford BLM. In northern California, the Kangaroo, Greider Creek, and Orleans Mt. roadless areas on the Klamath National Forest and the Salt Creek and Soldier Creek roadless areas on the Six Rivers National Forest all contain significant areas of mature forest. In Washington, examples include Dark Divide, Horseshoe, Pompey, and Wobbly roadless areas on the Gifford Pinchot National Forest.

Federal lands must carry more than their share of late-successional forest to compensate for non-federal forest practices.

Even though non-federal forests have a disproportionate share of the best tree-growing lands (Site Class 1 and 2), old forests are extremely rare on non-federal lands. The remaining mature and old-growth forest that does exist occurs predominantly on federal forests lands, so these lands represent the best place to look for timely restoration of old forests.[117] Because young forests are over-represented and unlikely to develop into old-growth on private lands, public lands should emphasize restoring some "extra" older forests to compensate.

Harvest rotation ages on non-federal forest lands are trending downward, which further simplifies the landscape and deprives wildlife of the habitat features they need to survive. Nonaka & Spies (2005) found that it will be challenging to support a functional old growth ecosystem on federal lands alone.

> Under the [current policy scenario], ownership pattern indirectly constrained development of landscape structure because of the contrasting forest management regimes used by different ownership types. … For example, young forests will

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[116] Strittholt, J. 2005˙ Oregon Legacy Wild Forests. CBI. http://www.consbio.org/what-we-do/oregons-legacy-wild-forests

[117] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf p 36.

> occur primarily on private lands, and mature and old-growth forests will occur primarily on state and federal lands. … [N]ot all landowners have the same ecological goals. Consequently, even if public lands had a goal of achieving the [historic range of variability] of landscape structure, it would not be possible to reach it using those lands alone.[118]

Until industrial forest practices are reformed, federal forests must be managed to compensate for a severe lack of old-growth, lack of large snags and down wood, and severely degraded habitat quality on non-federal lands.

If non-federal forests continue to be managed like this, then federal forests need extra protection in order to compensate.

Mature forests on Oregon BLM lands deserve extra protection.

Certain areas deserve extra protection because they have been disproportionately impacted by past clearcutting and are fragmented by ownership patterns. In other words, mature forests become even more valuable and important in areas where old growth is acutely depleted, such as BLM's holdings in western Oregon and the Oregon Coast Range. "[I]t is critical that ecosystem

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[118] Nonaka, E., Thomas A. Spies. 2005. Historical Range Of Variability In Landscape Structure: A Simulation Study In Oregon, USA. Ecological Applications, 15(5), 2005, pp. 1727–1746.

types that have received greater proportional cutting, especially the low-elevation forests on the Westside, be provided the highest level of protection and restoration."[119] This aptly describes BLM lands in western Oregon.

Unfortunately, the BLM's recently adopted Western Oregon Plan Revision would dramatically increase the rate of liquidation of mature forests, because the oldest forests are temporarily protected in "deferred timber management areas." With old growth forests still included in the timber base but temporarily off-limits, BLM can only meet it's unrealistic high timber targets by increasing the rate of mature forest clearcutting. This will just decimate the next generation of old growth in spite of the critical ecological value of BLM lands in western Oregon.

The Scientific Analysis Team found that "reduced long-term distribution of spotted owl habitat linking the Oregon Coast Range, Klamath Mountains, and Oregon Cascades West Physiographic Provinces is highly likely to reduce chances of spotted owls moving among these provinces. The distribution of [reserves in] National Forests alone will not meet the Interagency Scientific Committee's Strategy's requirements for well-distributed blocks of habitat connected by dispersal habitat."[120]

Social Reasons to Protect Mature Trees and Forests

The public strongly supports protection of mature forests.

Sixty-five percent of residents of Oregon and Washington support protection of not just old growth, but also mature forests, on National Forest and BLM lands.[121] This support spans virtually all demographics, with greater than 60% support among men and women, all age groups, all education levels, rural and urban counties, those who have lived in the Northwest for a short time or a long time, and every income bracket.

The only group that did NOT have a majority in support of mature forest protection was self-identified Republicans, with only 48% in support. However, there were still more Republicans in support of protection than opposed to protection (48% vs. 46%). Notably, 78% of Democrats support protection of mature forests, as do 69% of self-identified "independent" or "other" voters.

Logging mature forest is socially unacceptable and will remain controversial and legally entangled.

We cannot resolve the ongoing conflict over management of older forests by protecting just the old growth while leaving mature forests legally unprotected. OSU's K. Norm Johnson made a prescient observation in 1993 when he told Congress, "While option 9 may reserve the lion's share of late successional forest on federal land, it does not escape the historic dependence on

[119] NRC 2000. p 6.

[120] 1993 SAT Report. Chapter 2, p 69. citations omitted.

[121] Davis, Hibbitts & McCaig, Inc. 2002. Mature Growth Forests. February 2002.

late-successional forest and old growth as the source of harvest volume. How publicly acceptable this policy will be remains to be seen."[122] Recent history has shown that the public will not tolerate more destructive logging of mature and old-growth forests, nor will they tolerate a delay in the natural rate of recovery of old forests and their value for drinking water, carbon storage, fish and wildlife, and recreation. The public's aversion to non-restorative logging on federal forest lands has only been increased by the infamous 1995 Rescissions Act "salvage rider," the agencies' failure to faithfully implement the Aquatic Conservation Strategy and Survey and Manage programs, and the Bush Administration's assault on listed species and the NWFP.[123]

Recently reported results from the DEMO project (Demonstrating Ecosystem Management Options) show that the public acceptability of logging is more strongly influenced by the effect of logging on wildlife habitat than the impact of logging on scenic quality.[124] This highlights the importance of maintaining habitat to support viable populations of native wildlife as required by the 1982 regulations implementing the National Forest Management Act.

Adopting a partial solution by protecting just old growth and encouraging inappropriate commodity extraction from mature forests would lead to more conflict. Shifting federal forest management to a restoration paradigm gets everyone at the table working toward a common goal. Fortunately, there is emerging common ground never before seen in the northwest. In recent years, practical, non-controversial, science-based restoration efforts receive broad support among the public and the scientific community. These restoration priorities include: thinning dense young planted stands; removing small fuels from forests that suffer from fire exclusion; rescaling the road system; reintroducing fire; and, rehabilitating streams. Implementing these priority actions can improve ecosystems, create jobs, and produce a modest supply of timber.

If forest policy protects only old-growth forests and tries to encourage logging of mature forests,[125] controversy will continue and very little timber from mature forest will make it to the mill. It is unlikely that Congress will adopt radical amendments to the Endangered Species Act and other popular laws as such changes would be politically unpopular.

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[122] Johnson, K.N. 1993. Testimony concerning the Administration's forest ecosystem management plan for the Pacific Northwest: Joint hearing before the Subcommittee on Specialty Crops and Natural Resources of the Committee on Agriculture, and the Subcommittee on National Parks, Forests, and Public Lands of the Committee on Natural Resources, and the Subcommittee on Environment and Natural Resources of the Committee on Merchant Marine and Fisheries, House of Representatives, One Hundred Third Congress, First Session, August 3, 1993 http://www.archive.org/stream/administrationsf00unit/administrationsf00unit_djvu.txt

[123] Heiken, D. 2004. "The Northwest Forest Plan Ten Years Later" Outlook [newsletter]. Oregon State Bar Environment and Natural Resources Section. Summer 2004. http://dl-client.getdropbox.com/u/47741/Northwest%20Forest%20Plan%20ten%20years%20later%20%28DH%20final%29.doc

[124] Aubry, K.B., Halpern, C.B., and C.E. Peterson. 2009 *in press*. Variable-retention harvests in the Pacific Northwest: A review of short-term findings from the DEMO study. Forest Ecology and Management.

[125] In a draft legislative concept paper, Senator Ron Wyden (D-OR) proposes to define "old growth" in moist forest types as >120 years of age. Wyden, Ron. 2008. http://wyden.senate.gov/forestproposal/WydenDraftForestRestorationProposal.pdf. Wyden Draft Forest Proposal. Office of Senator Ron Wyden, United States Senate. While this political definition of "old growth" includes some mature forest, it leaves significant areas of mature forest unprotected.

The bottom line is this: If our policies protect all mature and old-growth forest, *more* timber will get to the mills than if our policies leave some mature forest theoretically available for logging. If we don't take *all* mature forests off the table, the Forest Service and BLM will continue to try to sell controversial mature forest timber sales, and the timber industry will continue to try to log it. Public and judicial controversy will continue, precluding collaboration between the conservation community, timber industry and federal forest agencies. The ideal forest policy will steer the agencies away from controversial logging of mature forests and trees and steer them instead toward science-based restoration; variable density thinning of monoculture plantations; and, removing surface and ladder fuels from fire-suppressed dry ponderosa pine and dry mixed-conifer forest types to conserve and restore old-growth conditions.

Mature forest logging on the Willamette National Forest.

Visual comparison of logged and unlogged mature forests.

Mature forests are beautiful.

Standing under the canopy of a mature forest, one gets the distinct feeling that *this beautiful place should not be destroyed by logging.* Each year that feeling gets stronger, both as the forest becomes more complex and as society evolves. The National Commission on Science for Sustainable Forestry reported that "the high social value placed on older forests in [the Pacific Northwest] grows from recognition of the recreational and aesthetic opportunities that they offer as well as their ecological importance. … Another study recommended that large, mature trees should be retained in forest thinning projects because they are an important part of scenic beauty."[126]

Practical Reasons to Protect Mature Trees and Forests

Complicated environmental analyses will be required to justify logging mature forests compared to less controversial thinning of young plantations.

Since mature forests can harbor late successional wildlife, logging will trigger expensive and time-consuming wildlife surveys. More detailed Environmental Impact Statements (EISs) will often be needed instead of relatively abbreviated Environmental Assessments (EAs). Formal instead of informal consultation under the Endangered Species Act will more often be triggered.

Clear rules work better than discretion.

History shows that when the agencies are given ambiguous rules discretion will be abused, which leads to ecological harm and fuels distrust of the agencies. When rules are clear and unambiguous, and when there are practical ways for the public to hold the agencies accountable, the agencies will avoid pitfalls and have more success. There may well be instances when stands

[126] NCSSF 2008. Beyond Old Growth Older Forests in a Changing World - A synthesis of findings from five regional workshops. National Commission on Science for Sustainable Forestry. http://ncseonline.org/00/Batch/NCSSF/BOG/OldGrowth_final%203.10.08.pdf

older than 80 years could benefit from thinning or when trees older than 120 years could be removed from dry forests, but those are exceptional circumstances that do not refute the overwhelming value of clear rules. There may be ecological sacrifices associated with those exceptional circumstances when thinning is disallowed, but those will be minor compared to the significant harm that would result from excessive discretion. In short, the large problems created by excessive discretion far exceed the small problems created by unambiguous rules. This was implicit in the 1993 report of Scientific Analysis Team discussed above under the subsection "moist forests … need time, not logging." The SAT report highlighted the risks of pushing the envelope and allowing logging in questionable cases, including that the agencies' mitigation plans are not always carried out, contracts are not fully implemented and enforced, and the agencies lack the funds and commitment to monitor and change practices that need improvement.[127]

"Predictable timber supply" is an oxymoron.

Setting policy that tries to establish and produce a predictable timber supply has failed again and again. This is especially true when, as here in the northwest, we are trying to squeeze blood out of a turnip. These forests are already suffering from decades of unsustainably high logging rates, and there are numerous listed species that need more protection, not another short-sighted push for volume.

Don't misinterpret this point. There is significant timber production from NW federal forests. Between 1995 and 2005, the Forest Service and BLM auctioned over 5.7 billion board feet of timber (representing over 1 million log truck loads) within the Northwest Forest Plan area. Parked bumper-to-bumper, one million log trucks would stretch over 10,000 miles. Timber production is occurring; it's just not as predictable as some would prefer, yet that is an unavoidable consequence of our a complex, dynamic social system trying to manage these complex, dynamic ecosystems that we are still struggling to fully understand.

Jack Ward Thomas, former Chief of the US Forest Service, wrote a piece that put the inherent uncertainty of timber targets in perspective.

> The vision that I was taught in school of the "regulated forest" and the resultant predictable outputs of commodities has turned out to have been a dream. And a dream that could only be realized in a time of seemingly boundless virgin forests. This vision held only so long as, no matter what the circumstances, there was more timber available over the next ridge. And, that timber was relatively cheap--easy to access and log--and environmental risks were either less appreciated or more palatable than at present. Further, it was assumed that good forestry was--as a matter of course--good wildlife management, good watershed and management, etc.

[127] SAT Report, pp 147-151.

By now it is becoming obvious that this dream was built on the pillars of the seemingly boundless virgin forest and an ethic of manifest destiny coupled with hubris of being able to predict the response of nature and humans. This was coupled with an inflated sense of understanding of forested ecosystems and of human control. Perhaps it is time to recognize that such stability is not attainable .

… So, stability in timber supply from the public lands is simply a myth, a dream that was never founded in reality. It is time to stop pretending.[128]

Some of these uncertainties can be managed by focusing on truly non-controversial restoration projects. Going forward, a modest supply of wood products can be provided from federal lands, but it must be a by-product of restoration. Management goals must be framed in terms of restoration accomplishments, not volume targets.

Economic Reasons to Protect Mature Trees and Forests

Avoided carbon emissions equals avoided climate mitigation costs.

It will be very expensive to address climate change once it is in full swing, so it makes economic sense to store carbon in mature forests. Economists estimate that the cost of avoiding emissions is far less than the cost of responding after the fact.[129] Several studies have shown that changing forest practices is one of the more efficient and economical ways to store carbon and reduce emissions.[130] In a review of recent research regarding the economics of forest carbon storage, the authors concluded: "it appears that carbon sequestration may play a substantial role in a global greenhouse gas emissions abatement program. In the cost range of 10 to 150 dollars per ton of carbon it may be possible to sequester 250 to 500 million tons per year in the United States, and globally upwards of 2,000 million tons per year, for several decades."[131]

Given that carbon storage is just one of many important ecological services provided by mature and old forests —adding to the already well-recognized value of clean water, biodiversity, nutrient cycling, hydrologic buffering, slope stabilization, and quality of life— every effort should be made to avoid as much warming as we can by protecting mature forests.

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128 Jack Ward Thomas, The Instability of Stability, http://web.archive.org/web/20001201174000/http://coopext.cahe.wsu.edu/~pnrec97/thomas2.htm

129 Kenneth J. Arrow, "The case for mitigating greenhouse gas emissions", real-world economics review, issue no. 45, 15 March 2008, pp. 66-67, http://www.paecon.net/PAEReview/issue45/Arrow45.pdf ("A straightforward calculation shows that mitigation is better than business as usual – that is, the present value of the benefits exceeds the present value of the costs – for any social rate of time preference less than 8.5%.")

130 McKinsey & Company. 2009. Pathway to a Low Carbon Economy - Version 2 of the Global Greenhouse Gas Abatement Cost Curve. http://globalghgcostcurve.bymckinsey.com/default.aspx

131 Kenneth R. Richards And Carrie Stokes. 2004. A Review Of Forest Carbon Sequestration Cost Studies: A Dozen Years Of Research. Climatic Change 63: 1–48, 2004. http://www.springerlink.com/content/p21n67k614178711/fulltext.pdf

The timber industry does not need to log mature forest to provide jobs.

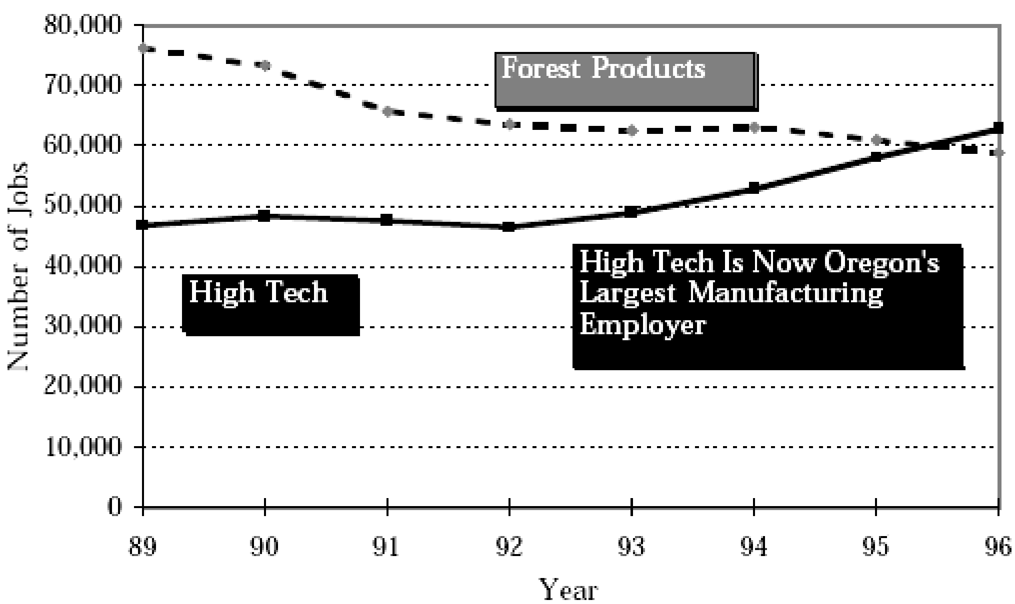
Less than 2% of the jobs in Washington and Oregon are in the lumber and wood products sectors. Only a small fraction of those jobs are on federal land, and only a small fraction of those jobs are dependent upon logging mature forests. Many more environmentally benign jobs are available in restoring roads and streams, thinning young plantations, and managing for water, fire, carbon, and recreation.

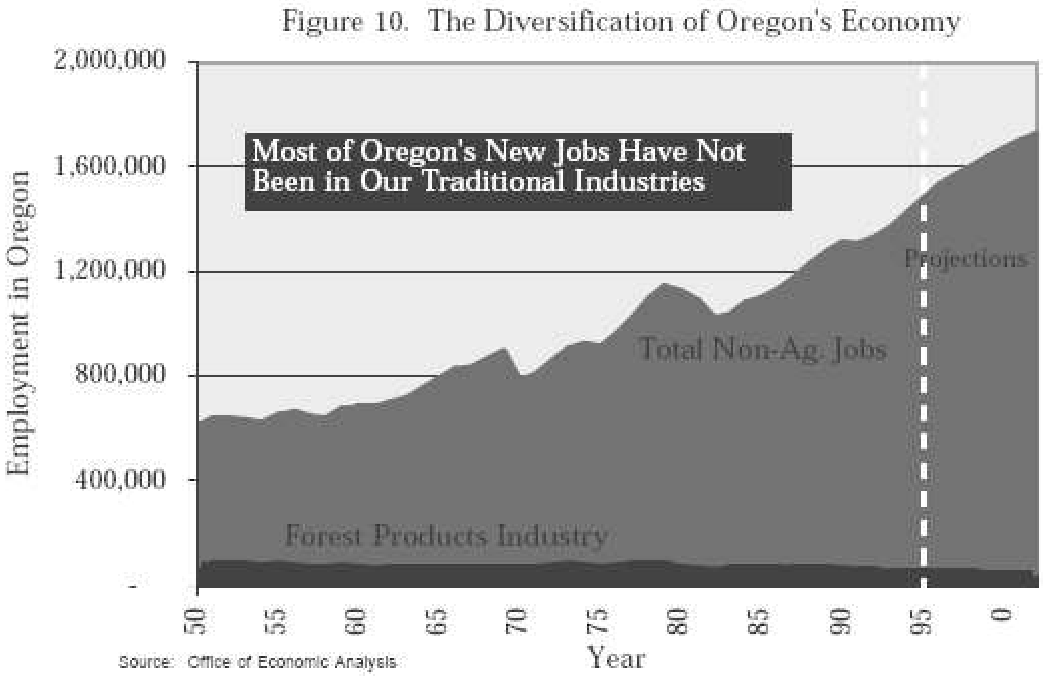
Logging mature forest is not needed to prop up the economy.

The timber industry represents a small and shrinking portion of the northwest's growing economy. The timber industry has been declining since long before the current economic downturn, while other industries have grown, and these trends are likely to continue. Economic development strategies should focus on other sectors that are poised for growth. The Pacific Northwest economy has greatly diversified in the last decade. During the 1990s the Pacific Northwest economy typically created more new jobs every year than exist in the entire lumber and wood products sectors.

Timber is a small and diminishing share of the NW economy, and on top of that, productivity increases mean that over time fewer jobs are created per volume of timber produced, so the net benefits to the economy of a given logging level continue to decline.

Figure 9. Employment Trends in the Forest Products and High Tech Industries





[Source: Oregon Shines II. http://www.oregon.gov/DAS/OPB/docs/osII.pdf]

Logging mature forest is not needed to prop up the timber industry.

Less than 10% of the logging in Oregon and Washington in recent years has been on federal forest lands. Only a fraction of that is represented by logging of mature forests. Much more environmentally benign and socially acceptable timber volume can be derived from thinning young plantations or small diameter fuel reduction where ecologically appropriate. The timber industry in the northwest is more and more reliant on logging non-federal forest lands. This is appropriate, because the timber industry controls a large and productive land base and the highest and best use of our federal forests is to provide public goods that are not well-provided on non-federal lands, such as clean water, habitat, biodiversity, carbon storage, recreation, soil conservation, flood control, nutrient cycling, etc.

What's good for the timber industry might not be good for the economy as a whole.

The timber industry tends to boom and bust, which has harmful repercussions on the rest of the economy. These cascading adverse effects are amplified or dampened depending on the timber industry's share of the overall economy. When the timber industry grows, the rest of the economy faces increased strain from the boom/bust cycle. On the other hand, policies which help the timber industry rescale to match the smaller housing and construction markets will inherently help stabilize the northwest economy.

Fierce global competition in the wood products sector also places downward pressure on wages and benefits. Technological changes in the timber industry mean that timber harvest can increase while employment and wages decrease. Real wages in sawmills decreased by 17% between 1979 and 1989. According to the Oregon Progress Board, "There is no great job 'recovery' in sight for

Oregon's primary wood products industry. Oregon Department of Forestry predicts that current low harvest levels will not increase in the future, and are likely to stabilize at near their current levels."[132] Although this report is almost ten years old, it's prediction has proven to be accurate and remains valid for the future as well.

Mature Forests Enhance Quality of Life and Help Diversify the NW Economy.

The state should be looking for economic development opportunities that focus on growth industries like technology, information, and environmentally sustainable energy, instead of focusing on extractive industries. According to the Oregon Progress Board,

> A recent report endorsed by over 60 Northwest economists noted that Oregon's economy has been remarkably healthy and vibrant over the same decade that declines in the wood products industry were pronounced. They attribute much of the region's economic growth to the ability of its natural beauty to attract new business, and they suggest policies to preserve forests and attract high technology.[133]

It would be wise to invest in forest restoration and related initiatives that yield significant returns of ecosystems services and quality of life that attracts skilled workers and the companies that hire them. The Oregon Economic Development Department has long recognized that our magnificent forests offer a significant comparative advantage for Oregon's tourist industry, and it recognizes the need for the state to help the timber industry transition from logging old growth to younger stands.[134]

Conclusion

Congress and policy-makers at all levels should recognize the myriad ecological, social, practical, and economic reasons to protect old-growth AND mature forests. There is much work to be done in our federal forests: storm-proofing and removing roads, rehabilitating streams, managing fire, maintaining and enhancing recreation facilities, as well as thinning dense young stands and removing small surface and ladder fuels from dry forest suffering from fire exclusion. If done carefully, this restoration agenda will help protect and enhance ecosystem services like clean water, carbon storage, biodiversity, nutrient cycling, hydrologic buffering, and slope stability. It will also create jobs and provide a modest amount of wood products. Let's get to work.

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[132] Oregon Progress Board. 1997. Oregon Shines II: Updating Oregon's Strategic Plan, A REPORT TO THE PEOPLE OF OREGON, January 21, 1997. http://www.oregon.gov/DAS/OPB/docs/osII.pdf

[133] Oregon Progress Board. 1997. Oregon Shines II: Updating Oregon's Strategic Plan, A REPORT TO THE PEOPLE OF OREGON, January 21, 1997. http://www.oregon.gov/DAS/OPB/docs/osII.pdf

[134] OEDD. May 1989. Oregon Shines: An Economic Strategy for the Pacific Century. http://www.oregon.gov/DAS/OPB/docs/OS_PartIISection3.pdf, page II-58

OREGON WILD

2 April 2021

TO: NOAA, NMFS
VIA: OceanResources.Climate@noaa.gov

Subject: Recommendations for More Resilient Fisheries and Protected Resources Due to Climate Change

Please accept the following comments from Oregon Wild concerning the Request for Information (RFI) for Recommendations for More Resilient Fisheries and Protected Resources Due to Climate Change, published in the Federal Register on March 3, 2021. https://www.federalregister.gov/documents/2021/03/03/2021-04137/recommendations-for-more-resilient-fisheries-and-protected-resources-due-to-climate-change. Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon's wildlands, wildlife, and water as an enduring legacy.

The RFI asks for recommendations on how to make fisheries and protected resources more resilient to climate change. Our comments are mostly focused on recommendations for enhancing the resilience of PNW watersheds that are critical to conservation and recovery of salmonid evolutionarily significant units (ESUs) that are economically important and/or threatened & endangered. Salmonids rely on cold clear water and complex aquatic habitat that is best produced from large, redundant, well-connected watersheds that are relatively intact and undeveloped, with relatively more mature & old-growth forest, wide well-protected riparian buffers that provide shade and continuous inputs of nutrients and structure, high amounts of large trees both live and dead, large patches of undeveloped/unroaded lands, low road density, and fewer road/stream crossings.

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Key Recommendations

Key recommendations for increasing climate resilience of salmonid's freshwater habitat:

- Emphasize no-regrets strategies. Focus on management strategies that have high potential conservation benefits and few adverse trade-offs;
- Enhance resilience by reducing/avoiding climate change. Therefore, reduce and avoid carbon emissions, especially emissions from logging in watersheds with protected salmonids;
- Manage for resilience through redundancy. Climate change will challenge our ability to conserve all ecologically important sites, but if there are many such sites the overall system can maintain resilience;
- Maintain and restore biodiversity in all its dimensions, including genetic diversity of salmonids so we don't diminish the library of adaptive possibilities;
- Enhance connectivity of habitat and populations so fish can move to suitable refugia when climate extremes require it. Restore fish passage that is blocked by culverts, dams, diversions, etc;
- Protect instream flows which is required to maintain suitable habitat and connectivity;
- Protect existing high quality habitat/refugia, and restore degraded habitats;
- Encourage longer rotations on non-federal land to increase wood recruitment, improve hydrologic function, reduce sedimentation, and reduce cumulative impacts;
- Reduce logging rates and conserve all mature & old-growth forests on federal land to increase wood recruitment, improve hydrologic function, reduce sedimentation, and reduce cumulative impacts;
- Encourage natural recovery after natural disturbance in order to encourage wood retention, carbon storage, and hydrologic function associated with diverse climate-adapted vegetation;
- Encourage lower road density on public and private lands;
- Encourage wider stream buffers on federal land non-federal land;
- Anticipate disturbance from climate extremes, such as wildfire and intense precipitation. Encourage larger culverts to accommodate larger storms;
- Protect and restore large undeveloped/unroaded areas;

Core Principles For Climate Adaptation

We reviewed the literature and found a number of relevant recommendations for core principles to guide managing for climate adaptation/resilience. Such as these from the National Wildlife Federation:

> Box 3.1 Key characteristics of climate-smart conservation.
>
> **Link actions to climate impacts** – Conservation strategies and actions are designed specifically to address the impact of climate change in concert with existing threats; actions are supported by an explicit scientific rationale.
>
> **Embrace forward-looking goals** – Conservation goals focus on future, rather than past, climatic and ecological conditions; strategies take a long view (decades to centuries) but account for near-term conservation challenges and needed transition strategies.
>
> **Consider broader landscape context** – On-the-ground actions are designed in the context of broader geographic scales to account for likely shifts in species distributions, to sustain ecological processes, and to promote collaboration.
>
> **Adopt strategies robust to uncertainty** – Strategies and actions ideally provide benefit across a range of possible future conditions to account for uncertainties in future climatic conditions, and in ecological and human responses to climate shifts.
>
> **Employ agile and informed management** – Conservation planning and resource management is capable of continuous learning and dynamic adjustment to accommodate uncertainty, take advantage of new knowledge, and cope with rapid shifts in climatic, ecological, and socioeconomic conditions.
>
> **Minimize carbon footprint** – Strategies and projects minimize energy use and greenhouse gas emissions, and sustain the natural ability of ecosystems to cycle, sequester, and store carbon.
>
> **Account for climate influence on project success** – Considers how foreseeable climate impacts may compromise project success; generally avoids investing in efforts likely to be undermined by climate-related changes unless part of an intentional strategy.
>
> **Safeguard people and nature** – Strategies and actions enhance the capacity of ecosystems to protect human communities from climate change impacts in ways that also sustain and benefit fish, wildlife, and plants.
>
> **Avoid maladaptation** – Actions taken to address climate change impacts on human communities or natural systems do not exacerbate other climate-related vulnerabilities or undermine conservation goals and broader ecosystem sustainability.
>
> ...
>
> Although adaptation is about addressing the impacts of rapid climate change, adaptation actions should not aggravate the underlying problem of global warming. Indeed, minimizing the carbon footprint of adaptation actions can help society avoid the "worst-case" scenarios for climate change, which would make successful adaptation in human and natural systems difficult, if not impossible, to achieve. Ideally, adaptation efforts should contribute to meeting climate mitigation goals both by minimizing or reducing the greenhouse gas emissions from project operations, including from any construction and

> ongoing maintenance, as well as by managing natural systems in ways that sustain or enhance their ability to cycle, sequester, and store carbon. Some of the most obvious synergies between adaptation and mitigation are those aimed at enhancing carbon stocks in natural forests, and carbon sequestration increasingly is becoming a major consideration in forest management. Strategies for increasing the capture and storage of forest carbon include: avoiding deforestation; afforestation (i.e., establishment of trees in areas have not been forests or where forests have not been present for some time); decreasing forest harvest; and increasing forest growth (McKinley et al. 2011).

Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. Climate-Smart Conservation: Putting Adaptation Principles into Practice. National Wildlife Federation, Washington, D.C. http://www.nwf.org/pdf/Climate-Smart-Conservation/NWF-Climate-Smart-Conservation_5-08-14.pdf

In 2010, The Nature Conservancy said:

> We have consolidated our recommendations into five approaches to climate change adaptation that should be considered during new or revised regional conservation assessments. They are:
>
> 1. Identifying climatic refugia; identifying and protecting biodiversity in those areas least likely to undergo significant climate induced changes.
> 2. Conserving the geophysical stage; geophysical diversity helps to maintain species diversity, such that conserving representative examples of geophysical settings as part of regional conservation, offers an approach to conservation that will hopefully protect regional diversity under both current and future climates.
> 3. Enhancing regional connectivity; maintaining or improving the permeability of land and water for the movement of both individuals and ecological processes (e.g., hydrological flows). Doing so, a) provides the best opportunity for the natural adaptation of species and communities whose response to a changing climate is to track optimal habitat conditions, and b) can help maintain natural patterns of connectivity with regard to hydrological flows, critical to the ecological integrity of a region.
> 4. Sustaining social-ecological systems and functions; the explicit use of conservation actions in a region to help sustain key ecosystem processes and functions that improve the capacity of both ecological and human systems to deal with the impacts of climate change.
> 5. Taking advantage of emerging opportunities; identifying and taking advantage of novel opportunities for conservation action, some of which are likely to arise directly as a result of climate change (e.g., renewable energy develops, REDD, etc.)

Game, E. T., C. Groves, M. Andersen, M. Cross, C. Enquist, Z. Ferdaña, E. Girvetz, A. Gondor, K. Hall, J. Higgins, R. Marshall, K. Popper, S. Schill, and S. L. Shafer (2010) Incorporating climate change adaptation into regional conservation assessments. The Nature Conservancy. Arlington, Virginia. http://ibcperu.org/doc/isis/12278.pdf

These climate adaptation principles are adapted from Climate Leadership Initiative, Framework for Integrative Preparation Planning:

- Reduce anthropogenic stress in anticipation of increased climate stress, which means less logging, less roads, less weeds, etc.
- In the face of uncertainty, "no regrets" decisions are preferable.
- Maintain diversity of native species, genes, and ecosystem composition and structure.
- Maintain self-organized ecosystem resilience and resistance.
- Maintain natural disturbance regimes such as recurrent wild fire and flood plain inundation.
- Maintain connectivity for wildlife interaction with food supply and migration to more suitable habitat under new climate conditions.
- Linking forest management with sustainable carbon-neutral energy planning.
- Complementarity – this concept captures the co-benefits that climate change preparation strategies will create by improving wildlife habitat, biodiversity, water quality, carbon storage, scenic values, and other "ecosystem services."
- Equity should be adhered to across generations, among human communities and between human and natural systems.
- Uncertainty requires recognition that it is sometimes necessary to act on less than complete knowledge, which is the case in making climate projections.
- Humility requires recognizing that interventions to prepare ecosystems for climate change should be informed, limited, and strategic.
- Abundance and redundancy will spread the risks of habitat loss due to climate change spatially across landscapes.

The latter 10 principles are taken from: Climate Leadership Initiative. 2008. Preparing the Pacific Northwest for Climate Change — A Framework for Integrative Preparation Planning for Natural, Human, Built and Economic Systems. Institute for a Sustainable Environment. University of Oregon. February 4, 2008. http://climlead.uoregon.edu/publicationspress/Preparing_PacNW_for_ClimateChange_4-2-08.pdf https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/6989/Preparing_PacNW_for_ClimateChange_4-2-08.pdf?sequence=1. These principles are expanded upon in the context of marine and aquatic systems:

1.6 Aquatic and Marine Ecosystem Principles, Strategies, Polices, and Data Gaps

Four principles stand out for preparing aquatic and marine ecosystems for climate change. Although these principles share common elements with those identified by terrestrial scientists, they differ in methods and strategies for implementation.

1.6.1 ***Principle Number One:*** *As with terrestrial systems, the over-arching principle is maintaining* ***ecosystem function, composition, and structure***,. Adhering to this principle maintains the species diversity and integrity necessary for aquatic and marine ecosystems to withstand climate change impacts such as more intense storm events, higher water temperatures, and sea level rise and higher salt concentrations for marine systems and estuaries.

1.6.1.1 *Strategies.* Strategies consistent with ecosystem function and composition include maintaining refugia and protected areas, avoiding stream channelizing and fixing past mistakes, and linking rivers and flood plain restoration to bordering wetlands. These actions will also provide increased water storage during anticipated periods of drought. Marine reserves should be designed to provide cold spots, maximize topographical relief, and provide for pole ward movement with migration corridors between reserves. Marine reserves should be managed adaptively to account for uncertainty around climate impacts on the marine environment. By maintaining breeding stocks, marine reserves also contribute to food security.

1.6.1.2 *Policies.* Policies consistent with the ecosystem structure and function principle include reducing or eliminating invasive species expected to flourish with higher CO2 concentrations. Transportation development mitigation policies should provide for better replacement of disturbed function with a similar function; wetlands that provide habitat for the particular species affected by the road development as an example. Policies should make explicit the need to consider carbon storage in preparation measures, such as those that retain vegetative cover.

1.6.1.3 *Information Needs:* How can wetlands and floodplains serve ecosystem needs and accommodate human development at the same time? How do elevated CO2 concentrations affect water use efficiency of different species? How does climate change induced wild fire impact ecosystem structure and function?

1.6.2 ***Principle Number Two:*** *Maintaining* ***natural flow regimes*** *to provide sufficient water quantity, water quality and cooler temperatures for aquatic species.* This principle is increasingly important given the higher temperatures and periods lower summer flows and drought projected for the future. A strategy consistent with this principle is to use the natural floodplain for water storage, and retain upland wetlands for the same purpose. There is a need for better enforcement of existing wetlands law, and accounting for both surface and groundwater in water permitting. Vegetation and hydrological modeling will be needed to predict changes in terrestrial vegetation and river discharge.

1.6.3 ***Principle Number Three: Connectivity between refugia****, and between refuges and habitat.* This may require policies that amend land-use codes and require further limitations on development. More research may be needed on the consequences of all land-use policies and decisions in the context of climate change.

1.6.4 ***Principle Number Four:*** *Maintaining* **disturbance regimes** *such as frequent flood plain inundation.* This will ensure the dynamic river and streamside interaction necessary for nutrient and sediment interception. It will also contribute to the maintenance of a diverse and vital riparian area.

1.6.5 ***Principle Number Five: Chemical health and integrity*** *of freshwater, marine and estuarine regimes.* This is needed to eliminate endocrine disrupters that are damaging to both vertebrates, shell fish, and crustaceans. Marine coastal ecosystems are already subject to stresses from non-climate impacts from commercial fisheries, aquaculture, development, tourism, noise and light pollution, oil spills, industrial and shipping dumping, pesticides, and fertilizers. One strategy is to reduce nutrient laden runoff into estuaries (for example, limiting dairy farm runoff into Tillamook Bay). Agency policies that maximize use of natural coastal geomorphology rather than artificially constructed jetties should be adopted to better protect shorelines against sea level rise and storm surges. Research will be needed on viable approaches to coastal armoring.

1.6.6 ***Principle Number Six:*** *The principle of* **complementarity** *should be followed to ensure that efforts to prepare aquatic and marine systems for climate change do not undermine or have unintended consequences for other aspects of natural systems as well as built, human and economic systems.*

The Mt Hood National Forest developed some ideas about climate resilience in aquatic systems:

From a habitat resilience standpoint, maintaining as much water as possible in streams and lakes during periods of low flow will likely be the most effective way to combat the harmful effects of climate change, but other management actions could also produce long-term benefits. Maintaining key flood-plain connections will also act as a hydrologic safety valve that helps reduce the scouring effect of high flows on redds (Bisson 2008).

Another management response to climate change involves restoring longitudinal connections throughout a drainage network, i.e., removing anthropogenic blockages to fish migrations up and down the watershed. With a constricted system of perennial stream channels in summer it will be important for all potentially usable habitats to be available (Bisson 2008).

Another management safeguard involves protecting and restoring riparian forests on valley floors and on alluvial terraces adjacent to stream channels. Riparian forests play an important role in the dynamics of the water table beneath and adjacent to streams, in moderating discharge during flow extremes, in controlling the concentration of soluble nutrients, in mediating the seasonal input of organic matter and terrestrial food items to aquatic ecosystems, and in regulating microclimate (Bisson 2008).

Policies that explicitly maintain instream flows by limiting water withdrawals, enhancing flood-plain connectivity by opening historically flooded areas where possible, removing anthropogenic barriers to fish movement, and protecting riparian forests will be needed to conserve habitat resilience in the face of climate change. Without such policies in place, aquatic habitats are likely to become increasingly isolated, simplified, and less likely to recover after significant disturbance events (Bisson 2008).

Although options for forest managers to minimize the harm to aquatic resources from climate change are limited, there are several management actions that can help protect salmon and trout (Bisson 2008):

1. Minimize anthropogenic increases in water temperature by maintaining well-shaded riparian areas.
2. Maintain a forest stand structure that retains snow, reduces the "rain on snow" effect associated with forest openings, and promotes fog drip.
3. Disconnect road drainage from the stream network to soften discharge peaks during heavy rainstorms.
4. Ensure that fish have access to seasonal habitats, e.g., off-channel wintering areas or summer thermal refugia.
5. Protect springs and large groundwater seeps from development and water removal, as these subterranean water sources will become increasingly important when surface flows are altered by climate change.

Mt Hood NF 2011. Road Decommissioning For Habitat Restoration Project, Increment 2 EA (Collawash).
http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/60337_FSPLT2_034976.pdf

See also, USFWS, NOAA 2012. Public Review Draft of the National Fish, Wildlife and Plants Climate Adaptation Strategy. http://www.wildlifeadaptationstrategy.gov/public-review-draft.php
http://www.wildlifeadaptationstrategy.gov/pdf/public_review_draft.pdf
Forest Ecosystems - Background Paper:
http://www.wildlifeadaptationstrategy.gov/pdf/Forest_Ecosystems_Paper.pdf

Connectivity

Climate change is expected to render some existing habitats unsuitably warm, dry, disturbed, etc. so wildlife will need to move to other areas that remain suitable or perish. Therefore, ecosystem connectivity is a core element of climate resilience. As explained by the Wildlife Conservation Society:

Connectivity refers to the ease with which organisms move between particular landscape elements; the number of connections between patches, relative to the maximum number of potential connections (Lindenmayer and Burgman 2005). Determining what is meant by connectivity for a species or landscape is a critical initial step in developing any conservation assessment for connectivity. Worboys (2010) further refines the concept of connectivity very well and defines four major types of connectivity commonly expressed in conservation science. These include:

1. **Habitat Connectivity** which is defined as connecting patches of suitable habitat for a particular species or species group (Lindenmeyer and Fischer 2006).
2. **Landscape Connectivity** which is defined as the connectedness of patterns of vegetation cover in a landscape (Lindenmeyer and Fischer 2006).
3. **Ecological Connectivity** is the connectedness of ecological processes across landscapes at varying scales. Ecological processes include trophic relationships, disturbance processes, nutrient flows and hydro-ecological flows (Soule et al. 2006).
4. **Evolutionary Process Connectivity** maintains the natural evolutionary processes including evolutionary diversification, natural selection and genetic differentiation operating at large scales. Typically evolutionary processes require movement of species over long distances, long time-frames and management of unnatural selection forces (Soule 2006).

…

- A large scale interconnected landscape of natural lands with embedded protected areas can provide opportunities for many species to respond to climate change and increasing human pressures (Heller and Zavaletta 2009, Carroll et al. 2009, Spring et al. 2010,Worboys et al. 2010). However, conserving connectivity conservation areas is not a substitute for continued establishment of reserves or protected areas around the world (Worboys et al. 2010).

…

- Conserving connectivity is likely to be most difficult in working landscapes (e.g. agricultural, forestry, extractive industry) because of human domination of these landscapes. …

…

- The nature context-what nature needs-should be the principle driver for initiating and maintaining connectivity conservation (Worboys et al. 2010). Although it remains uncertain how much connectivity is enough we contend that nature needs extensive connectivity. There is little conservation risk in providing extensive connectivity while there is great risk for providing too little. We must strive to escape the minimalist trap in conserving connectivity (Sanderson et al. 2006).
- If adverse effects of climate change are to be minimized connectivity assessment should establish priorities for preserving connecting landscapes and reserve protection. High priority should be given to conserving connecting habitats that are irreplaceable and highly threatened (Noss et al. 2002, Spring et al. 2010). Spring et al. (2010) indicates that corridors where delay cost is highest should be an immediate

priority. Such corridors make relatively large contributions to regional connectivity and are more easily fractured.

…

It's important to acknowledge that there is substantial uncertainty regarding where or how species and communities will adapt to a changing climate, but providing a well connected, robust landscape will be important for maintaining opportunities for species to shift, even if we don't know how it's all going to play out (Heller and Zavaleta 2009, Krosby et al. 2010, Hansen and Hoffman 2010).

…

There is an urgent need to merge past, current and future data sources with new technologies to meet the challenge of modeling wildlife habitat and connectivity needs in the face of impending climate change.

Keith Aune, Paul Beier, Jodi Hilty & Fraser Shilling. 2011. Assessment and Planning for Ecological Connectivity: A Practical Guide. Wildlife Conservation Society. Bozeman, MT. 2011.
http://www.wcsnorthamerica.com/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=7292&PortalId=37

Biodiversity

Biodiversity manifests at many scales - regions, landscapes, watersheds, patches, structures, functions, species, genes, etc. The process of evolution and adaptation depend on the existence and persistence of these differences so maintaining diversity is key to climate adaptation and resilience.

Dominick DelaSalla offers -

Ten Reasons that Biodiversity Helps Address Climate Problems

1. Areas of high ecological integrity (generally intact systems) with full complement of species and processes (biodiverse) are more resilient (capable of rebounding from disturbance) and resistant (capable of withstanding disturbance) to climate change and human disturbances.
2. High levels of biodiversity are associated with productive ecosystem services, including pollination (in major decline in agriculturally simplified systems), carbon sequestration and long-term storage (highest in old-growth biodiverse forests), nutrient cycling, soil formation, predator-prey dynamics (complex food webs), and provisioning services such as clean air and water, food, timber, and fiber. All of these services are at risk in a changing climate and from their exploitation.
3. High levels of biodiversity tend to be associated with human-well being (quality of life) and human health, which are at risk from increased air pollution, reduced quality and quantity of clean water, respiratory ailments, and natural disasters exacerbated by climate change. Natural systems and their inherent biodiversity can ameliorate at least some of these ailments as nearly 1 of every 4 medicines was originally synthesized from the world's tropical rainforests that we also desperately need for a stable climate.
4. A diverse coastal environment with intact and functional wetlands is best at absorbing increasing storm surges and sea-level rise caused by global warming.

5. A diverse streamside channel with fully functional and intact riparian areas and wetlands are more capable of ameliorating flood damages and storing water especially if keystone species such as beaver are present.
6. Biodiversity is a kind of climate change insurance – we humans know very little about how natural systems work and how tipping points can trigger cascading ecological effects. Examples from marine fisheries abound where entire systems have collapsed due to over-fishing of a few commercially valuable fish that limit options for climate change adaptation.
7. There is magic in wild places; climate change removes that magic as a product of an ever-increasing human footprint – a dangerous feedback loop is being set up where biodiversity is hammered, resulting in diminished ecosystem services, concomitant impacts to humans that then put more pressure on those systems until they are extinguished. Numerous studies have linked poverty to decline in natural capital and this will only worsen as the poor feel climate impacts disproportionately.
8. Diversity in nature allows for more adaptation options in the future –biodiverse prairies with their full complement of wildflowers, for instance, are more capable of rebounding after disturbance than mega-farms.
9. Intact and connected landscapes are better able to provide refugia for climate-forced wildlife migrations than fragmented areas with low levels of diversity and artificial barriers to migration.
10. High levels of genetic diversity allow for greater phenotypic plasticity (i.e., more adaptive responses) than low levels of genetic diversity. Similarly, genetically modified organisms may be maladaptive in a changing climate due to their simplified genetic structure.

DelaSalla, Dominick 2013. Why Biodiversity is Important to Solving Climate Chaos: Top 10 Reasons. Island Press Field Notes Blog. Sept 13, 2013. http://ipfieldnotes.org/why-biodiversity-is-important-to-solving-climate-chaos-top-10-reasons/

Climate Mitigation is Climate Adaptation

One of the most effective ways to address climate change is to avoid climate warming and ocean acidification in the first place by reducing and avoiding GHG emissions. Luckily there is harmony between the need to reduce GHG emissions and the need to conserve habitat of protected species. In particular, watersheds where protected salmonids live typically store vast amounts of carbon, and salmonids do better in watersheds with lots of carbon-rich mature & old-growth forests and less logging and roads. Salmonids tend to fare poorly in carbon-depleted watersheds with lots of logging and high road density. NMFS can help harmonize multiple goals by advocating for widespread forest conservation to meet salmonid conservation goals and climate mitigation and adaptation goals.

It is important to recognize that all efforts to reduce GHG emissions benefit protected species and resources by reducing warming (and associated stress and disturbance) with an additional benefit to marine ecosystems of reducing ocean acidification.

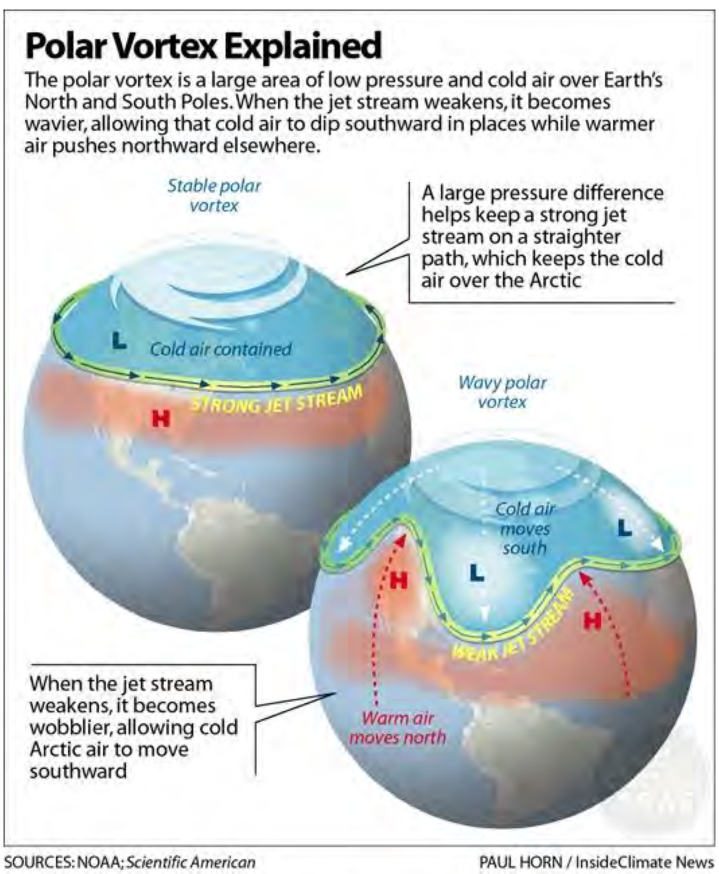
Climate Change Expected to Intensify the Hydrological Cycle.

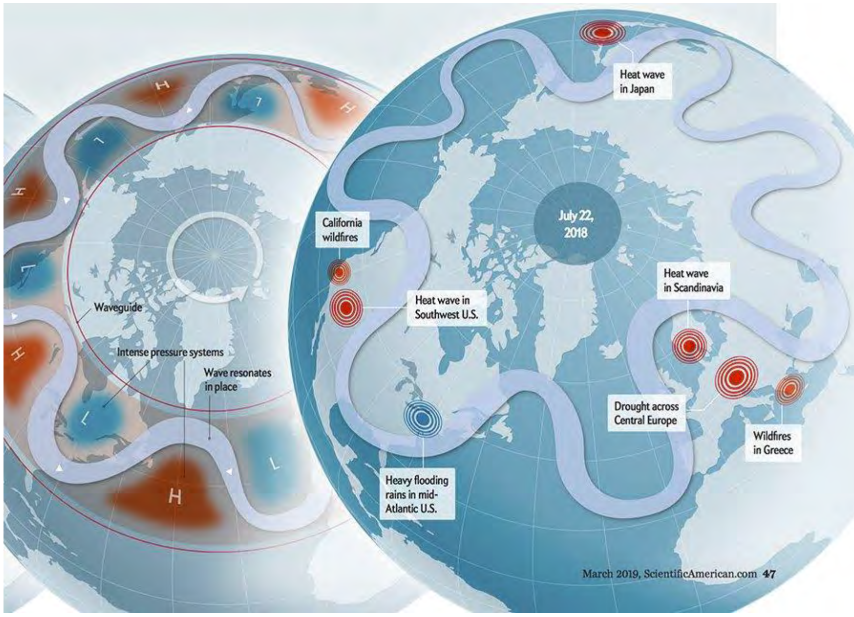
The 2014 National Climate Assessment concludes that global climate change is expected to intensify the hydrologic cycle and reduce the ability of watersheds and ecosystems to regulate water quality and water flow and buffer extreme events. http://nca2014.globalchange.gov/ Efforts toward watershed and riparian conservation should therefore be increased.

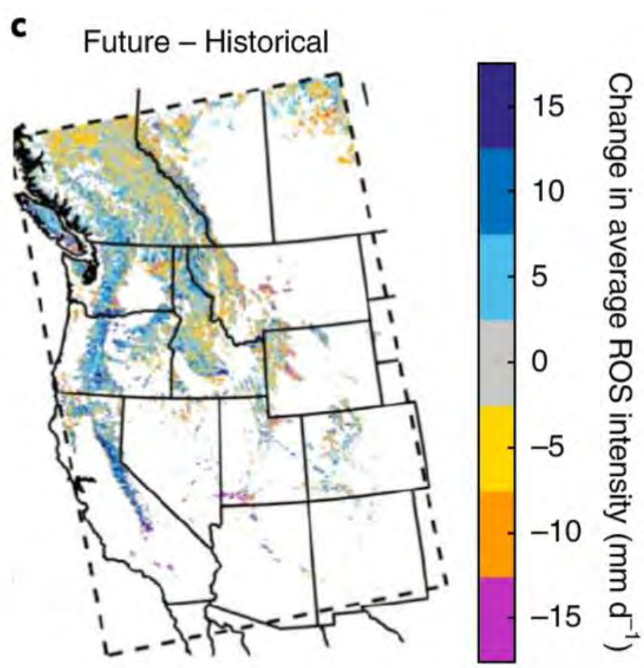
Climate change is expected to warm the poles relatively more than it warms the equator … which reduces the temperature difference between the poles and equator … which slows the jet stream ... which makes the jet stream more sinuous ...

> "Since the jet acts as the boundary between cool, Canadian air to the north and warm, subtropical air to the south, this means that hot extremes are penetrating unusually far to the north under the ridges of high pressure, and cold extremes are extending unusually far to the south under the trough of low pressure" Dr. Jeff Masters, July 3, 2013.

These oscillations between cold and warm can be expected to increase rain-on-snow events at mid-latitudes. Keith N. Musselman, Flavio Lehner, Kyoko Ikeda, Martyn P. Clark, Andreas F. Prein, Changhai Liu, Mike Barlage & Roy Rasmussen. 2018. Projected increases and shifts in rain-on-snow flood risk over western North America. Nature Climate Change (2018). Published: 06 August 2018. https://www.nature.com/articles/s41558-018-0236-4; https://rdcu.be/36Cq This study shows that in a warmer climate, rain-on-snow events may be less frequent, but more intense in the Cascades.







In addition ... the slower jet stream means that storms move more slowly ... and the warmer atmosphere holds more water ... which means storms can release more water ... Therefore, Global warming means we should expect more slow moving storms with more precipitation. All of which explains why increased flooding is a likely result of global warming. These risks require changes to management of forests and road systems to protect aquatic systems. Riparian buffers should be wider, road density should be reduced, culverts enlarged, cumulative rates of clearcutting and disturbance should be reduced, etc. Fish need access to refugia during storms, so improving fish passage needs to be emphasized.

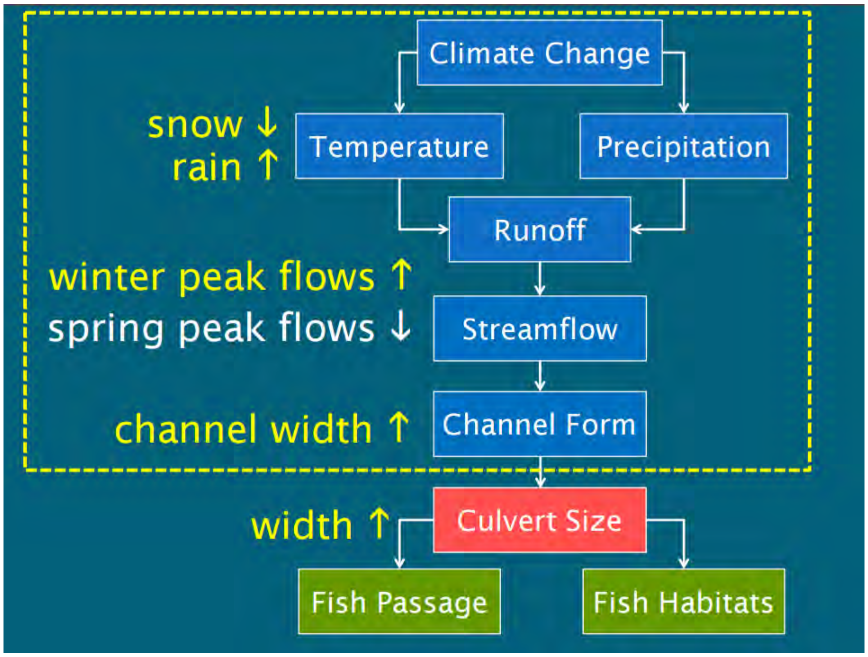
> According to a newly-published NOAA-led study in Geophysical Research Letters, as the globe warms from rising atmospheric concentrations of greenhouse gases, more moisture in a warmer atmosphere will make the most extreme precipitation events more intense.
> …
> "We have high confidence that the most extreme rainfalls will become even more intense, as it is virtually certain that the atmosphere will provide more water to fuel these events," said Kenneth Kunkel, Ph.D., senior research professor at CICS-NC…
> …
> The findings of this report could inform "design values," or precipitation amounts, used by water resource managers, insurance and building sectors in modeling the risk due to catastrophic precipitation amounts. Engineers use design values to determine the design of water impoundments and runoff control structures, such as dams, culverts, and detention ponds.

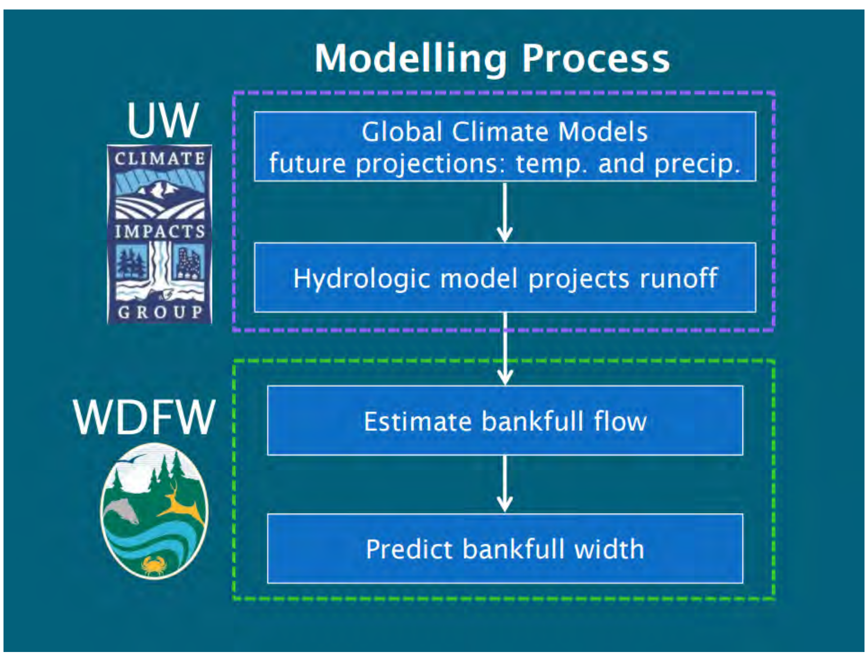
National Oceanic and Atmospheric Administration. A warming world will further intensify extreme precipitation events, research shows. ScienceDaily. April 8, 2013. http://www.sciencedaily.com/releases/2013/04/130408190938.htm *citing* Kenneth E. Kunkel, Thomas R. Karl, David R. Easterling, Kelly Redmond, John Young, Xungang Yin, Paula Hennon. Probable maximum precipitation (PMP) and climate change. Geophysical Research Letters, 2013; DOI: 10.1002/grl.50334

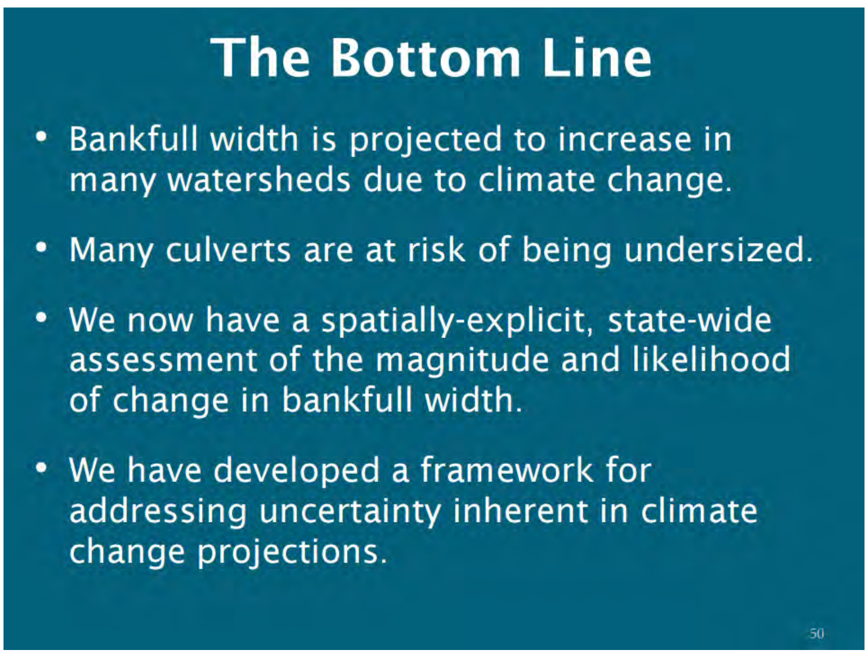
Note: The finding of a wavier jet stream related to artic warming is disputed. A wavier jet stream may be a real effect with a different cause or may be related to natural variability. Russell Blackport & James Screen 2019. A51A-06 - Insignificant effect of Arctic amplification on the amplitude of mid-latitude atmospheric waves. AGU 12-13-2019. https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/544010 ("Abstract: ... waviness remains largely unchanged in model simulations featuring strong Arctic amplification. Here we show that the previously reported trend toward a wavier circulation during autumn and winter has reversed in recent years, despite continued Arctic amplification, resulting in negligible multi-decadal trends. Models capture the observed correspondence between a reduced temperature gradient and increased waviness on interannual to decadal timescales. However, model experiments in which a reduced temperature gradient is imposed do not feature increased wave amplitude. Our results strongly suggest that the observed and simulated covariability between waviness and temperature gradients on interannual to decadal timescales do not represent a forced response to Arctic amplification.").

Climate change is upon us and the agencies must account for the impacts such as increasing significant precipitation events, and an elevationally broader transient snow zone. The agencies should respond to this new information by maintaining greater vegetation cover, soil cover, avoid road construction, reduce road density, and increase efforts to resize culverts for larger storm events.

The following slides are from the Washington Dept of Fish & Wildlife:







Washington Dept of Fish & Wildlife. 2016. Incorporating Climate Change Projections Into Culvert Design, A project funded by the North Pacific Landscape Conservation Cooperative, 18 May 2016.
https://nplcc.blob.core.windows.net/media/Default/2014_Documents/water_crossing_structures/NPLCC_WDFW_18May2016.pdf

New information on snowmelt physics reveals that it is not so much rain but warm wind that causes big run-off events. Warm wind can have strong influence at elevations above the typical winter rain zone. This raises serious concerns with regen harvest and thinning that opens up the canopy and exposes the snow-pack to warm winds. Canopy reduction should be carefully evaluated and restricted at all elevations not just the mid-elevations thought to be associated with transient snow.

II. Snowmelt Physics

After a long period of cold weather, a snowpack can absorb large amounts of heat before thaw occurs. Once the temperature of the snowpack reaches zero degrees Celsius throughout, liquid water starts forming within the snowpack. When the liquid water exceeds a threshold (about 15 percent of total snowpack water equivalent), snowmelt begins.

Solar radiation is the dominant energy transfer for snowmelt during clear sky periods. Usually snowmelt occurs on south facing slopes and hilltops before snowmelt occurs on north facing slopes and other parts of the basin. In winter and early spring, sun angles are low and days are short; thus snowmelt from solar radiation alone during this period is usually gradual and intermittent.

The significance of latent heat for snowmelt has been described by Dunne and Leopold (1978):

> "If water from moist air condenses on a snowpack, 590 calories of heat are released by each gram of condensate. This is enough energy to melt approximately 7.5 gm of ice, which when added to the condensate yields a total of 8.5 gm of potential runoff".

Latent and sensible heat transfers can result in high snowmelt rates, as warm moist air moves into a region. Latent and sensible heat transfers can cause rapid snowmelt from all parts of a basin simultaneously, day and night, even during winter. Warm temperatures, high humidity, and strong winds have large effects on the rate of snowmelt. In comparison, heat supplied by rainfall is usually minor, unless a warm rainfall of long duration occurs. A more detailed description of equations for snowmelt are given by Price and Dunne (1976).

Dunne and Leopold (1978) show that "highest melt rates were associated with the warm sector of a large weather disturbance" (Quebec, May of 1973). For the last three days of an eight day melt of the snowpack in May of 1973 (Quebec), melt due to latent heat was shown to be nearly equal to melt from net radiation, and melt from latent heat during the last three days was shown to be around 50 percent of the melt due to sensible heat transfer from atmospheric convection (mixing).

From the theoretical and physical descriptions given above, it is clear that the rate of snowmelt increases as humidity increases, due to latent heat released as water vapor condenses when air temperatures are above freezing.

http://www.mnforsustain.org/climate_snowmelt_dewpoints_minnesota_neuman.htm.

Extreme winter precipitation events are projected to increase significantly in western United States. Dominguez *et al.* (2012)

> **Abstract:** "We find a consistent and statistically significant increase in the intensity of future extreme winter precipitation events over the western United States, as simulated by an ensemble of regional climate models (RCMs) driven by IPCC AR4 global climate models (GCMs). All eight simulations analyzed in this work consistently show an increase in the intensity of extreme winter precipitation with the multi-model mean projecting an area-averaged 12.6% increase in 20-year return period and 14.4% increase in 50-year return period daily precipitation. In contrast with extreme precipitation, the multi-model ensemble shows a decrease in mean winter precipitation of approximately 7.5% in the southwestern US, while the interior west shows less statistically robust increases."

Citation: Dominguez, F., E. R. Rivera, D. P. Lettenmaier, and C. L. Castro (2012), Changes in winter precipitation extremes for the Western United States under a warmer climate as simulated by regional climate models, Geophys. Res. Lett., doi:10.1029/2011GL050762, in press. http://www.agu.org/pubs/crossref/pip/2011GL050762.shtml.

Amplifying the hydrologic cycle will have diverse adverse consequences, including impairing forests ability to process and absorb nitrogen pollution.

> When water enters a forest, either through rain or runoff, the soil, leaves and trees absorb things and make the water cleaner than when it came in. But 21 years of data from more than 100 streams across 20 states ... showed an increasing amount of severe storms and floods created times when the water moved too fast and hampered forests' ability to filter nitrate, according to Stephen Sebestyen, a research hydrologist with the Forest Service. "There were some, in particular, short-term duration events, rainfall or snowmelt events, when some of that atmospheric nitrate rapidly reached the streams," Sebestyen said. "And those amounts were rather large."

Jonathan Ahl 2019. Climate Change Is Hurting Forests' Ability To Filter Agricultural Nitrate Pollution. Harvest Public Media. Nebraska Public Radio. May 13, 2019. http://netnebraska.org/article/news/1174616/climate-change-hurting-forests-ability-filter-agricultural-nitrate-pollution *citing* Sebestyen, Stephen D., et al. 2019. Unprocessed Atmospheric Nitrate in Waters of the Northern Forest Region in the U.S. and Canada. Environmental Science & Technology. 53(7): 3620-3633. https://doi.org/10.1021/acs.est.9b01276, https://www.fs.fed.us/nrs/pubs/jrnl/2019/nrs_2019_sebestyen_001.pdf.

Climate change will also likely increase the risk of landslides, with serious implications for public safety, water quality, and fish habitat impacts. The interaction of logging and climate change will cause unacceptable cumulative effects, which can be mitigated by not logging, or focusing on thinning dense stands of small trees.

> In a study modelled on clear-cut lands on the Olympic Peninsula, they anticipate the climate of 2045 and conclude that there will be a 7-11 percent increase in the land that is highly vulnerable to landslides. The researchers say their findings are applicable to the Cascade Mountain Range area as well. … Clear-cutting reduces the rainfall that can be intercepted by leaves and reduces the ability of roots to reinforce soil that is more likely to be saturated under the Northwest's changing climate. Wet soil is not cohesive, so it becomes very unstable," said Adam. "If you don't have a lot of vegetation and deep roots

holding that soil in place, then it becomes susceptible to landslides. … "The combination of warming, precipitation and less snow means more liquid precipitation, which will then sit in the soil and keep it wet and unstable," said Adam.

Phys.org 2017. Changing climate to bring more landslides on logged land, researchers say. November 9, 2017. https://phys.org/news/2017-11-climate-landslides.html *citing* M.G. Barik et al, Improved landslide susceptibility prediction for sustainable forest management in an altered climate, Engineering Geology (2017). https://doi.org/10.1016/j.enggeo.2017.09.026 ("Two factors that are known to reduce soil strength and increase landslide susceptibility are clear cutting (due to reduced root contributions to soil strength) and degree of soil saturation.")

Climate driven landslides are also a source of accelerated greenhouse gas emissions, because landslides severely disturb the top meter of soil where most of the carbon is stored, and landslides kill trees and other vegetation initiating decomposition. Gianvito Scaringi 2017. Climate Change-Driven Landslides Can Enhance Carbon Dioxide Emissions. Science Trends. November 6, 2017. https://sciencetrends.com/climate-change-driven-landslides-can-enhance-carbon-dioxide-emissions/ ("[R]ainfall-induced landslides and soil erosion have the potential to release large amounts of CO2 in the atmosphere, which, in turn, can boost the climate change. … And the effects, unfortunately, persist for long time, even if the slopes are artificially revegetated. Dr. Les Basher and colleagues from the Landcare Research institute in Nelson, New Zealand, showed that the revegetation of landslide sites is unable to restore the soil carbon stock completely, even decades after a landslide, resulting in a long-term net loss of carbon from the top soil layer, …")

Federal forest management must address climate change and its impacts on cold water fish such as salmon. Primary recommendations include improving fish passage and maintaining cool clean water. Jim Martin & Patty Glick. A great wave rising - Solutions for Columbia and Snake River Salmon in the Age of Global Warming. http://www.nwf.org/~/media/PDFs/Global-Warming/Reports/AGreatWaveRising.ashx.

Efforts to make aquatic systems more resilient to climate change must address the cumulative effects of land use and climate change on aquatic systems. Mathias Kuemmerlen, Britta Schmalz, Qinghua Cai, Peter Haase, Nicola Fohrer, Sonja C. Jähnig. An attack on two fronts: predicting how changes in land use and climate affect the distribution of stream macroinvertebrates. Freshwater Biology, 2015; DOI: 10.1111/fwb.12580 http://www.sciencedaily.com/releases/2015/05/150518102027.htm

The amplified hydrologic cycle also includes periods of drought. Scientists have suggested that large trees should be conserved so that they can mitigate climate change by harvesting water from fog. This is especially important in coastal and mountainous areas. Gordie Reeves 2017. Climate Modeling Results. Elk River Watershed Restoration Planning Project Public Presentation Notes. Port Orford, February 02, 2017. http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/105036_FSPLT3_3949335.pdf ("Opportunities for mitigation based on model predictions include: 1. Capturing fog with large trees … Trees capture and condense tremendous amounts of water. a. Relies on very large trees”).

Managing for Large Wood Helps Buffer Climate Extremes.

If watersheds are managed to produce large amounts of large wood it will do a lot to enhance resilience to climate stress. Managing for large dead wood, means that green trees are allowed to grow for a long time and allowed to die *in situ,* and allowed to remain in place instead of being removed to the mill. This means there is less need for logging and less need for roads. Managing for large wood means there is more wood available on hillslopes to capture, store, and release water, sediment, and nutrients. Managing for large wood means there is more large trees to provide shade to streams, Managing for large wood means there is more wood available for recruitment instreams which provides many functions such as energy dissipation, habitat partitioning, bank stability, etc. (described in more detail below).

> Large wood in streams—preferably whole trees with root wads and all—provides the randomness and dynamic environment that fish absolutely need to survive in the ever-changing waters they occupy. Wood breaks up the current and spreads water sideways across its natural floodplain, creating wonderful, dynamic and necessary diversity while also absorbing energy that could cause serious damage downstream otherwise, such as flooding or unnatural erosion. It sorts gravels during high flows, creating those beautiful spawning gravel beds laid out like blankets among bigger rock. It makes those current breaks downstream of log jams. It provides cooling shade and cover, and slow pools and edge habitat that baby fish need after emerging from those gorgeous gravels to ride out high flows, find food and hide from prying eyes. Decomposing wood and the nutrients it produces jumpstarts that the natural processes critical to insect, animal, amphibian and plant life.

Alan Moore, Why Fish Love ‘Large Woody Debris.’ Trout Unlimited. 2-4-2013. http://troutunlimitedblog.com/large-woody-debris-makes-for-fishy-rivers/ Joshua J. Roering, professor of geological sciences at the University of Oregon studies the processes that create fish habitat and concluded: “[Coho salmon] seem to respond to the heterogeneity that is so inherent in most real landscapes. Nature is messy, and the fish have adapted to that." University of Oregon (2013, February 11). Large, ancient landslides delivered preferred upstream habitats for coho salmon. ScienceDaily. Retrieved from http://www.sciencedaily.com/releases/2013/02/130211135045.htm

> The presence of LWM within a stream channel is critical to maintaining the integrity of the system, in fact, there cannot be an overabundance of LWM. … Riparian Reserves provide important wildlife habitat, which justifies the heavy loading of LWM in the creeks and the floodplains. … In the Riparian Reserves … it is desirable to maintain healthy forest stands over the long-term while maintaining high snag densities and green tree replacements. … It is recognized that Riparian Reserves constitute an area where higher risks are taken (including reduced fire suppression efforts) in order to allow natural processes to occur and continue without human intervention.

Deschutes NF 1999. Crescent-Odell Watershed Analysis, pages 164-165.

> In an undisturbed forest ecosystem, wood is naturally "recruited" to streams in various ways. Riparian trees growing along the channel fall into the channel when they are undercut by the stream, toppled by beavers, burned by fire or blown down during storms. Upslope trees can be transported into the channel by events such as avalanches or landslides . Flooding can wash trees into the channel and during highwater they may be pushed downstream.
>
> In-stream woody debris has been drastically reduced in some streams by historical forest management practices. Logging near rivers and streams limited the number of trees that could fall into streams. Road building that channeled streams through culverts prevented downstream wood recruitment. "Stream cleaning" was sometimes conducted to remove fallen trees from streams, for beautification, to prevent damage to infrastructure downstream, or in a misguided attempt to assist fish migration.
>
> Scientists have now come to understand that in-stream LWM [large woody material] is ecologically important for a number of reasons:
>
> 1. LWM can help spawning gravels accumulate , by stopping the gravel from moving downstream;
> 2. Pools can form behind LWM, which provide important juvenile rearing habitat, as well as habitat for all fish during periods of low-flows;
> 3. LWM can help slow stream speed , which helps adult fish as they move upstream and shelters rearing juveniles from using too much energy fighting currents;
> 4. LWM provide shade , offering pockets of cooler water, and can help to lower the temperature of an entire stream;
> 5. LWM provides fish with refuge from predators ;
> 6. LWM can help to stabilize banks, prevent erosion and decrease sediment movement that can harm downstream fish habitat;
> 7. LWM is important to the aquatic food chain, because it traps organic matter and provides habitat for insects and invertebrates, which are both food for fish.
>
> All of these elements add "complexity" to a stream. When it comes to fish habitat, complexity is a good thing. And one of the best ways to make a stream complex is to simply add wood.

Hannah Ettema 2014. Seven Reasons Why Fish Need Wood.
https://www.nationalforests.org/blog/seven-reasons-why-fish-need-wood

The agency should not manage for *minimum* levels of dead wood because *optimal* levels of dead wood are much higher than minimums. In fact, there may not be any maximum. "The presence of LWM within a stream channel is critical to maintaining integrity of the system, in fact, there cannot be an overabundance of LWM." Deschutes NF, 1997. Big Marsh Watershed Analysis.

Restoration of riparian reserves requires several things, including accumulation of basal area and conifer regeneration, both of which require retention of abundant live trees. The 1993 report of the Scientific Analysis Team (SAT), an appendix to FEMAT and the NFWP says:

> Several studies (Steinblums 1977, Franklin et al. 1981, Heimann 1988, Andrus et al. 1988, Ursitti 1991, and Morman 1993) have found the basal area of conifers, which reflects the size and number of trees present, to be less in riparian areas of second-growth forests than in late-successional and old-growth forests. …
>
> Maintenance of riparian forests in late-successional and old-growth forests and restoration in second-growth forests will depend on regeneration rates of conifers in the future. Regeneration of conifers in the riparian zones of natural stands is dependent, at least in part, on downed large trees. Researchers at the Pacific Northwest Research Station, Corvallis, Oregon found that more than 80 percent of conifer regeneration in the riparian zones along coastal Oregon streams that they studied occurred on down logs. The role of nurse trees in forest regeneration in the Pacific Northwest is widely recognized (Harmon et al. 1986). in riparian zones, nurse trees originate within 0 to 400 feet of the active channel. Greater retention of live trees and snags in riparian stands and adjacent upslope source areas will enhance the generation of future riparian forests

1993 SAT Report, page 460. The agency may claim that thinning helps regenerate conifers, but it comes at the expense of basal area and recruitment of nurse logs.

Logging to Create Early Seral Habitat is Not Needed. Climate change may increase early seral.

Some argue that logging emulates natural disturbance and regeneration harvest (clearcutting) is beneficial to creation of complex early seral forests that are under-represented. This argument suffers from a series of flaws: (i) logging does not mimic natural disturbance because it removes rather than retains vast amounts of biomass, and replanting truncates the complex early seral vegetation community that flourishes for decades after natural disturbance; (ii) the shortage of older forests is much more significant than the shortage of young forests; (iii) climate change will create vast amounts of early seral forest. We do not need to amplify that trend; (iv) there is a sea of young forests on private lands, which may not be high quality habitat, but the sheer quantity of young forests somewhat compensates for the lack of quality (e.g. roadsides and recent clearcuts are still slightly diverse); and (v) the species that depend on early seral forest tend to be high mobile and opportunistic, so they need less help than the specialized and less mobile species that depend on mature & old-growth forests.

> Although many existing silvicultural systems have been designed to mimic stand-scale natural disturbances, McRae et al. (2001) and Palik et al. (2002) remind us that natural disturbances are inherently different from those of silviculture. One difference, of course, relates to the amount of carbon removed from the site when harvesting a forest. Removals tend to be much greater with harvesting than for fire, for example. Fire tends to

create a complex mosaic of forest types and ages on the landscape. Forest harvesting, as commonly practiced, tends to simplify forest composition and structure.

Crow, T.R. and A.J. Perera. 2004. Emulating natural landscape disturbance in forest management – an introduction. Landscape Ecology 19: 231-233. http://www.firescience.gov/projects/01-1-3-43/project/01-1-3-43_01_1_3_43_Deliverable_02.pdf.

From a wildlife perspective, stand-replacing fires and timber harvesting both represent major disturbances which significantly alter habitats … Despite their similarities, fire and logging differ in several of the habitat conditions they procure for wildlife. Wildfires, especially when severe, generate large amounts of standing (eventually downed) dead trees including large ones which represent an important habitat and food source for many wildlife species (Drapeau et al. 2002; Pedlar et al. 2002). … [T]he spatial variability of fire severity creates various amounts of green or mixed-severity stands over the burned landscape (e.g., Kafka, Gauthier, and Bergeron 2001; Smyth et al. 2005), which represent important refuge sites for some wildlife species (Norton and Hannon 1997; Tittler and Hannon 2000; Lance and Phinney 2001; Tittler, Hannon, and Norton 2001). Contrarily, clearcut harvesting removes most of the large live trees, leaves few standing deadwood, and retains variable amounts of non-commercial trees and understory vegetation. … All studies directly comparing bird assemblages in burned and harvested stands reported an important divergence in bird assemblages, especially for the first years following disturbance (Hutto 1995; Schulte and Niemi 1998; Hobson and Schieck 1999; Imbeau, Savard, and Gagnon 1999; Schieck and Hobson 2000; Morissette et al. 2002; Simon, Schwab, and Otto 2002). One of the most striking differences lies in the abundance of the snag-associated guild in post-fire stands. … [H]igh snag densities are clearly missing in harvested stands (Schulte and Niemi 1998; Pedlar et al. 2002; Simon, Schwab, and Otto 2002). Concordantly, Imbeau, Savard, and Gagnon (1999) found no resident and cavity-nesting species in recent clearcuts, where little retention (green or dead trees) has been left on site. Similarly, Hobson and Schieck (1999) found very distinct assemblages between burned and harvested forests, a difference that was partly explained by the dominance of several snag-associated species. These major differences in the abundance of snag-associated species are of particular importance considering that several of these have been identified as the most sensitive to the long-term effects of forestry (Imbeau, Mönkkönen, and Desrochers 2001). … The magnitude of the initial divergence and eventual convergence in bird communities between fire and harvesting may greatly depend on the level of residual vegetation (Schieck and Hobson 2000). Schieck and Hobson (2000) found that bird assemblages from larger patches within disturbed stands supported more species from older forests than smaller ones. In contrast, bird communities from smaller patches (within cut blocks vs. burned stands) mainly reflected the surrounding post-disturbance communities, therefore showing the same initial divergence in bird assemblages between post-fire and post-harvest stands reported by

Hobson and Schieck (1999). Nonetheless, over time these small patch communities also became more similar to those inhabiting mature fire origin forests and hence converged as succession proceeded (although some differences still persisted up to 60 years after disturbance). … Early after disturbance, most stand-level attributes differ between harvesting and wildfire. Structurally, young post-fire stands are characterized by more snags and less downed woody debris than young post-harvest stands. … Biodiversity elements significantly differ between burned and logged sites. Early after disturbance, significant differences in understory vascular and non-vascular community composition are commonly reported. Faunal assemblages, be they mammals, invertebrates, or birds, all seem to respond differently initially to harvesting- and wildfire-induced disturbances. … At the stand scale, while most forest attributes are different early after disturbance between burned and logged stands, the majority of these converge a few decades after fire. A few exceptions are to be noted, though. … [W]hile faunal communities do become less different as time passes, late in succession some species present in burned stands are either significantly less abundant or absent in similarly aged logged stands. … Post-fire salvage logging affects ecological processes, biological legacies, and the abundance of species commonly encountered only after fire. Removal of fire-killed trees can affect tree regeneration, understory composition, the abundance and distribution of dead wood, wildlife habitat, and soil properties. … At the landscape scale, the most important difference between fire and harvesting regimes is the distribution of stand age classes. The proportion of stands older than the rotation period (usually 100 yrs) tends toward zero under a fully regulated harvesting regime, while it is around 37% under a fire regime of similar rotation period. This results in a significant loss of over-mature forests in managed landscapes, potentially affecting organisms that are often associated with such stands.

NCASI. 2006. Similarities and differences between harvesting- and wildfire-induced disturbances in fire-mediated Canadian landscapes. Technical Bulletin No. 924. Research Triangle Park, N.C.: National Council for Air and Stream Improvement, Inc. http://landscape.zoology.wisc.edu/People/Simard/NCASI924.pdf

The presence of coarse woody debris is critical for biodiversity conservation. … In general, post-fire forest ecosystems include the presence of large numbers of snags and downed woody debris. This dead material provides important habitat elements for many species of plants and animals, while also storing a great deal of carbon (MacDonald 1993; Fleming and Freedman 1998; Freedman et al. 1996). Clearcut harvesting of natural forests results in the removal of most of the aboveground woody biomass from the site because trees are the commodity being harvested. … Because clearcut harvesting concentrates on the removal of biomass, it fails to produce large-dimension snags and coarse-woody debris in intensively managed forests, … Although both harvesting and wildfire kills trees, only fire leaves them as dead standing biomass. … The fire-killed snags and woody debris cast partial shade, which ameliorates the surface microclimate and may enhance the survival of pine seedlings (Fraser and Farrar 1953; Cayford and

> McRae 1983; Carleton and MacLellan 1994). … Some studies have suggested that the cover and richness of the understorey vegetation of a natural forest may never fully recover from clearcutting. … Wildfires reduce the presence of some hosts that assist the spread of pests and pathogens while clearcutting may promote them. … [E]xclusion of fire from such ecosystems, along with forestry practices that leaves young infected trees in the residual stand, leads to increased abundance of this parasite. In contrast, fire eliminates Dwarf mistletoe. … Numerous studies have determined the potential removals of nutrients with conventional and whole-tree clearcuts … The data show that clearcutting removes large amounts of biomass and nutrients from the site, and that these are equivalent to a substantial fraction of the site capita of these materials. … During a wildfire, biomass capital of the stand is lost by combustion, as is that of nitrogen through the oxidation of organic compounds and the release of gaseous NO and NH3. In intense wildfires these losses of biomass and nitrogen can be comparable in magnitude to what would be removed by the clearcutting of comparable stands. Unlike wildfire, however, clearcutting also removes large amounts of phosphorus, potassium, calcium, and magnesium contained in the tree biomass; these materials are mostly conserved *in situ* during a wildfire. … Clearcut harvesting with heavy equipment can cause severe soil compaction along skidding lanes and it can also disrupt soil profiles by churning … Permanent roads are not generally associated with wildfire management or suppression (although temporary access routes may be constructed while fighting some wildfires). An extensive road network is, however, necessary for timber harvesting and subsequent stand management. Roads affect biodiversity in many ways. Roads directly remove natural habitat, alter drainage and stream dynamics, cause erosion, introduce edge effects, fragment contiguous ecosystems, alter species movements, and act as corridors for the introduction of non-native species …. Road density is a useful indicator of ecological threat … [I]t is erroneous to assume that forest harvesting plays the same ecological role as wildfire.

D.J. McRae, L.C. Duchesne, B. Freedman, T.J. Lynham, and S. Woodley, 2001. Comparisons between wildfire and forest harvesting and their implications in forest management. Environ. Rev. 9. 223-260 (2001); DOI: 10.1139/er-9-4-223

There is no shortage of young forests. The cumulative effects of widespread logging (on public and private lands), plus natural disturbance, combined with anticipated effects of climate change, leaves the world with a shortage of old forest. To address this altered age-class distribution, land management agencies need to be letting forests grow, not regenerating more of them. Allan Brettman, May 28, 2020, News Release: Global Environmental Changes Leading to Shorter, Younger Trees https://www.pnnl.gov/news-media/global-environmental-changes-leading-shorter-younger-trees. ("[T]he globally averaged tree size has declined over the last century and is likely to continue declining due to continuing environmental changes. Several factors have led to the loss of trees through human activity and natural causes – clear-cutting, wildfire, insects and disease are leading causes. … 'Over the last hundred years we've lost a lot of old forests," McDowell said." And they've been replaced in part by non-forests and in part by young forests. This has consequences on biodiversity, climate mitigation, and forestry.' … Wood harvests alone have had a huge impact on the shift of global forests towards younger ages ... Where forests are re-established on harvested land, the trees are smaller and biomass is reduced."). This need to retain mature forests is made more urgent by the fact that increasing stress and disturbance driven by climate change will make it harder to hold onto the mature forests we have now.

Efforts to artificially enhance early seral should recognize that climate change might take care of this for us, and in fact might make it much harder to hang on to the mature forests we have. "Ecologically, increased distribution and frequency of disturbances may result in increased distribution and dominance of early successional ecosystems dominated by fire adapted species..." Lemieux, Christopher J., Daniel J. Scott, Rob G. Davis and Paul A. Gray. 2008. Changing Climate, Challenging Choices: Ontario Parks and Climate Change Adaptation. University of Waterloo, Department of Geography: Waterloo, Ontario http://web.archive.org/web/20101023221023/http://www.fes.uwaterloo.ca/geography/faculty/danielscott/PDFFiles/NRCAN-Report-FINAL.pdf. Conversely, it may become harder to maintain existing late-seral ecosystems and species, so existing late-successional old-growth forests should be retained in order to avoid making the LSOG shortage worse.

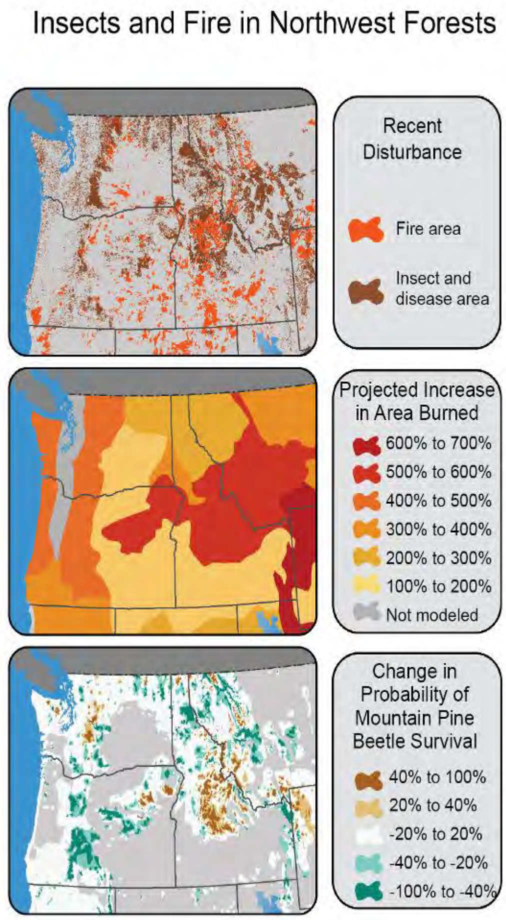
Waring & Coops (2015) explained that we can expect more fire as a result of climate change.

> Wildland fires can be expected to establish new landscape patterns over time, while correcting the "fire deficit" created following a century of fire exclusion (Marlon et al. 2012; North et al. 2015). The patterns are not expected to attain stability, however, because projected temperature increases, derived from 11 climate models, are expected to result in an increase in total cloud-to-ground lightning flashes of 12 % ± 5 % per degree Celsius of global warming, equivalent to a 50 % increase over the rest of this century for the contiguous United States (Romps et al. 2014).

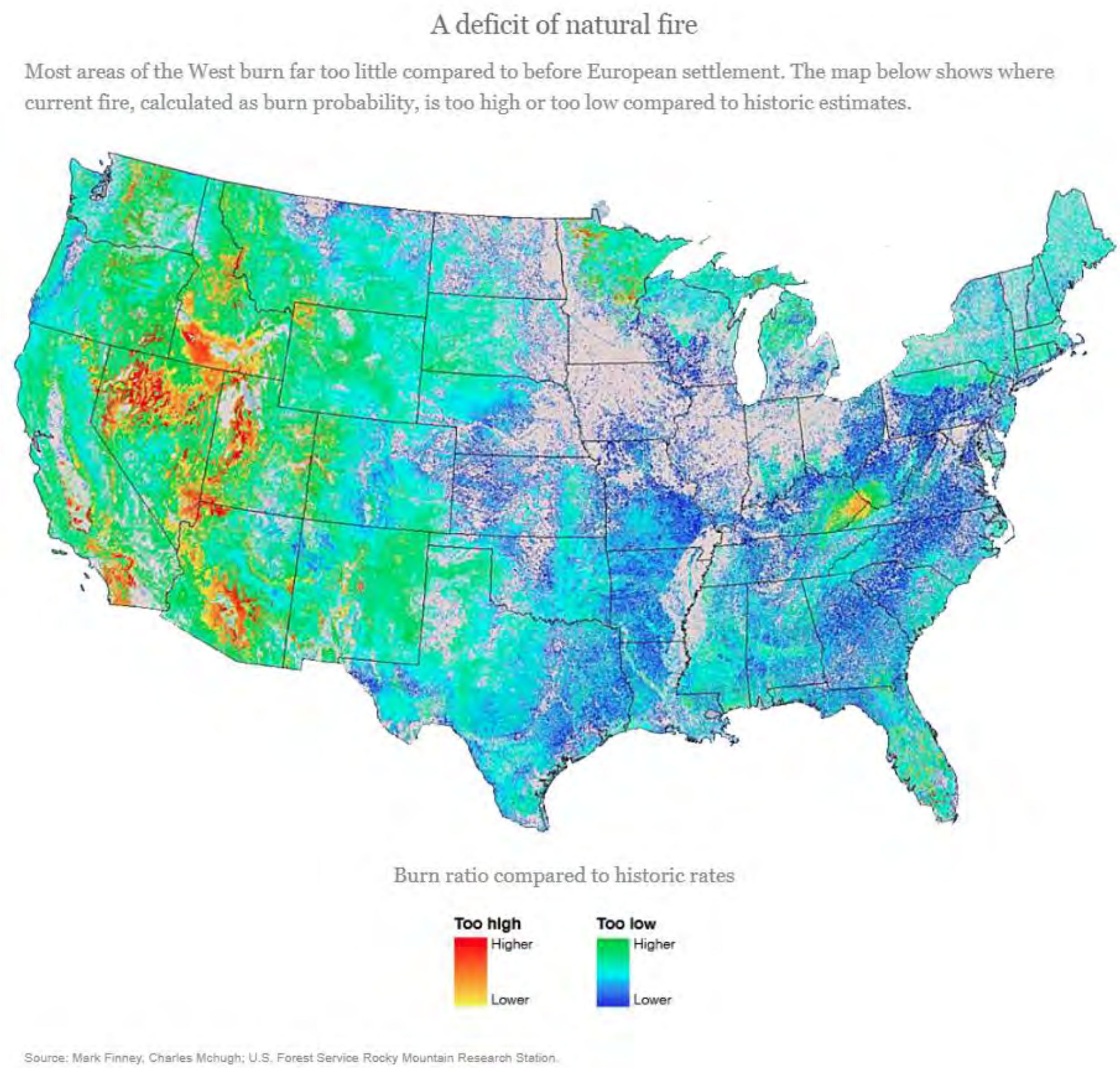
Richard H. Waring, Nicholas C. Coops. 2015. Predicting large wildfires across western North America by modeling seasonal variation in soil water balance. Climatic Change. March 2016, Volume 135, Issue 2, pp 325–339. http://link.springer.com/article/10.1007/s10584-015-1569-x. See also, Jennifer R. Marlon, Patrick J. Bartlein, Daniel G. Gavin, Colin J. Long, R. Scott Anderson, Christy E. Briles, Kendrick J. Brown, Daniele Colombaroli, Douglas J. Hallett, Mitchell J. Power, Elizabeth A. Scharf, and Megan K. Walsh. Long-term perspective on wildfires in the western USA. PNAS, February 14, 2012 DOI: 10.1073/pnas.1112839109. http://www.pnas.org/content/109/9/E535.full.pdf ("Biomass burning in the western United States has remained in dynamic equilibrium with climate at least since 500 CE to the 1800s CE. Burning generally increased when temperatures and drought area increased, and decreased when temperatures and drought declined. … Against the backdrop of climatic and ecological processes, human activities had a marked impact on biomass burning after the late 1800s. … The data do suggest however that even modest increases in temperature and drought (relative to those being projected for the 21st century) are able to perturb the level of biomass burning as much as large-scale industrialized human impacts on fire. … Since the mid 1800s, the trend in fire activity has strongly diverged from the trend predicted by climate alone and current levels of fire activity are clearly out of equilibrium with contemporary climate conditions. The divergence in fire and climate since the mid 1800s CE has created a fire deficit in the West that is jointly attributable to human activities and climate change … Although the current rate of biomass burning is not unusual (even allowing for post-1980 CE increases in burning such as in ref. 3), it is clearly out of equilibrium with the current climate. Our long-term perspective shows that the magnitude of the 20th century fire decline, while large, was matched by "natural" fire reduction during cold, moist intervals in the past (e.g., LIA). Current fire exclusion and suppression however, is taking place under conditions that are warmer and drier than those that occurred during the MCA, which calls into question their long-term efficacy.")

> Human-induced climate change promotes the conditions on which wildfires depend, enhancing their likelihood and challenging suppression efforts. Human-induced warming has already led to a global increase in the frequency and severity of fire weather, increasing the risks of wildfire. ... Fire weather refers to periods with a high likelihood of fire due to a combination of high temperatures, low humidity, low rainfall and often high winds. Rising global temperatures and more frequent heatwaves and associated droughts increase the likelihood of wildfire by promoting hot and dry conditions which are conducive to fire weather. ... **Western US and Canada**. Models suggest that the impacts of anthropogenic climate change on fire weather extremes and fire season length emerged in the 2010s (Abatzoglou et al., 2019; Williams et al., 2019; Abatzoglou & Williams, 2016). Yoon et al. (2015) similarly predicted the occurrence of extreme fire risk would exceed natural variability in California by 2020. ... **Paleo records also support increased wildfires during warmer periods**. Sedimentary charcoal records and other indicators of fire activity have been used to extend records of fire throughout the Holocene period (the past 12,000 years) and beyond, enabling assessment of long-term interactions between climate and biomass burnt (Marlon et al., 2013, 2016). Other model–data comparisons reveal robust correspondence between fire and climate during the Holocene in most regions ...

Matthew W. Jones, Adam Smith, Richard Betts, Josep G. Canadell, I. Colin Prentice, and Corinne Le Quéré 2020. Climate Change Increases the Risk of Wildfires. Rapid Response Review using ScienceBrief.org. Published 14 January 2020. https://tyndall.ac.uk/sites/default/files/wildfires_briefing_note.pdf, https://sciencebrief.org/briefs/wildfires.



2014 National Climate Assessment. http://nca2014.globalchange.gov/



Tony Schick 2018. Can 'Moneyball' Fix How The West Manages Wildfire? OPB/EarthFix July 16, 2018 https://www.opb.org/news/article/fire-wildfire-west-management-science-data-risk-moneyball/

Tepley AJ, Thompson JR, Epstein HE, Anderson-Teixeira KJ. Vulnerability to forest loss through altered postfire recovery dynamics in a warming climate in the Klamath Mountains. Glob Change Biol. 2017; 00: 1–16. https://doi.org/10.1111/gcb.13704. ("In the context of ongoing climatic warming, certain landscapes could be near a tipping point where relatively small changes to their fire regimes or their postfire forest recovery dynamics could bring about extensive forest loss, with associated effects on biodiversity and carbon-cycle feedbacks to climate change. Such concerns are particularly valid in the Klamath Region of northern

California and southwestern Oregon, where severe fire initially converts montane conifer forests to systems dominated by broadleaf trees and shrubs. Conifers eventually overtop the competing vegetation, but until they do, these systems could be perpetuated by a cycle of reburning.")

"'We see climate change affecting the system from two directions,' says Thompson. 'First, it is slowing conifer growth, keeping them low to the ground and more vulnerable to future fires for a longer period of time. Second, climate change is making fire more frequent. This phenomenon, which researchers call the 'interval squeeze,' threatens to transform this and other arid, fire-prone forests worldwide.' " Harvard Forest. 2017. Study: Wildfire in a Warming Climate Could Relegate Some Forests to Shrubland. Thursday, April 27, 2017. http://harvardforest.fas.harvard.edu/news/study-wildfire-warming-climate-could-relegate-forests-shrubland.

Rupert Seidl, Juha Honkaniemi, Tuomas Aakala, Alexey Aleinikov, Per Angelstam, et al 2020. Globally consistent climate sensitivity of natural disturbances across boreal and temperate forest ecosystems. Ecography. Published: 29 March 2020 https://doi.org/10.1111/ecog.04995 https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/ecog.04995 ("Natural disturbances are among the most climate-sensitive processes in forest ecosystems (Lindner et al. 2010) and are expected to respond strongly to ongoing climatic changes (Seidl et al. 2017). … Our results confirmed that high disturbance activity in boreal and temperate forests was consistently associated with warmer and drier than average conditions. … Specifically, we highlight that forest disturbances are likely to increase under warmer and drier conditions in boreal and temperate forests (Seidl et al. 2017). This finding of high climate sensitivity underlines the need for robust projections of future disturbance regimes in order to gauge their impacts on ecosystems and the services they provide to society (Scheller et al. 2018, Seidl et al. 2019)..").

Plantations are Mal-Adapted to Climate Change

Complex/Diverse Forests Better Address Climate Change Than Simplified Plantations.

> ... [R]educing emissions from deforestation and degradation may also yield co-benefits for adaptation by maintaining biodiversity and other ecosystem goods and services, while plantations, if they reduce biological diversity may diminish adaptive capacity to climate change (e.g., (Chum et al., 2011). Primary forests tend to be more resilient to climate change and other human-induced environmental changes than secondary forests and plantations (Thompson et al., 2009). The impact of plantations on the carbon balance is dependent on the land-use system they replace, while plantation forests are often monospecies stands, they may be more vulnerable to climatic change (see IPCC WGII Chapter 4) ... Adaptation measures in return may help maintain the mitigation potential of land-use systems. ... Forest and biodiversity conservation, protected area formation, and mixed-species forestry-based afforestation are practices that can help to maintain or

> enhance carbon stocks, while also providing adaptation options to enhance resilience of forest ecosystems to climate change (Ravindranath, 2007) ...

IPCC AR5, Working Group III, Mitigation of Climate Change, Chapter 11 Agriculture, Forestry and Other Land Use (AFOLU) (Final Draft 2014) pp 46-47. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf.

A 2020 study found that natural regeneration can capture more carbon more quickly and more securely than plantations. Cook-Patton, S.C., Leavitt, S.M., Gibbs, D. et al. Mapping carbon accumulation potential from global natural forest regrowth. Nature 585, 545–550 (2020). https://doi.org/10.1038/s41586-020-2686-x. See also, FRED PEARCE 2020. Natural Debate: Do Forests Grow Better With Our Help or Without? Yale Environment 360. SEPTEMBER 24, 2020 https://e360.yale.edu/features/natural-debate-do-forests-grow-better-with-our-help-or-without

> [W]e tested the hypothesis that species-rich forests show greater temporal stability of C capture, and are more resistant to drought, than monodominant plantations. Carbon stocks in monodominant teak (Tectona grandis) and Eucalyptus (Eucalyptus spp.) plantations were 30-50% lower than in natural evergreen forests, but differed little from moist-deciduous forests. Plantations had 4-9% higher average C capture rates (estimated using the Enhanced Vegetation Index – EVI) than natural forests during wet seasons, but up to 29% lower C capture during dry seasons across the 2000-18 period. In both seasons, the rate of C capture by plantations was less stable across years, and decreased more during drought years (i.e., lower resistance to drought), compared to forests. Thus, even as certain monodominant plantations could match natural forests for C capture and storage potential, plantations are unlikely to match the stability – and hence reliability – of C capture exhibited by forests, particularly in the face of increasing droughts and other climatic perturbations.

Anand M Osuri, Abhishek Gopal, T R Shankar Raman, Ruth S DeFries, Susan C Cook-Patton and Shahid Naeem. 2020. Greater stability of carbon capture in species-rich natural forests compared to species-poor plantations. Environmental Research Letters. Accepted Manuscript online 6 December 2019. https://doi.org/10.1088/1748-9326/ab5f75; https://iopscience.iop.org/article/10.1088/1748-9326/ab5f75/pdf.

Regen will replace more-resilient larger mature forests with less-resilient small young trees.

> Physiological sensitivity to climate also varies with tree size. The relative sensitivity of leaf stomata to high evaporative demand is greater in young than old ponderosa pine (Irvine et al., 2004), and young trees are more susceptible to soil water deficits due to shallower rooting and their greater vulnerability of their roots to broken water columns (Domec et al., 2004). Over the course of dry summers, 20%, 45% and 47% of water used by young, mature and old pine trees in sandy soils is extracted from below 80 cm depth (Irvine et al., 2004). Hydraulic redistribution from deep soil layers will be missed, along with the added storage capacity, if models that assume 1 m soil depth.

… During the extreme drought years of 2001 and 2002, old ponderosa pine trees in Oregon showed only a small decline in water transport efficiency to leaves (11–24%) whereas in mature pine, the efficiency declined by 46%, and for young pine, by 80% (Irvine et al., 2004). The ability of young pine to open their stomata more widely than older trees, increases the rate that water flows through a unit of their sapwood. As a result, younger trees risk the breakage of a larger proportion of their water columns, which may account for the high mortality in a young ponderosa pine plantation in California (Goldstein et al., 2000).

Law, B.E., Waring, R.H. 2015. Review and synthesis - Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests. Forest Ecology and Management 355 (2015) 4–14. http://people.forestry.oregonstate.edu/richard-waring/sites/people.forestry.oregonstate.edu.richard-waring/files/publications/Law%20and%20Waring%202015.pdf

Simon Lewis et al (2019) urge greater emphasis on restoring and protecting natural forests as a climate mitigation strategy.

To stem global warming, deforestation must stop. And restoration programmes worldwide should return all degraded lands to natural forests — and protect them. More carbon must be stored on land, while recognizing competing pressures to deliver food, fuel, fodder and fibre.

We call on the restoration community, forestry experts and policymakers to prioritize the regeneration of natural forests over other types of tree planting — by allowing disturbed lands to recover to their previous high-carbon state. This will entail tightening definitions, transparently reporting plans and outcomes and clearly stating the trade-offs between different uses of land.

...

Natural-forest restoration is clearly the most effective approach for storing carbon. But clashing priorities are sabotaging carbon storage potential.

...

Today's forest-restoration schemes must increase their carbon sequestration potential to meet global climate commitments. We suggest four ways in which this could happen.

First and foremost, countries should increase the proportion of land that is being regenerated to natural forest.

...

Second, prioritize natural regeneration in [forests] which all support very high biomass forest compared with drier regions. ...

...

> Third, build on existing carbon stocks. Target degraded forests and partly wooded areas for natural regeneration; focus plantations and agroforestry systems on treeless regions ...
> ...
> Fourth, once natural forest is restored, protect it. ...

Simon L. Lewis, Charlotte E. Wheeler, Edward T. A. Mitchard & Alexander Koch. 2019. Restoring natural forests is the best way to remove atmospheric carbon
Plans to triple the area of plantations will not meet 1.5 °C climate goals. Plans to triple the area of plantations will not meet 1.5 °C climate goals. New natural forests can ... Nature 568, 25-28. 2 April 2019.
https://www.nature.com/magazine-assets/d41586-019-01026-8/d41586-019-01026-8.pdf.

> "... precisely because reforestation takes a very long time, it should be taboo today to cut down mature, species-rich forests, which are large carbon reservoirs and a valuable treasure trove of biological diversity."

Stefan Rahmstorf. 2019. Can planting trees save our climate? RealClimate – Climate science from climate scientists, 16 July 2019.
http://www.realclimate.org/index.php/archives/2019/07/can-planting-trees-save-our-climate/

A climate simulation study in Europe found that "... Norway spruce was most resilient to climate change when planted in mixed-species stands. Our results are consistent with the growing evidence from empirical and experimental studies on the positive effects of mixed forests under climate change (Bauhus et al. 2017; Jactel et al. 2018)." Honkaniemi, J., Rammer, W. & Seidl, R. 2020. Norway spruce at the trailing edge: the effect of landscape configuration and composition on climate resilience. Landscape Ecol (2020), pp 1-16.
https://doi.org/10.1007/s10980-019-00964-y
https://link.springer.com/content/pdf/10.1007%2Fs10980-019-00964-y.pdf.

It is also much cheaper to allow diverse young forests to regenerate naturally than to do artificial planting. Pedro H.S. Brancalion, Paula Meli, Julio R.C.Tymus, Felipe E.B. Lenti, Rubens M. Benini, Ana Paula M. Silva, Ingo Isernhagen, Karen D.Holl 2019. What makes ecosystem restoration expensive? A systematic cost assessment of projects in Brazil. Biological Conservation. Volume 240, December 2019, 108274.
https://doi.org/10.1016/j.biocon.2019.108274

Plantation Forestry Will Adversely Affect Stream Flow and Water Temperature.

Salmonids require cold water and adequate instream flows all year long and climate change is expected to make it harder to meet that need during longer, hotter summers. Science is confirming that the cumulative effects of regen harvest and plantation forestry as commonly practices in the Pacific Northwest causes a significant reduction in summer low stream flows and likely result sin an increase in summer stream temperatures. Salmonid bearing watersheds would be more resilient if watersheds had a higher proportion of mature & old-growth forests, which implies less regen harvest and longer harvest rotations.

Under the 1897 Organic Act the National Forests were reserved from the public domain in part "for the purposes of securing favorable conditions of water flows." 16 USC §475. The 1937 O&C Act that governs BLM lands in western Oregon includes a mandate to manage forests to "regulate stream flow." The agencies need to address significant new scientific information indicating that logging and road building cause adverse hydrological effects, including peak flows in the decade immediately following logging, followed by adverse low flows resulting from the flush of thirsty young vegetation that grows after logging.

As a general proposition, it is well understood that human induced increases in evapotranspiration reduces dry-season water availability. Padrón, R.S., Gudmundsson, L., Decharme, B. et al. Observed changes in dry-season water availability attributed to human-induced climate change. Nat. Geosci. 13, 477–481 (2020). https://doi.org/10.1038/s41561-020-0594-1. ("Our analysis reveals a spatial pattern of changes in average water availability during the driest month of the year over the past three decades compared with the first half of the twentieth century, with some regions experiencing increased and some decreased water availability. The global pattern is consistent with climate model estimates that account for anthropogenic effects, and it is not expected from natural climate variability, supporting human-induced climate change as the cause. There is regional evidence of drier dry seasons predominantly in extratropical latitudes and including Europe, western North America, northern Asia, southern South America, Australia and eastern Africa. We also find that the intensification of the dry season is generally a consequence of increasing evapotranspiration rather than decreasing precipitation.").

Additional logging on federal lands will create dense young conifer stands that will exacerbate the cumulative watershed impacts of past (and ongoing) management on federal and non-federal lands. The likely hydrologic effects include increased peak flows in the decade immediately after logging, followed by several decades of reduced summer stream flow, increased daily streamflow variation, and increased daily peak stream temperatures. These have potentially significant biological effects, and these effects are of particular concern in light of climate change. The same problem would likely be caused by dense replanting of conifers after fire. Data from the Caspar Creek paired watersheds in Northern California indicate that partial logging can also cause these effects.

Perry & Jones (2016) looked at decades of hydrologic data from paired watersheds in the Western Cascades and found -

ABSTRACT: Analysis of 60-year records of daily streamflow from eight paired-basin experiments in the Pacific Northwest of the United States (Oregon) revealed that the conversion of old-growth forest to Douglas-fir plantations had a major effect on summer streamflow. Average daily streamflow in summer (July through September) in basins with 34- to 43-year-old plantations of Douglas-fir was 50% lower than streamflow from reference basins with 150- to 500-year-old forests dominated by Douglas-fir, western hemlock, and other conifers. …. Young Douglas-fir trees, which have higher sapwood area, higher sapflow per unit of sapwood area, higher concentration of leaf area in the upper canopy, and less ability to limit transpiration, appear to have higher rates of evapotranspiration than old trees of conifer species, especially during dry summers. Reduced summer streamflow in headwater basins with forest plantations may limit aquatic habitat and exacerbate stream warming, and it may also alter water yield and timing in much larger basins. Legacies of past forest management or extensive natural disturbances may be confounded with effects of climate change on streamflow in large river basins. ...

Discussion - This study showed that, relative to mature and old-growth forest dominated by Douglas-fir and western hemlock or mixed conifers, forest plantations of native Douglas-fir produced summer streamflow deficits within 15 years of plantation establishment, and these deficits have persisted and intensified in 50-year-old forest stands . … This finding has profound implications for understanding of the effects of land cover change, climate change, and forest management on water yield and timing in forest landscapes. The size of canopy opening explained the magnitude and duration of initial summer streamflow surpluses and subsequent streamflow deficits, consistent with work on soil moisture dynamics of canopy gaps. … Together, the paired basin and experimental gap results indicate that even-aged plantations in 8 ha or larger clearcuts are likely to develop summer streamflow deficits, and these deficits are unlikely to be substantially mitigated by dispersed thinning or small gap creation. Relatively high rates of summer evapotranspiration by young (25 to 45 years old) Douglas-fir plantations relative to mature and oldgrowth forests apparently caused reduced summer streamflow in treated basins. Young Douglas-fir trees (in AND 1) had higher sapflow per unit sapwood area and greater sapwood area compared to old Douglas-fir trees (in AND 2; Moore, Bond, Jones, Phillips, & Meinzer, 2004). In summer, young Douglas-fir trees have higher rates of transpiration (sapflow) compared to old Douglas-fir trees, because their fast growth requires high sapwood area and because their needles appear to exercise less stomatal control when vapor pressure deficits are high. Leaf area is concentrated in a relatively narrow height range in the forest canopy of a forest plantation, whereas leaf area is distributed over a wide range of heights in a mature or old-growth conifer forest. In summer, these factors appear to contribute to higher daily transpiration rates by young conifers relative to mature or older conifers, producing pronounced reductions in streamflow during the afternoons of hot dry days (Bond et al., 2002). At sunset, transpiration ceases, and streamflow recovers. Hence, daily transpiration produces large diel variations in streamflow in AND 1 (plantation) relative to AND 2 (reference). … Reduced summer streamflow has potentially significant effects on aquatic ecosystems. Summer streamflow deficits in headwater basins may be particularly detrimental to anadromous fish, including steelhead and salmon, by limiting habitat, exacerbating stream temperature warming, and potentially causing large-scale die-offs … Reductions in summer streamflow in headwater basins with forest plantations may affect water yield in much larger basins. Much of the Pacific Northwest forest has experienced conversion of mature and old-growth forests to Douglas-fir plantations over the past century. Climate warming and associated loss of snowpack is expected to reduce summer streamflow in the region (e.g., Littell et al., 2010). Declining summer streamflows in the Columbia River basin may be attributed to climate change (Chang, Jung, Steele, & Gannett, 2012; Chang et al., 2013; Hatcher & Jones, 2013), but these declines may also be the result of cumulative forest change due to plantation establishment, … Despite summer streamflow deficits, young forest plantations in the Andrews Forest yield more water in winter, contributing to increased flooding (Harr & McCorison, 1979; Jones & Grant, 1996; Beschta, Pyles, Skaugset, & Surfleet, 2000; Jones, 2000; Jones & Perkins, 2010).

Conclusions … Long-term paired-basin studies extending over six decades revealed that the conversion of mature and old-growth conifer forests to plantations of native Douglas-fir produced persistent summer streamflow deficits of 50% relative to reference basins, in plantations aged 25 to 45 years. This result challenges the widespread assumption of rapid "hydrologic recovery" following forest disturbance …

Perry, T. D., and Jones, J. A. (2016) Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology, doi: 10.1002/eco.1790. http://onlinelibrary.wiley.com/doi/10.1002/eco.1790/full

Perry, T. 2007. Do Vigorous Young Forests Reduce Streamflow? Results from up to 54 Years of Streamflow Records in Eight Paired-watershed Experiments in the H. J. Andrews and South Umpqua Experimental Forests. OSU MS Thesis. https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/7683/Perry_Thesis.pdf?sequence=1 ("This study quantified the magnitude and timing of summer streamflow deficits in paired-watershed experiments in the Cascade Range of Oregon … Summer streamflow deficits of intermediate size and persistence developed in watersheds in which 25 to 30% of the area had been patchcut in the 1960s or 1970s. A sparse (12%) precommercial thin of a 27-year-old stand exhibiting summer streamflow deficits had comparatively little effect on streamflow deficits. Streamflow deficits emerged as early as March or April and persisted into October … These findings are consistent with previous studies demonstrating (1) increases in water use in certain conifer species relative to others (e.g. Douglas-fir versus pine); (2) higher water use in young (i.e., 10 to 50-yr-old) compared to old (100 to 250- yr-old) stands of many tree species; and (3) decreased interception capacity of young relative to old forest stands associated with loss of canopy epiphytes.")

These results are confirmed in the Oregon Coast Range.

> This study examined long-term changes in daily streamflow associated with forestry practices over a 60-year period (1959 to 2017) in the Alsea Watershed Study, Oregon Coast Range, Pacific Northwest, USA. We quantified the response of daily streamflow to (1) harvest of mature/old forest in 1966, (2) 43- to 53-yr-and 48- to 58-yr-old old industrial plantation forests in 2006–2009, and (3) logging of the plantations using contemporary forest practices, including retention of a riparian buffer, in 2010 and 2014. Daily streamflow from a 40- to 53-yr-old Douglas-fir plantation was 25 % lower on average, and 50 % lower during the summer (June 15 to Sept 15 of 2006 to 2009), relative to the reference watershed containing mature/old forest. Low flow deficits persisted over six or more months of each year. Surprisingly, contemporary forest practices (i.e., clearcutting of the plantation with riparian buffers in 2009 and 2014) had only a minor effect on streamflow deficits. ... High evapotranspiration from rapidly regenerating vegetation, including planted Douglas-fir, and from the residual plantation forest in the riparian buffer appear to explain the persistence of streamflow deficits after logging of nearly 100 % of the forest plantation. Results of this study indicated that 40- to 50-yr rotations of Douglas-fir plantations can produce persistent, large summer low flow deficits. While the clearcutting of these plantations, with retention of riparian buffers, increased daily streamflow slightly, they did not return to pre-first entry conditions.

Catalina Segura, Kevin D.Bladon, Jeff A.Hatten, Julia A. Jones, V.Cody Hale, George G. Ice. 2020 Long-term effects of forest harvesting on summer low flow deficits in the Coast Range of Oregon. Journal of Hydrology. https://doi.org/10.1016/j.jhydrol.2020.124749, http://fews.forestry.oregonstate.edu/publications/Segura_JoH_2020.pdf . This study is significant because it addresses a couple of the agencies' favorite excuses—that clearcuts mitigate the problem by increasing low flow (this study shows that fresh clearings did little to mitigate for thirsty plantations). The agencies also argue that fire-regenerated mature stands aren't old-growth as described in Perry & Jones so the studies don't apply to them (this study uses just such a stands as reference).

Coble et al (2020) conducted a review and found -

> We identify three distinct periods of expected low flow responses as regrowth occurs following forest harvest: in the first period an initial increase in low flow can occur as replanted stands regenerate, in the second period low flow is characterized by mixed and variable responses as forests become established, and in the third period, which follows canopy closure, low flow declines may occur over long timescales. Of 25 small

catchments with ≥10 years post-harvest data, nine catchments had no change or variable low flow and 16 catchments experienced reduced low flow years after harvest.

Coble, Ashley A; Barnard, Holly; Du, Enhao; Johnson, Sherri; Jones, Julia; Keppeler, Elizabeth; Kwon, Hyojung; Link, Timothy E; Penaluna, Brooke E; Reiter, Maryanne; River, Mark; Puettmann, Klaus; Wagenbrenner, Joseph 2020. Long-term hydrological response to forest harvest during seasonal low flow: Potential implications for current forest practices. Science of The Total Environment, ISSN: 0048-9697, Vol: 730, Page: 138926 https://doi.org/10.1016/j.scitotenv.2020.138926.

A paired-watershed study looked at clearcutting in snowmelt-dominated watersheds in British Columbia and found:

> About two decades after the onset of logging and as the extent of logging increased to approximately 50% of the catchments, reductions in daily summertime low flows became more significant for the July–September yield (43%) and for the analysis by calendar day (11–68%). Reductions in summertime low flows were most pronounced in the catchment with the longest postharvest time series…. Additionally, these reductions in streamflow corresponded to persistent decreases in modelled fish habitat availability that typically ranged from 20% to 50% during the summer low-flow period in one of the catchments, suggesting that forest harvest may have substantial delayed effects on rearing salmonids in headwater streams. … Historically, paired-catchment analyses that examined forest harvesting have generally led to the understanding that logging increases streamflow (Moore & Wondzell, 2005), at least for the first 5 to 10 years, which could be interpreted as a benign or even favourable effect of logging on fish habitat availability. The results from this study show otherwise: Not only does logging have a delayed effect of reducing summertime streamflow, it reduces summertime streamflows at a time when further reductions to already low flows (<10% MAD [mean annual discharge]) are likely to cause severe degradation in aquatic habitat (Tennant, 1976). The eco-hydraulic modelling also indicates that forest harvesting reduces WUA [weighted usable area] at a time when fish may also be subject to additional stresses associated with logging, such as increased stream temperatures (e.g., Gomi, Moore, & Dhakal, 2006).

Gronsdahl, Moore, Rosenfeld et al 2019. Effects of forestry on summer low flows and physical fish habitat in snowmelt-dominant headwater catchments of the Pacific Northwest. Hydrological Processes 33(25):3152-3168. https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.13580.

OFRI's "working paper" on the forestry and drinking water summarized these findings:

Consistent with Perry and Jones (2017) and Gronsdahl (2019), Segura et al. (2020) attributed persistent streamflow deficits after logging to high evapotranspiration from rapidly regenerating vegetation, including planted commercial timber species. The authors note that their findings for summer streamflow deficits in young stands in the Oregon Coast Range were similar in magnitude to those detected in Douglas-fir plantations in the western Cascades (Perry and Jones 2017; Jones and Post 2004) indicating that Douglas-fir plantations of similar age have similar evapotranspiration rates relative to mature and old-growth forest reference stands in all of these locations. Overall, Segura et al. (2020) found that 40- to 50-yr rotations of Douglas-fir plantations can produce persistent, large summer low flow deficits, and that clearcutting with retention of riparian buffers increased daily streamflow slightly but flows did not return to conditions when the old/mature forests were intact. The authors suggest that additional work is needed to investigate how intensively managed forests and expected warmer, drier conditions in the future may influence summer low flows.

OSU Institute for Natural Resources 2020. Trees to Tap: Forest Management and Community Drinking Water Supplies. Final Report June 15, 2020. https://oregonforests.org/sites/default/files/2020-06/Trees-To-Tap-Science-Review-Working-Papers_1.pdf P 62..

Coble et al (2020) conducted a literature review on the low flow impacts of logging:

> We identify three distinct periods of expected low flow responses as regrowth occurs following forest harvest: in the first period an initial increase in low flow can occur as replanted stands regenerate, in the second period low flow is characterized by mixed and variable responses as forests become established, and in the third period, which follows canopy closure, low flow declines may occur over long timescales. … We identified 25 small harvested catchments ranging in size from 0.10 to 33.9 km2 , with 17 to 100% of overstory vegetation removed (Table 2). Stand age of reference catchments was older than 80 years in fourteen catchments, younger than 80 years in nine catchments, and was not reported in two catchments (Table 2). Riparian buffers were retained in only five catchments. Hydrological period 1 resulted in one or more years of increased low flow in 21 of the 25 small catchments reviewed. The duration of increased low flow ranged from 0 to 40 years, with a mean and median of 8.8 years and 8 years, respectively. … Low flow declines relative to the control catchment define hydrological period 3. These declines were observed in 16 harvested catchments of 25 evaluated (64%) and represent a relatively short duration (3 year duration occurring 43 to 46 y post-harvest, Coyote Creek; Perry and Jones, 2017) to a much longer duration (20 years occurring 27 to 47 years post-harvest, H.J. Andrews, Hicks et al., 1991; Perry and Jones, 2017). This response was observed in 0.10 to 4.5 km2 catchments with 25 to 100% of the catchment harvested (Table 2). … In the Mediterranean climate of the Pacific Northwest, the growing season corresponds with the seasonally dry low flow period, when evaporative demand and solar irradiance are elevated. Elevated transpiration rates typically occur during this season, although these may not be sustained for its entire duration due to insufficient water supply (Irvine et al., 2004; Wharton et al., 2009). … [H]igh rates of water use by the young stand can risk potential hydraulic dysfunction through cavitation and embolism formation in the xylem (Tyree and Sperry, 1988). … Age-related

ecosystem structure (root system and stem capacitance) can have important implications for seasonal drought responses, such that ET declines in early seral conifer stands as the summer progresses while mature or old-growth conifer stands maintain ET throughout the summer (Irvine et al., 2002; Wharton et al., 2009; Kwon et al., 2018). Young stands are likely to be more vulnerable to increased water stress than mature conifer stands if the Pacific Northwest experiences longer or more severe droughts, due to differences in age-related ecosystem structure. … The 25 catchment studies we reviewed documented low flow responses to treatments that represented forest practices at the time studies were initiated. Many of these treatments reflect historic practices when harvest included large clearcuts of old-growth trees without the retention of riparian buffers. … We generally lack long-term data on the suite of current forest practices that are common on the landscape, as well as future practices, including riparian buffers of varying widths, riparian buffers with varying levels of management activities, pre-commercial and commercial thinning, uneven stand management, monoculture or diverse tree species. Some prior treatments are relevant, and aid in our understanding of long-term low flow responses to current practices. … Few studies in our review included riparian buffers in their treatment … Retention of riparian buffers, along with other current harvest practices, may limit low flow increases (hydrological period 1) but one study suggests buffers may not relieve low flow declines (hydrological period 3) that are already occurring following earlier harvest (Segura et al., 2020). … As riparian buffers continue to age, eventually reaching late-seral then old-growth conditions, those stands may contribute to age-related reductions in ET rates during the low flow season. Therefore, if dense, young stands within riparian buffers are currently contributing to reductions in low flow via elevated ET rates (i.e., Segura et al., 2020), on longer timescales these responses may not persist. … Natural disturbance can elicit similar hydrological responses to harvest of overstory vegetation, and at larger catchment scales hydrological responses to forest harvest are often confounded with natural disturbance. For example, low flow and annual runoff increased following a mountain pine beetle epidemic (Potts, 1984) and following forest fires (Niemeyer et al., 2019). Seasonal and annual responses can also differ following disturbance. Following a wildfire that affected 45% of the Boise River catchment in Idaho, water yield increased annually and in most months, but declines were observed in June and July (Luce et al., 2012). Annual runoff, but not low flows, increased with proportion of Swiss needle cast in the catchment in the Oregon Coast Range (Bladon et al., 2019). … Native aquatic taxa in the Pacific Northwest are adapted to seasonal low flow conditions when resources become concentrated for weeks to months. Generally, seasonal low flow presents stressors for biota. During seasonal low flow, aquatic invertebrates emerge from dry streambeds (Banks et al., 2007), invertebrate drift declines (Danehy et al., 2016), amphibian larvae metamorphose, and basal food resources can control food webs (Power et al., 2008). When low water levels reduce the availability of cover, fish survival is low (Berger and Gresswell, 2009), vulnerability to predators is especially high (Harvey and Nakamoto, 2013; Penaluna et al., 2016) and the consumption of prey is reduced (Li et al., 2016). Reduced consumption likely occurs because suitable locations to feed are reduced (Fausch, 1984; Hayes et al., 2007) leading fish to have minimal growth or weight loss (Penaluna et al., 2016; Jensen, 2017). Consecutive years of extremely low seasonal flows associated with drought have been shown to have long-lasting consequences for aquatic food webs (Power et al., 2008; Matthews and Marsh-Matthews, 2017). … Ultimately, any forest management that seeks to limit low flow increases (hydrological period 1) or mitigate long-term declines (hydrological period 3) must be informed by a mechanistic understanding of the underlying processes. Yet, basic mechanistic questions such as how water uptake by trees affects subsurface water storage and streamflow or how distribution of trees in the catchment (riparian versus upland) affect water use remain active topics of research.

Coble, Ashley & Barnard, Holly & Du, Enhao & Johnson, Sherri & Jones, Julia & Keppeler, Elizabeth & Kwon, Hyojung & Link, Timothy & Penaluna, Brooke & Reiter, Maryanne & River, Mark & Puettmann, Klaus & Wagenbrenner, Joseph. (2020). Long-term hydrological response to forest harvest during seasonal low flow: Potential implications for current forest practices. Science of The Total Environment. 730. 138926. 10.1016/j.scitotenv.2020.138926. https://www.researchgate.net/profile/Elizabeth_Keppeler/publication/341045718_Long-term_hydrological_response_to_forest_harvest_during_seasonal_low_flow_Potential_implications_for_current_forest_practices/links/5ed50f1e458515294527ba23/Long-term-hydrological-response-to-forest-harvest-during-seasonal-low-flow-Potential-implications-for-current-forest-practices.pdf.

These findings are also supported by this study pf post-fire salvage logging and replanting. Ryan J. Niemeyer,| Kevin D. Bladon, Richard D. Woodsmith 2020. Long-term hydrologic recovery after wildfire and post-fire forest management in the interior Pacific Northwest. Hydrological Processes, 2020:1-16. http://fews.forestry.oregonstate.edu/publications/Niemeyer_HP_2020.pdf.

The implications of these studies are significant. Ecologically, if plantations are causing lower low flows, then, as the study says, "this finding has profound implications for understanding the effects of land cover change, climate change, and forest management on water yield and timing in forest landscapes." A host of well-established ecological processes related to low summer flows are a huge issue for fish, other aquatic organisms, and ecosystem services provided by summer stream flows:

- High stream temperatures for example are very commonly a critical limiting factor for fish populations, and this problem is obviously worsening with global climate change. The period of low flow in streams corresponds with the highest temperatures (as well as return timing for salmon) in late summer, and less water in streams has profound effect on stream temperature.

• Lower low flows also relates to sheer amounts of aquatic habitat that are available, both to fish and other aquatic species. The impact of forest plantations on low flows is felt from the top down, i.e. the water volume is removed before it first arrives in headwater streams. Fish and other aquatic critters find their habitat from the bottom, up. Smaller headwater streams offer the bulk of the habitat for rearing fish, like juvenile Coho salmon or trout, who colonize streams as far up as they can find habitat. Lower flows are reduce pools and pool depth, limit migration, and otherwise restrict quality habitat.
• Low summer flows can cause water shortages and even interfere with established water rights. This implication is particularly pertinent here because there are nearby municipal water supplies, and private and agricultural users of limited surface water.

This new finding that logging and tree planting reduce summer low flows challenges the general assumption that there is "hydrologic recovery" only a couple decades after logging, an assumption which underpins current approaches to forest management in several important respects. For example the O&C Act mandates that O&C forestlands: "shall be managed, ... for permanent forest production, and the timber thereon shall be sold, cut, and removed in conformity with the principal of sustained yield for the purpose of ... **protecting watersheds, regulating stream flow**...." 43 USC 1181a. The 2016 RMPs, while ignoring any low flow impact from logging and replanting, does direct the BLM as part of adaptive management to consider and guard summer stream flow.

Other studies have also found that tree plantations deplete stream flow. Bentley, L, Coomes, DA. Partial river flow recovery with forest age is rare in the decades following establishment. Glob Change Biol. 2020; 00: 1– 16. https://doi.org/10.1111/gcb.14954, https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/gcb.14954. ("43 unique catchment experiments fitted our selection criteria, ... The final data set contains 770 data points, sourced from 13 countries. These studies were selected to satisfy strict inclusion criteria, designed to avoid variables that could confound the effects of forestation, discussed below. All studies report the effect of increasing forest cover on non-forested land; however, some catchments are reported to have had forest cover historically ... Contrary to classical studies, but in agreement with reviews in recent years, we found dramatic decreases in river flow within the years immediately following forestation. ... Greater annual precipitation is associated with greater decreases in annual river flow following forestation, suggesting that forest water use and interception increase in response to greater water availability at annual timescales, ... The mean age at which a minimum in river flow response occurs (the largest difference from control flow in partially recovering catchments) is 15.3, with a range of 3–47. ... We find that negative effects of forestation on catchment river flow are widespread at annual timescales, and are of similar magnitude to those previously reported (Bosch & Hewlett, 1982; Filoso et al., 2017; Jackson et al., 2005). ... [S]ignals of river flow recovery driven by forests age are rare. This suggests that generally, for up to the five decades following establishment, no substantial river flow recovery can be expected to occur after the initial decline. ... Widespread afforestation, reforestation and spontaneous forest regeneration remain important to current and future endeavours to counter biodiversity loss and anthropogenic climate change. However, our study reinforces the findings of previous research, showing that forestation is associated with significant decreases in river flow at annual timescales. In many places where river flow has value for both economic activity and welfare (Meyer, 1997), this would constitute a notable ecosystem disservice, particularly given predicted decreases in precipitation reliability for many parts of the world (IPCC, 2014).").

Concerns for low summer flow are further compounded by global climate change, ESA listings of salmon and trout, and CWA findings (e.g. 303(d) lists) related to high stream temperatures. This information is highly significant for a number of reasons. The agency does not have a rational basis for saying streamflow is within the range of natural variability given the new information suggesting plantation development has likely diminished low flows. The agency is aware of a host of reasons and ways that low flow is important: it causes fish passage problems at unspecified culverts (itself a violation of the Clean Water Act BMPs for forest roads, which require aquatic passage); causes increases in stream temperature that are known to be harmful to fish; and takes available water from other water users, among other known impacts. The significance of the Perry & Jones paper is especially plain when it is compared with the foundational assumptions of the broader levels of analysis, such as the RMP and Watershed Assessments. Because summer low flows are already a major issue, if more of the low summer flow is used up growing trees on BLM's plantation then even less will be available for the other competing users.

Concerns about low summer streamflow caused by logging are amplified by climate change which is expected to warm streams and shrink habitat suitable for cold-water fish like salmonids. This warming effect is expected to occur in the next 20-40 years, which is also the time period that low summer flows are expected due to proposed logging. The agency needs to consider the cumulative effects of climate change plus logging.

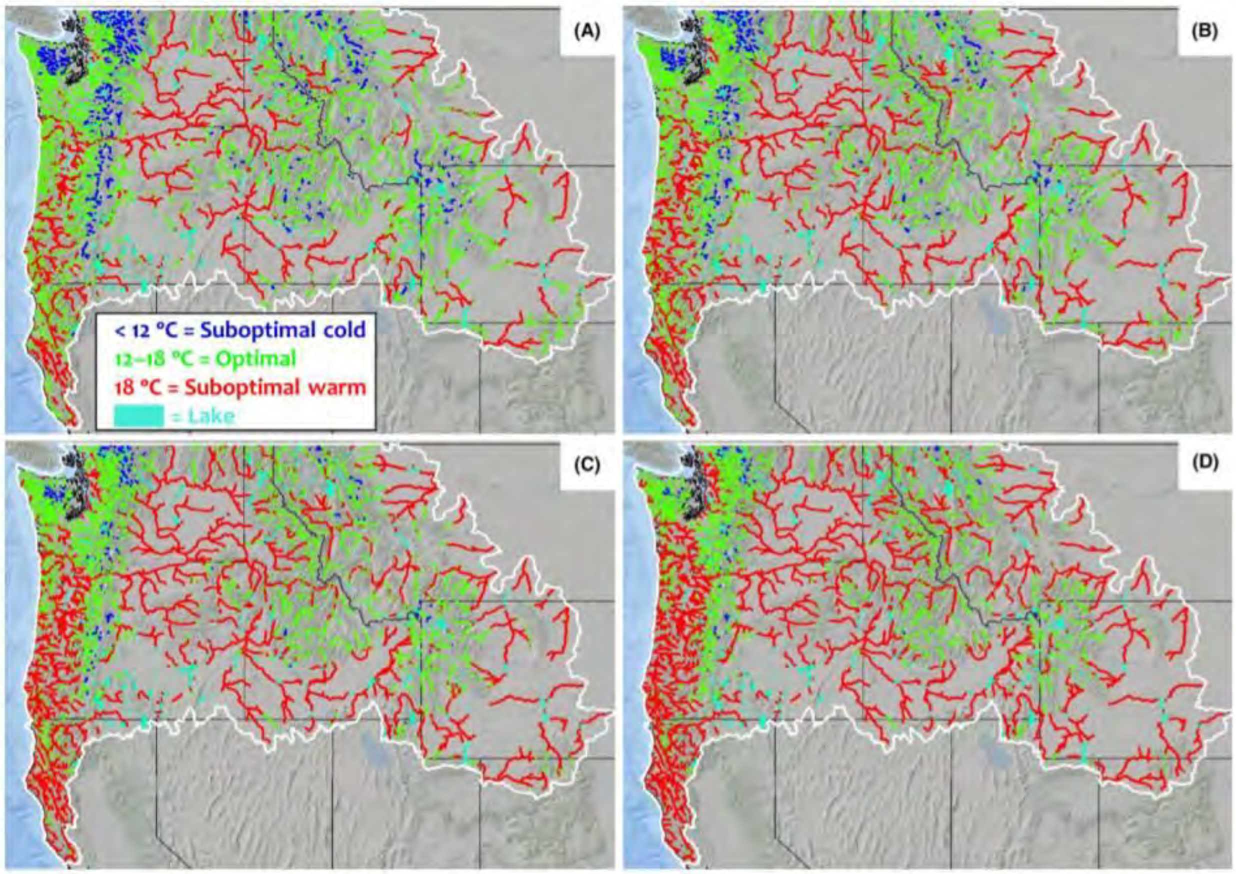


FIGURE 8. Rivers classified by thermal suitability for Brown Trout and Rainbow Trout under scenarios of mean August temperatures that represent **(A)** baseline conditions for 1993–2011, **(B)** +1.0°C, **(C)** +2.0°C, and **(D)** +3.0°C. Supplement G contains high-resolution images of the figure panels, including versions based on different color palettes.

Isaak, D.J.; Luce, C.H.; Horan, D.L.; Chandler, G.; Wollrab, S.; and D.E. Nagel. 2018. Global warming of salmon and trout rivers in the northwestern U.S.: Road to ruin or path through purgatory? Transactions of the American Fisheries Society. doi: 10.1002/tafs.10059. https://www.fs.fed.us/rm/pubs_journals/2018/rmrs_2018_isaak_d001a.pdf. ("Future warming of 1–3°C would increase Sockeye Salmon exposure by 5–16% (3–143 degree-days) and reduce thermally suitable riverine trout habitats by 8–31% while causing their upstream shift. Effects of those changes on population persistence and fisheries are likely to be context dependent, and strategic habitat restoration or adaptation strategies could ameliorate some biological impairments, but effectiveness will be tempered by the size of rivers, high costs, and pervasiveness of thermal effects. Most salmon and trout rivers will continue to provide suitable habitats for the foreseeable future, but it also appears inevitable that some river reaches will gradually become too warm to provide traditional habitats.")

Riparian Reserve thinning.

There is a controversy about thinning in riparian reserves, but the best available science shows that removing commercial sized trees from riparian reserves reduces the recruitment of large wood for many decades. So, proponents of restoration thinning in riparian reserves must show that the benefits of thinning outweigh these clear and long-lasting adverse consequences.

> Riparian thinning proponents consider stand density in riparian areas as a static factor that can be controlled and enhanced by "proper" management--often that is thinning, to benefit a narrowly defined aspect of biodiversity, or to attain a specific stand structural outcome.
>
> In my experience, natural disturbance processes are so diverse, so frequent, so unpredictable, and expressed across a broad enough range of scales in riparian forests that there is little or no justification for imposing additional human disturbance, in the form of thinning, tree tipping, or similar practices, with the expectation of producing a specific stable-state outcome. In fact, the complex and dynamic regime of natural disturbance renders any active human intervention highly unlikely to produce the anticipated or desired outcome for any significant length of time. In truth the interaction of unpredictable natural disturbance with imposed human disturbance makes it far more likely that unanticipated and undesired outcomes will occur (e.g., greatly accelerated and more widespread windthrow, with resulting floodplain and streambank instability and erosion).
>
> This is precisely why FEMAT ACS rules emphasized process-based conservation actions (in terms of both restrictions and outcomes) in riparian forests--not state-based ones.
>
> Riparian thinning proponents often point to homogeneous, low-diversity undesirable vegetation conditions, such as "stunted, overcrowded forests." that in their view demand thinning. I have observed that any syndrome of homogeneity or static supposedly static vegetation state is rather limited to a few locales, with the vast majority of sites showing every sign of natural processes of vegetation succession and natural disturbance generating sufficient diversity of sites, species and growth rates to assure that future forest outcomes, left unaltered, would be just fine and beneficial for water quality and biological diversity outcomes. I note that Pollock and Beechie's (NMFS Northwest Science Center) stand modeling work, based on field-verified processes and rates of tree species recruitment, growth and mortality in the forest types of concern, shows this same outcome (and their simulations don't even include external stand disturbances like wildfire, floods, landslides, or major wind events).

Chris Frissell, personal communication, January 15, 2019.

Dead wood is important to meeting many aquatic and terrestrial wildlife habitat values. Dead wood is also important for ecological services such as the capture, storage and release of water, sediment, and nutrients including, carbon. Most riparian reserves are short of dead wood due to past and ongoing logging, roads, fire suppression, etc. Natural processes of stand growth and mortality will correct this shortage, whereas logging will capture and export mortality and reduce and delay recruitment of wood to both streams and uplands within riparian reserves. This is not a minor short-term effect, but rather a significant long-term effect. Such effects are inconsistent with the Aquatic Conservation Strategy which prohibits logging in riparian reserves unless it is needed to meet objectives, and requires that management actions "maintain" and "not retard" ACS objectives, including dead wood. Any proposal to log riparian reserves must address these factors, develop clear goals, provide clear linkages between proposed actions and desired outcomes. Any alleged benefits of logging must be weighed against likely adverse effects on dead wood recruitment.

> Riparian areas are widely considered to be important wildlife habitat. Cool air temperatures due to the presence of cool and turbulent surface waters, typically dense vegetative canopy cover, and their location in the lowest portions of watersheds combine to maintain a distinct microclimate along stream channels and in the adjacent riparian area. Maintaining the integrity of the vegetation in these areas is particularly important for riparian-dependent species of amphibians, arthropods, mammals, birds, and bats.
> …
> Large quantities of down logs are an important component of many streams. Coarse woody debris influences the form and structure of a channel by affecting the profile of a stream, pool formation, and channel pattern and position. The rate at which sediment and organic matter are transported downstream is controlled in part by storage of this material behind coarse woody debris. Coarse woody debris also affects the formation and distribution of habitat, provides cover and complexity, and acts as a substrate for biological activity. Coarse woody debris in streams comes directly from the adjacent riparian area, from tributaries that may not be inhabited by fish, and from hillslopes.

1994 FSEIS page 3&4-61.

Under the NWFP: "The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed." 1994 FSEIS p 3&4 – 69. Clearly, this requires the agency to show there is a need for intervention. The 1993 SAT Report (which underpins the ACS) said "Within these protection areas, timber management and other ground disturbing activities are prohibited unless a site-specific watershed analysis indicates such activities will accelerate meeting desired ecological conditions." And "Within the Riparian Habitat Conservation Areas, timber management and other land management activities are essentially prohibited unless the watershed analysis indicates such activity is necessary to accelerate meeting desired ecological conditions." 1993 SAT Report. Ch 5, p 296. "[F]or areas where riparian conditions are presently degraded, management activities must be designed to improve habitat conditions." 1993 SAT Report. Ch 5, p 464.

> Large wood in streams—preferably whole trees with root wads and all—provides the randomness and dynamic environment that fish absolutely need to survive in the ever-changing waters they occupy. Wood breaks up the current and spreads water sideways across its natural floodplain, creating wonderful, dynamic and necessary diversity while also absorbing energy that could cause serious damage downstream otherwise, such as flooding or unnatural erosion. It sorts gravels during high flows, creating those beautiful spawning gravel beds laid out like blankets among bigger rock. It makes those current breaks downstream of log jams. It provides cooling shade and cover, and slow pools and edge habitat that baby fish need after emerging from those gorgeous gravels to ride out high flows, find food and hide from prying eyes. Decomposing wood and the nutrients it produces jumpstarts that the natural processes critical to insect, animal, amphibian and plant life.

Alan Moore, Why Fish Love 'Large Woody Debris.' Trout Unlimited. 2-4-2013. http://troutunlimitedblog.com/large-woody-debris-makes-for-fishy-rivers/ Joshua J. Roering, professor of geological sciences at the University of Oregon studies the processes that create fish habitat and concluded: "[Coho salmon] seem to respond to the heterogeneity that is so inherent in most real landscapes. Nature is messy, and the fish have adapted to that." University of Oregon (2013, February 11). Large, ancient landslides delivered preferred upstream habitats for coho salmon. ScienceDaily. Retrieved from http://www.sciencedaily.com/releases/2013/02/130211135045.htm

> The presence of LWM within a stream channel is critical to maintaining the integrity of the system, in fact, there cannot be an overabundance of LWM. … Riparian Reserves provide important wildlife habitat, which justifies the heavy loading of LWM in the creeks and the floodplains. … In the Riparian Reserves … it is desirable to maintain healthy forest stands over the long-term while maintaining high snag densities and green tree replacements. … It is recognized that Riparian Reserves constitute an area where higher risks are taken (including reduced fire suppression efforts) in order to allow natural processes to occur and continue without human intervention.

Deschutes NF 1999. Crescent-Odell Watershed Analysis, pages 164-165.

> In an undisturbed forest ecosystem, wood is naturally "recruited" to streams in various ways. Riparian trees growing along the channel fall into the channel when they are undercut by the stream, toppled by beavers, burned by fire or blown down during storms. Upslope trees can be transported into the channel by events such as avalanches or landslides . Flooding can wash trees into the channel and during highwater they may be pushed downstream.
>
> In-stream woody debris has been drastically reduced in some streams by historical forest management practices. Logging near rivers and streams limited the number of trees that could fall into streams. Road building that channeled streams through culverts prevented downstream wood recruitment. "Stream cleaning" was sometimes conducted to

remove fallen trees from streams, for beautification, to prevent damage to infrastructure downstream, or in a misguided attempt to assist fish migration.

Scientists have now come to understand that in-stream LWM [large woody material] is ecologically important for a number of reasons:

8. LWM can help spawning gravels accumulate , by stopping the gravel from moving downstream;
9. Pools can form behind LWM, which provide important juvenile rearing habitat, as well as habitat for all fish during periods of low-flows;
10. LWM can help slow stream speed , which helps adult fish as they move upstream and shelters rearing juveniles from using too much energy fighting currents;
11. LWM provide shade , offering pockets of cooler water, and can help to lower the temperature of an entire stream;
12. LWM provides fish with refuge from predators ;
13. LWM can help to stabilize banks, prevent erosion and decrease sediment movement that can harm downstream fish habitat;
14. LWM is important to the aquatic food chain, because it traps organic matter and provides habitat for insects and invertebrates, which are both food for fish.

All of these elements add "complexity" to a stream. When it comes to fish habitat, complexity is a good thing. And one of the best ways to make a stream complex is to simply add wood.

Hannah Ettema 2014. Seven Reasons Why Fish Need Wood.
https://www.nationalforests.org/blog/seven-reasons-why-fish-need-wood

The agency should not manage for *minimum* levels of dead wood because *optimal* levels of dead wood are much higher than minimums. In fact, there may not be any maximum. "The presence of LWM within a stream channel is critical to maintaining integrity of the system, in fact, there cannot be an overabundance of LWM." Deschutes NF, 1997. Big Marsh Watershed Analysis.

Restoration of riparian reserves requires several things, including accumulation of basal area and conifer regeneration, both of which require retention of abundant live trees. The 1993 report of the Scientific Analysis Team (SAT), an appendix to FEMAT and the NFWP says:

> Several studies (Steinblums 1977, Franklin et al. 1981, Heimann 1988, Andrus et al. 1988, Ursitti 1991, and Morman 1993) have found the basal area of conifers, which reflects the size and number of trees present, to be less in riparian areas of second-growth forests than in late-successional and old-growth forests. …
>
> Maintenance of riparian forests in late-successional and old-growth forests and restoration in second-growth forests will depend on regeneration rates of conifers in the future. Regeneration of conifers in the riparian zones of natural stands is dependent, at least in part, on downed large trees. Researchers at the Pacific Northwest Research Station, Corvallis, Oregon found that more than 80 percent of conifer regeneration in the riparian zones along coastal Oregon streams that they studied occurred on down logs. The role of nurse trees in forest regeneration in the Pacific Northwest is widely recognized (Harmon et al. 1986). in riparian zones, nurse trees originate within 0 to 400 feet of the

> active channel. Greater retention of live trees and snags in riparian stands and adjacent upslope source areas will enhance the generation of future riparian forests

1993 SAT Report, page 460. The agency may claim that thinning helps regenerate conifers, but it comes at the expense of basal area and recruitment of nurse logs.

The NWFP EIS discloses that there are 199 species (not including fish) that are associated with late-successional and old-growth forests and riparian areas, including 13 amphibians, 38 birds, 29 mammals, and a wide variety of non-vertebrates. Table FSEIS page 3&4-11, page 3&4-62.

> Current amounts of large woody debris in coastal streams of Oregon and Washington are a fraction of historical levels (Bilby and Ward 1991, Bisson et al. 1987, NRC 1992). … Stream surveys by private timber companies and federal land management agencies in the Northwest reveal an overall loss of stream habitat quality (FEMAT 1993, Kaczynski and Palmisano 1993, Wissmar et al. 1994) that is strongly related to changes in riparian vegetation, especially harvest of merchantable riparian timber.

Everest, Fred H.; Reeves, Gordon H. 2006. Riparian and aquatic habitats of the Pacific Northwest and southeast Alaska: ecology, management history, and potential management strategies. Gen. Tech. Rep. PNW-GTR-692. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 130 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr692.pdf.

The FEMAT Report explained that logging in reserves must be well-planned and clearly documented:

> Prescriptions to be used for each stand should be well thought out and documented. They will be designed to produce stand structure and component associated with late-successional conditions. These components include large trees, snags, logs, and dense, multi-storied canopies. Prescriptions should show the treatments to be applied and the anticipated effects on the stand over time. They should also include a discussion of the actions, coordination efforts, and oversight that will be necessary for successful implementation. This discussion should draw on previous efforts made to implement similar prescriptions. Finally, the prescriptions should identify key stand attributes or accomplishments that should be monitored. For example, if snags are to be created, or regeneration established, the accomplishment of these actions and their results should be monitored.

1993 FEMAT Report at page III-34; 1994 FSEIS Vol II, page B-73. This means that the agencies cannot rely on analysis-free assertions that logging will enhance or accelerate late successional conditions or riparian conditions in some general way. Planning efforts intended to make aquatic systems more resilient to climate change must be much more explicit in terms of objectives, rationale, and the logical connection between intentions, actions and outcomes.

In order to retain options for recruitment of large wood in degraded stream systems, scientific recommendations include retention of trees >12" dbh.

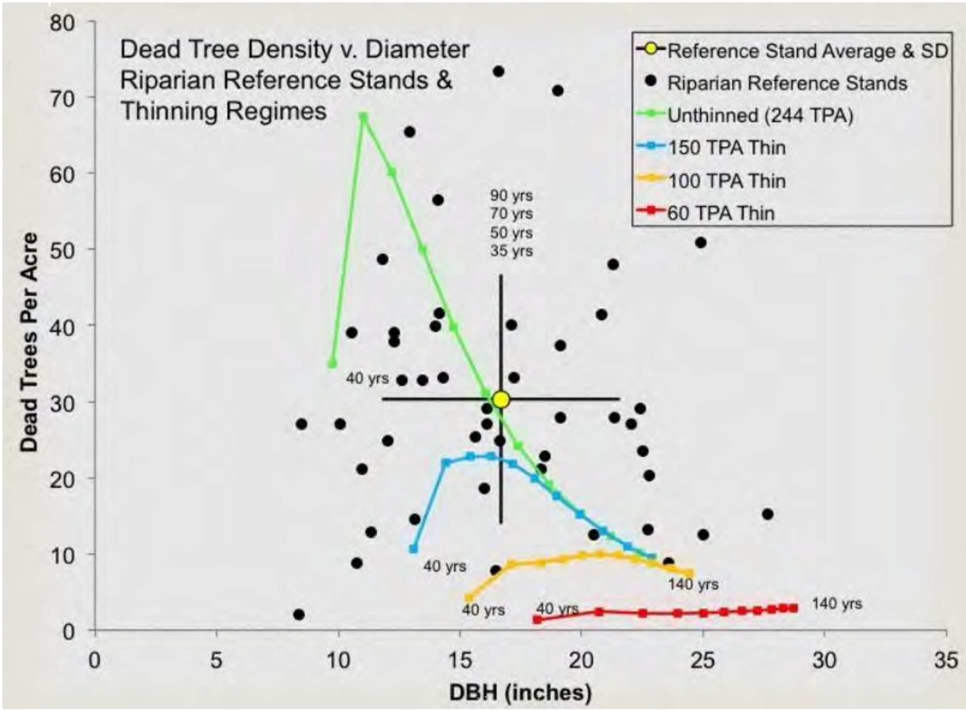
> Removal of trees from riparian zones may delay the recovery of fish habitat. At a minimum, the largest trees (that is, those > 12 inches in diameter at breast height) should be left in riparian areas for future sources of in-stream wood. This would apply to all streams, as recommended by Anderson and others (1992). Smaller trees could be removed as part of a program for riparian vegetation restoration.

Gordon H. Reeves and Fred H. Everest. 1994. REDUCING HAZARD FOR ENDANGERED SALMON STOCKS, *in* Eastside Forest Ecosystem Health Assessment; Volume IV. Everett, Richard L., comp. 1994. Restoration of Stressed Sites, and Processes. Gen. Tech. Rep. PNW-GTR-330. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station. https://www.fs.fed.us/pnw/pubs/pnw_gtr330.pdf.
(p 23).

New science brings into question the ecological value of commercial logging as a restoration tool in riparian reserves in the Coast Range and western Cascades of Washington and Oregon.

> … our data suggest that mature, late-successional conifer dominated forests have well developed structural characteristics in terms of abundant large trees in the overstory, abundant large snags, and a well-developed understory of shade-tolerant trees. We modeled the growth of young conifer stands to assess whether a common restoration treatment [thinning to 150 trees per hectare] would accelerate development of structural characteristics typical of reference conditions. We found that left untreated, the stands followed a trajectory towards developing forest structure similar to the average reference condition. In contrast, the restoration treatment followed a developmental trajectory along the outside range of reference conditions.

Pollock, M. M., T. J. Beechie, and H. Imaki. 2012. Using reference conditions in ecosystem restoration: an example for riparian conifer forests in the Pacific Northwest. Ecosphere 3(11):98. http://dx.doi.org/10.1890/ES12-00175.1 The following figure from this study shows that all types of thinning cause stand development to miss the reference stand trajectory for dead wood.



While careful and limited thinning of very young stands may be appropriate to help grow large trees in riparian reserves, the benefits of logging mid-seral and older stands becomes highly questionable. The NWFP ROD was clear that "Appropriate practices [for riparian reserves] may include … thinning densely-stocked young stands to encourage development of large conifers," but older stands are not mentioned. 1994 ROD p B-31; 1993 FEMAT Report, page V-57.

Where streams are degraded, management of riparian forests should strive to meet the high end of the natural range for large wood, not the central tendency. This brings into question the minimum requirements that pervade current standards. Fox & Bolton (2007) recommend -

> In degraded streams, where management is needed to restore favorable conditions, wood loads are often no longer found in the upper distribution of these ranges, or the distribution is centered around a lower mean. In these cases, merely managing for the mean or median will not restore the natural ranges of heterogeneity. Thus, for management purposes intending to restore natural wood-loading conditions, establishing instream wood targets based on the upper portion of the distribution observed in natural systems (i.e., the 75th percentile) rather than the lower portion of the distribution are reasonable as well as prudent to restore natural ranges.

Martin Fox & Susan Bolton (2007) A Regional and Geomorphic Reference for Quantities and Volumes of Instream Wood in Unmanaged Forested Basins of Washington State, North American Journal of Fisheries Management, 27:1, 342-359, DOI: 10.1577/M05-024.1. http://dx.doi.org/10.1577/M05-024.1

Since streams are already severely degraded by logging, any further logging in riparian reserves should be very carefully scrutinized to avoid further adverse effects. Any claimed benefits of logging in riparian reserves should be clearly justified and supported by compelling scientific evidence. And that is just what the NWFP Aquatic Conservation Strategy calls for. ACS Objective #8 calls for restoring and maintaining "amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability." Existing large wood levels are deficient across the landscape due to past and ongoing harvest practices. The objectives require retention <u>and long–term recruitment</u> of abundant trees and wood especially large wood that provides long-lasting ecological services.

"The effect that wood has on [fish] habitat is related to the size of the piece of wood relative to the channel size and gradient." East Alsea Landscape Management Project – EA Appendix H - Fish BE, 4-18-2011. Efforts to make aquatic systems more resilient to climate change must consider the effects of logging not only on absolute size of wood but on the size of wood relative to stream size and gradient. Dead wood of all sizes is important to streams and riparian function. In small streams, small wood can even perform the ecological and hydrological functions normally thought to require large wood. If the goal of logging is to create large trees faster, the proponents should document the size, gradient, and other characteristics of streams adjacent to each logging area and determine the size of wood that can serve key ecological and hydrological functions, then disclose the effects of logging relative to those relevant wood sizes.

Dead wood is important to both aquatic and terrestrial purposes of the riparian reserves network, so proponents of riparian logging cannot just focus on recruitment of wood to *streams*, but must also address the need to recruit optimal levels of snag and dead wood to meet the needs of *terrestrial* wildlife (primary cavity excavators, secondary cavity users, amphibians, mollusks, lichen, fungi, etc) which were intended to be benefited by riparian reserves.

We are concerned that thinning captures mortality which reduces and delays recruitment of large wood needed to meet ACSO #8 among others. Thinning is often conducted in riparian areas based on the false assumption that thinning accelerates the recruitment of large trees and therefore large snags, but rigorous analysis using stand simulation software clearly shows that assumption to be false. Note ACSO #8 is based on the aquatic objective more clearly stated in the SAT Report as "Maintain or restore riparian vegetation to provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems." 1993 SAT Report. Ch 5, p 456.

Thinning in stands of trees that are not yet of "pool forming" size may be beneficial, but after trees are of pool-forming size, thinning just captures and removes the mortality that should end up in the stream. (In simplistic terms, a pool-forming tree is one big enough to fall all the way across the stream, so it varies by stream size, but in general it only takes a small tree to form a pool in a small stream). See Roni, Philip, Timothy J. Beechie, Robert E. Bilby, Frank E. Leonetti, Michael M. Pollock, And George R. Pess. 2002. **A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds.** *North American Journal of Fisheries Management* 22:1–20, 2002 American Fisheries Society 2002 http://www.crab.wa.gov/LibraryData/RESEARCH_and_REFERENCE_MATERIAL/Environmental/020923StreamRestoreTechPNW.pdf.

Looking at the total miles of streams, small streams dominate, therefore most logging takes place along small streams. BLM has admitted that small wood can be functional in small streams.

TABLE 1. DIAMETER OF FUNCTIONAL WOOD PIECE AS IT RELATES TO WIDTH OF ACTIVE STREAM CHANNEL

Width of Stream (ft.)	Diameter of functional wood (in.)
15	4.5
20	6
30	9
40	12
50	15
>50	>20

From Beechie et al. 2000

BLM 2014. Planning Criteria - Western Oregon RMP Revisions, p 49. http://www.blm.gov/or/plans/rmpswesternoregon/plandocs.php. It's also worth noting that small streams are disproportionally ecologically important. "While small-stream habitats have only about 20% of the available salmon in the watershed, they provide 50% of bear consumption of salmon. 'This tells us that populations of sockeye salmon that spawn in little streams are disproportionately important to bears,' said study lead author Jonny Armstrong, an ecologist at Oregon State University. 'Bears profit from these small streams because they offer salmon at unique times of the season. To capitalize on plentiful salmon runs, bears need them to be spread across time.' Small streams typically have cold water, which leads to populations of salmon that spawn much earlier in the season when no other populations are available to predators such as bears." Branam, C. 2019. Easy prey: The largest bears in the world use small streams to fatten up on salmon. December 19, 2019. https://today.oregonstate.edu/news/easy-prey-largest-bears-world-use-small-streams-fatten-salmon *citing* Jonathan B. Armstrong, Daniel E. Schindler, Curry J. Cunningham, William Deacy, Patrick Walsh. 2019. Watershed complexity increases the capacity for salmon–wildlife interactions in coastal ecosystems. Conservation Letters. Published: 20 November 2019 https://doi.org/10.1111/conl.12689 https://conbio.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/conl.12689.

Rosenfeld & Huato (2003) found that large wood formed pools more reliably than small wood. Wood >24" dbh formed pools 42% of the time, while wood 6-12" dbh formed pools 6% of the time. However, this does not mean that small wood is of no use, especially if it's abundant. The cumulative influence of several pieces of small wood can approach the pool-forming function of large wood. Rosenfeld, J. S., and Huato, L. 2003. Relationship between LWD characteristics and pool formation in small coastal British Columbia streams. North American Journal of Fisheries Management 23:928–938. http://www3.telus.net/jordanrosenfeld/Home%20Page/Publications/Rosenfeld%20and%20Huato%202003.pdf. Similarly, Bilby and Ward (1989) surveyed characteristics of large wood in western Washington streams and found that size of stable pieces of large wood increases with stream size. Their values suggest that streams under 5 m in width require trees of about 30–35 cm in diameter to be useful as fish habitat and to be able to persist as stable LWM in the channel. Streams of about 10 m in width require larger trees of about 45 cm (1.5 ft) in diameter. Bilby, R. E.; Ward, J. W. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118: 368-378. These publications show the direct and cumulative value of small wood (which is often captured and exported by logging). This means that the agency cannot ignore or discount the value of small wood recruitment to streams. In sum, efforts to make aquatic systems more resilient to climate change must account for the effects of logging on both the quantity and quality of wood.

The effects of logging in riparian reserves should be described in terms of the number of pieces and the volume of wood, not just the size wood. Scientists recommend wood volume as a more meaningful measure of wood's value instream. "Total volume of wood through time was reported for all simulations, which is a more conservative measure of wood abundance than the number of pieces." Mark A. Meleason, Stanley V. Gregory, And John P. Bolte. 2003. Implications Of Riparian Management Strategies On Wood In Streams Of The Pacific Northwest. Ecological Applications, 13(5), 2003, pp. 1212–1221. http://www.geo.oregonstate.edu/classes/geo582/week_5_1_wood_movement/Meleasonetalstrategies.pdf.

Also, when the objective of riparian thinning is to develop structures suitable for instream habitat structures, there is a trade-off between quality and quantity. "Quality" is represented by the size of woody pieces. Larger is generally better, and thinning typically increases the growth rate of retained trees. "Quantity" is represented by the number of stems or the total volume of wood available for recruitment to streams and riparian uplands. Unthinned stands tend to have much higher number of stems and total wood volume, and they tend to recruit dead wood sooner. To justify logging, the agencies too often focus on growing large wood faster without acknowledging the adverse effects on wood quantity and delayed recruitment. The focus on wood size fails to tell a complete story because:

(1) Pieces of wood much smaller than 20 or 24" diameter can be ecologically functional. Many streams in adjacent to thinning projects are small and lack the power to move much wood, so small trees are still functional;

(2) Average stand diameter does not reflect actual wood recruitment to riparian reserves. A stand of large vigorous trees is not experiencing the ecological processes (mortality) necessary to recruit wood to streams and riparian uplands;
(3) Average stand QMD does not account for the number of stems or the volume of wood available for recruitment toward ecological services. A few large stems do not serve the same ecological function as a large number of slightly smaller stems.

Even when looking at the size and number of pieces, there is no long-term benefit from thinning. "Thinning accelerated the development of large diameter trees by about 20 years such that there were more live trees > 18" dbh in the two decades following thinning, relative to the unthinned stand, but this advantage was short-lived. Three decades after thinning, there were more live trees > 18" dbh in the unthinned stand and five decades after thinning there were twice as many live trees >18" dbh in the unthinned stand relative to the thinned stand. A similar trajectory was observed for the live trees > 24" dbh." Kim Kratz, Ph.D., Issue Paper for Western Oregon. NMFS, Oregon State Habitat Office. 7-23-2010. Appendix 1. page 38. https://www.blm.gov/or/districts/medford/forestrypilot/files/kswildetal-attach4.pdf. The most notable effect of thinning is to reduce recruitment of larger wood. Even during the brief period that the thinned stand had more large trees, those trees are unlikely to be recruited to the stream, because they are more vigorous as a result of thinning.

Contrary to common assumptions, thinning is not a zero sum game, especially not in the years immediately following thinning. The wood that is captured and removed does not regrow for decades, and if a disturbance event comes along during that time, the absolute volume of wood recruited to streams WILL be adversely affected. "[T]he data have not supported early expectations of 'bonus' volume from thinned stands compared with unthinned. … [T]hinnings that are late or heavy can actually decrease harvest volume considerably." Talbert and Marshall. 2005. Plantation Productivity in the Douglas-fir Region Under Intensive Silvicultural Practices: Results From Research And Operations. Journal of Forestry. March 2005. pp 65-70 *citing* Curtis and Marshall. 1997. LOGS: A Pioneering Example of Silvicultural Research in Coastal Douglas-fir. Journal of Forestry 95(7):19-25. "In this as in other LOGS installations, the unthinned plots have consistently produced more total volume (CVTS) than any of the thinning treatments." Curtis, Robert O.; Marshall, David D. 2009. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 18—Rocky Brook, 1963–2006. Res. Pap. PNW-RP-578. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 91 p. http://www.fs.fed.us/pnw/pubs/pnw_rp578.pdf.

NMFS Biological Opinion for the Siuslaw National Forest says that thinning close to streams sacrifices a lot of potential wood recruitment:

> According to the Organon forest growth model (Spies *et al.* 2013), and the RAIS in-stream wood recruitment models (McDade *et al.* 1990), thinning with 120-foot no-cut buffers adjacent to LFH would capture approximately 90-95% of existing wood recruitment.

> Thinning with 100-foot no-cut buffers would capture approximately 82-90% of existing wood recruitment, and 75-foot no-cut buffers would capture approximately 70-80% of the existing wood recruitment (McDade *et al.* 1990, Spies *et al.* 2013). Thinning with 30-foot no-cut buffers would capture approximately 40-50% of the existing wood recruitment (McDade *et al.* 1990, Spies *et al.* 2013). Thinning with 15-foot no-cut buffers would capture approximately 25% of wood recruitment.

NMFS 2020. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Siuslaw National Forest Vegetation and Aquatic Restoration Program (USFS File Code: 2600). NMFS Reference: WCRO-2019-04010. Sept 3, 2020.

> Modeling studies in western Washington indicate that riparian thinning increases LWM recruitment when trees in the initial stand are too small to create pools (LWM size required to create pools increases with increasing channel width) (Beechie et al. 2000). When trees in the initial stand already are large enough to form pools, thinning reduces the number of trees available for recruitment. For modeled Douglas fir stands, thinning increased LWM recruitment when channels were at least 15 m (49 feet) and the quadratic mean diameter of the stand was about 10 cm (3.9 inches) less than the minimum pool-forming diameter for the channel size. Recruitment was not enhanced by thinning for channels narrower than those described above.

NFMS 2005. Forest Practices on Non-Federal Lands and Pacific Salmon Conservation. Project Team Leader: Jeff Lockwood. Project Team Members: Steve Keller, Don Anderson, and Rick Edwards. NOAA/NMFS. January, 2005. http://www.blm.gov/or/plans/wopr/pub_comments/paper_documents/Paper_1764-1924/WOPR_PAPER_01921.10001.pdf.

> We found that single and double entry thinning, with no mitigation (buffers or mechanical tipping of trees into the stream) can lead to large losses of in-stream wood over a century time scale; single and double entry thins on one side of the stream leads to reductions of 33–42 % of instream wood with simultaneous thinning on both sides of the stream doubling those losses.

Lee E. Benda, S. E. Litschert, Gordon Reeves, Robert Pabst. 2015. Thinning and in-stream wood recruitment in riparian second growth forests in coastal Oregon and the use of buffers and tree tipping as mitigation. J. For. Res. DOI 10.1007/s11676-015-0173-2. https://www.fs.fed.us/pnw/lwm/aem/docs/reeves/2015_benda_etal_tree_tipping.pdf. This study showed that tree-tipping mitigated for the loss of wood recruitment caused by thinning compared to no action, but the study did not look at tree tipping independently of thinning, so the cost of thinning itself remains unaccounted for in that context.

> "Available research (et al., Beechie and Sibley 1997, Bilby and Ward 1989) indicates that trees as small as 5-6 inches in diameter can form pools in small streams. Thinning along small streams with wood deficits can significantly reduce recruitment of wood to streams

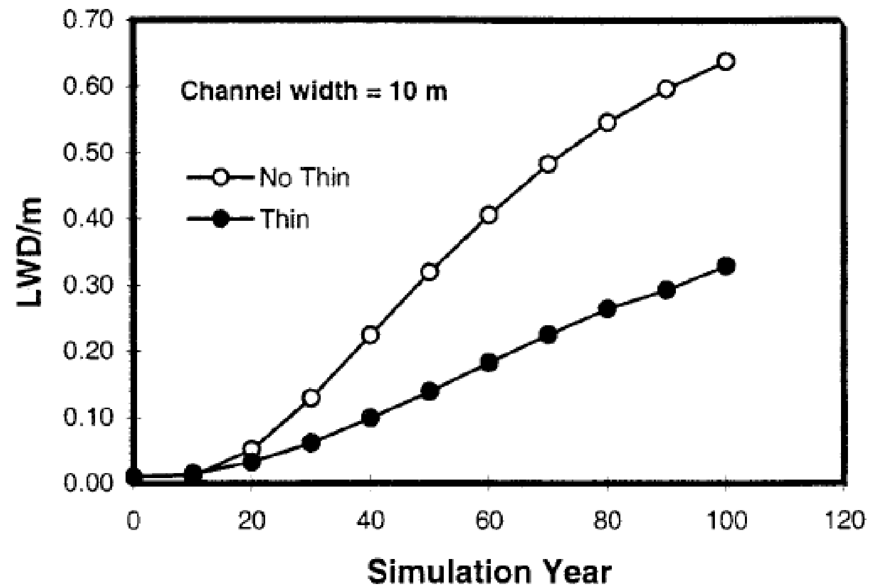
> (Beechie et al. 2000), and the risks of this happening appear to be significantly increased by the above management actions. [i.e. "thinning in riparian areas for all stream sizes"]
> ...
> Alternatives 2 and 3 will substantially decrease the large wood contribution to fish bearing streams relative to the No-Action Alternative, and the decreases will be long-term. This is because thinning will remove wood large enough to form pools from the riparian zone (if the term large wood is defined by its ability to form pools rather than the arbitrary value of >20 inches diameter) (Beechie et al. 2000)."

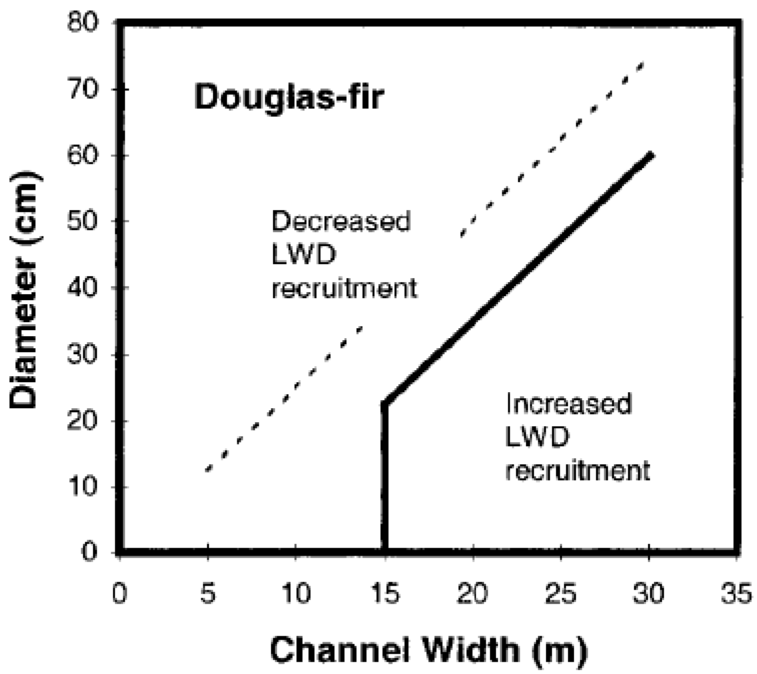
NMFS, Comments on DEIS for the WOPR dated 01-11-2008. pp 8-9, 21. http://www.blm.gov/or/plans/wopr/files/NOAA_comments.pdf. See also Roni, Philip, Timothy J. Beechie, Robert E. Bilby, Frank E. Leonetti, Michael M. Pollock, And George R. Pess. 2002. **A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds.** *North American Journal of Fisheries Management* 22:1–20, 2002 American Fisheries Society 2002 http://www.crab.wa.gov/LibraryData/RESEARCH_and_REFERENCE_MATERIAL/Environmental/020923StreamRestoreTechPNW.pdf. "Beechie et al. (2000) provided guidance for determining when thinning is appropriate and when it will result in a loss of near-term recruitment of LWD that may create fish habitat." Beechie found that

> "The models predict that thinning of the riparian forest does not increase recruitment of pool-forming LWD where the trees are already large enough to form pools in the adjacent channel and that thinning reduces the availability of adequately sized wood. Thinning increases LWD recruitment where trees are too small to form pools and, because of reduced competition, trees more rapidly attain pool-forming size"
>
> To evaluate effects of various stand treatments on LWD recruitment, we modeled treatments and controls for a range of initial mean diameters and channel widths. We modeled Douglas-fir stands of four different initial quadratic mean diameters (initial DBHq = 12, 23, 38, and 51 cm). For each initial DBHq we applied control (unthinned) and treatment (thinned) scenarios to channels 5, 10, 15, 20, 25, and 30 m wide. We applied three different levels of thinning for each combination of channel width and initial DBHq (Table 2) and selected the treatment providing the most LWD over the next 100 years to compare with the unthinned scenario. Large woody debris recruitment for the thinning treatment was then compared with the unthinned control, and the result was recorded as negative (thinning produced less LWD than control), positive (thinning produced more LWD than control), or neutral. … We estimated the proportion of riparian forests having trees that are large enough to create pools, using three thresholds for pool-forming diameter of LWD (*D*pf = 10, 30, and 38 cm) corresponding to channel widths of 4, 12, and 15 m. … When we compared thinned to unthinned scenarios for a range of initial stand diameters and channel widths in Douglas-fir stands, we found that thinning increases cumulative LWD abundance when the DBHq of the stand is about 10 cm less than the minimum pool-forming diameter for the adjacent channel (Figure 6). … **The**

models predict that thinning of the riparian forest will not increase recruitment of pool-forming LWD on any channel less than 15 or 20 m wide. Because relatively small debris can form pools in these channels and the trees reach poolforming size rapidly, thinning simply reduces the availability of adequately sized wood. Thinning may increase LWD recruitment to large channels because thinning reduces competition among trees and increases growth rates.

MODELING WOODY DEBRIS RECOVERY





Beechie, T., G. Pess, P. Kennard, R. Bilby, and S. Bolton. 2000. Modeling Recovery Rates and Pathways for Woody Debris Recruitment in Northwestern Washington Streams. North American Journal of Fisheries Management. 20:436–452. ftp://frap.cdf.ca.gov/pub/incoming/TAC/ISOR%20references%201-139%20%20KIRSTEN/Beechie%20et%20al.%202000.pdf.

Don't make the mistake of assuming that thinning is always consistent with the ACS because it helps grow large trees faster. First, thinning captures mortality and actually delays recruitment of large wood. Second, the agencies often misinterpret the Northwest Forest Plan ROD by confusing accelerated attainment of ACS objectives with ACS compliance. The NWFP ROD actually says that silviculture in riparian reserves is generally prohibited, and allowed only "if needed to attain" ACS objectives, not (as implied by the EA) if needed to "accelerate" ACS objectives. This is a common "group-think" misinterpretation of the ACS. The appropriate evaluation is to ask "will ACS objectives eventually be met without intervention?" If the answer is "yes," then silviculture is technically not allowed. Confusion may stem from the fact that the ACS also has a "do not retard" standard, but this is separate from the "if needed" test, and is itself a criteria to limit active management, not an excuse to reject the no action alternative. The "do not retard" standard cannot be interpreted to <u>require</u> active management whenever and wherever it would accelerate attainment of ACS objectives. That would lead to all kinds of problems, such as cumulative impacts, unintended consequences, and sacrificing some aquatic objectives in the pursuit of others. Oregon Wild is not absolutely opposed to treatment of riparian reserves but we want to avoid the slippery slope of just assuming "it's all good" without careful analysis and justification.

Under the NWFP: "The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed." 1994 FSEIS p 3&4 – 69. Clearly, this requires the FS to show there is a need for intervention.

Efforts to make aquatic systems more resilient to climate change via riparian logging must reflect accurate scientific analysis such as that presented by the NMFS:

> A strategy of thinning to accelerate the development of a few healthy, large-diameter trees does not translate into more large wood in streams. … Overall, an unthinned stand will produce a higher number of both live and dead trees across a range of diameter classes and will produce far more dead wood over a much longer time frame relative to a heavily thinned stand. … The tradeoff of getting a few more large standing live trees sooner at the expense of a continuous supply of both large and small trees over the long term period always needs to be considered.
>
> …
>
> Numerous studies suggest that all organic matter, including the various sizes of wood, has functional value in streams (and riparian areas), and that these functions vary with size (Bilby and Likens 1980, Beechie and Sibley 1997, Gurnell et al. 2002). Of particular

note is that large wood that cannot singly form pools will form pools in combination with other pieces of wood and other obstructions by forming "wood jams." Wood jams are common feature of natural streams of all sizes, and contain a distribution of wood sizes that, in concert, can form a semipermeable structure that can retain sediment (such as that used for spawning), nutrients and organic material, as well as form pools upstream and downstream of the obstruction (Bilby and Likens 1980, Bilby 1981, Bilby and Ward 1991).

…

Reid and Hilton (1998) found that 30% of the trees falling into streams were triggered by trees falling from farther upslope. More research on this subject is needed, but it speaks to the indirect importance of trees in the outer portion of the riparian zone for wood delivery to streams.

…

Managing for large instream wood also results in the creation of large riparian wood and large snags, both of which are beneficial to numerous species other than salmonids, such as cavity nesting birds and certain amphibians.

…

[NMFS's Northwest Fisheries Science Center's quantitative analysis of the East Alsea Landscape Management Project, Pollock, M.M.] (Appendix 1) suggests that typical riparian thinning regimes will result in a mature forest with fewer large diameter trees, fewer large diameter snags, and fewer large diameter pieces of wood on the riparian forest floor and in streams, relative to natural conditions. This largely stems from excessive thinning. In regards to stream habitat, many of the negative impacts created by the existing riparian thinning proposals could be largely avoided with wider no-thin buffers (e.g., see Appendix 1) and removing far fewer trees during thinning operations.

…

The exclusive use of the 24-inch/50-ft wood indicator by the USFS and BLM does not satisfy the requirement in 50 CFR 402.14 that both the action agency and NMFS use the best available scientific and commercial data, or (2) the requirement in 50 CFR 402.02 that the action agencies and NMFS analyze all effects of the proposed action … which would mean consideration of a broader range of sizes of wood.

…

Recommendations

- The USFS and BLM should include all sizes of wood in describing environmental baseline conditions and in analyzing the effects of its proposed actions, not just pieces of wood that are greater than 24 inches in diameter and greater than 50 ft in length.
- The USFS and BLM should adjust their tree diameter targets based on stream size. Databased curves are available for both functional-sized and key pieces of wood (e.g., Fox and Bolton 2007).

- The USFS and BLM should leave more thinned trees on the ground in riparian areas, particularly close to streams, on floodplains, and on steep sideslopes where some trees are likely to slide down into streams, than are required to meet wildlife needs.
- In order to better portray environmental baseline conditions and to understand the likely effects of thinning proposals, the USFS and BLM should develop stand data separately for riparian and upland forests.
- In order to insure adequate recruitment of conifer wood to streams, the USFS and BLM should measure riparian buffers from the outer edge of streamside hardwood forests, where present.
- The USFS and BLM should work with NMFS to develop reliable methods of wood recruitment modeling and procedures that could be used routinely in ESA section 7 consultations to promote decisions based on data instead of concepts and generalizations from the scientific literature.

…

Kratz, K.W. 2010. Response to April 1, 2010, Request by the Interagency Coordinating Subgroup for Position Paper to Support the February 23, 2010 Elevation of Two Northwest Forest Plan Issues to the Regional Executives. NOAA/NMFS July 23, 2010.

From Appendix 1 of the NMFS Memo quoted above:

> Thinning did accelerate the development of large diameter trees by about 20 years relative to the unthinned stand, but this benefit was short-lived because the higher number of trees in the unthinned stand allowed it to produce far more large diameter live and dead trees in the long run. A century after thinning, a 60 foot no cut buffer between a stream and the thinned forest provided 56% of the stream wood relative to an unthinned stand, while a 150 foot no cut buffer provided 91% of the stream wood relative to an unthinned stand. Our results suggest that the thinning regimes proposed by the Siuslaw National Forest will delay the development of key structural elements of forest and stream habitat by more than a century. The delay in stream habitat recovery can be minimized by creating a no cut buffer of 150 feet or more in width between streams and any forest thinning operations. Some of the delay in forest structure development caused by thinning might also be reduced by removing far fewer trees.
>
> …
>
> [Analysis based on a 37 year old Douglas-fir stand thinned to 55 TPA]
>
> **MORTALITY TREES — …** Trees in the thinned stand increased diameter rapidly, and in 20 years following thinning, had a greater number of > 18" diameter trees relative to the unthinned stand. However, from 30-100 years after thinning, the unthinned stand had more > 18" dbh trees, and by year 135 had over 5 [dead]TPA, compared to just 0.6 [dead]TPA in the thinned stand. Neither stand produced many trees > 24" dbh by year 135. The thinned stand produced slightly more > 24" [dead]TPA for each decade following thinning through year 115 (e.g. 0.5 v. 0.4 > 24" [dead]TPA at year 115), but by year 135 the unthinned stand was producing more large trees (0.7 v. 0.5 > 24" [dead]TPA). Further, at year 135, the trend of the > 24" dbh [dead]TPA in the unthinned stand was increasing, while in the thinned stand the > 24" dbh class had leveled off,

suggesting that beyond year 135 the unthinned stand would continue to produce a greater number of large dead trees. … Comparison of the thinned and unthinned mortality curves graphically illustrates that thinning greatly reduced riparian tree mortality and thus reduces the potential for snags, forest wood and instream wood. It is noteworthy that the proposed thinning reduces tree mortality during the period of stand development when tree mortality and thus snag and wood loading, is at its' highest. For example, for an unthinned stand at age 135, about 50 years past peak mortality, will still be producing about 10 trees per acre per decade. In contrast, a thinned stand will have about 0.5 [dead]TPA for the same time period. … The 30 foot no cut buffer, which approximates what the Siuslaw National Forest proposed …, would provide less than 30% of the in stream wood relative to a 250 foot no cut buffer at year 135.

…

[T]he vast majority of stands likely grew at densities higher than 55 TPA, and there is no evidence that such low density conifer stands were found in riparian environments. For example, Poage and Tappeiner (2002) estimated growth rates from the stumps of 505 large diameter Douglas-fir on upland sites and concluded that at age 50, about 75% of them were growing at tree densities higher than 53 TPA Since riparian forests generally are more productive and have higher tree densities than upland forests (Pollock et al., in review), we expect that the occurrence of young, low density riparian stands would be even less than in upland environments.

…

Even if the uncut buffer is 150 feet wide and the thinning is confined to the outer 100 feet of the Riparian Reserve, a century after thinning, the recovery rate of instream wood will still be lowered by about 10%. This is a significant decrease for a program that is ostensibly designed to improve riparian function. We conclude that the thinning of riparian forests to the degree contemplated in the Siuslaw National Forest will delay creation of late successional forest structure by more than a century. … Thinning treatments may exist which will accelerate the development of late successional forest structure in Riparian Reserves and that are consistent with the goals of the Northwest Forest Plan Aquatic Conservation Strategy, but they most assuredly will involve the removal of far fewer trees. … Future research should more comprehensively assess the conditions under which thinning accelerates or retards the development of key structural attributes of riparian forests.

Michael M. Pollock and co-authors to be determined. [*in review 2010*] Effects of Riparian Thinning on Development of Late-Successional Forest Structure in the Alsea Watershed, Oregon, USA. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington.

Consider extending the riparian buffers across ridgetops in order to provide interbasin connectivity for amphibians and other species. Science Findings, Issue 120 (February 2010)

Linked in: Connecting riparian areas to support forest biodiversity, based on science by Kelly Burnett and Deanna Olson. http://www.fs.fed.us/pnw/sciencef/scifi120.pdf.

Recommendations related to thinning in riparian reserves must be reconsidered in light of new information showing that logging does NOT increase the recruitment of functional wood, and the minor increase in very large live trees comes at great cost in terms of a significant reduction in recruitment of functional wood in medium and large size classes (smaller than "very large.")

> [T]here are long-term habitat tradeoffs associated with different thinning intensities. Species that utilize large diameter live trees will benefit most from heavy thinning, whereas species that utilize large diameter deadwood will benefit most from light or no thinning. Because far more vertebrate species utilize large deadwood rather than large live trees, allowing riparian forests to naturally develop may result in the most rapid and sustained development of structural features important to most terrestrial and aquatic vertebrates.
>
> …
>
> Over the course of the simulation, the most intensively thinned stands produced a third as many mortality trees >30 cm (145vs. 461) and half as many mortality trees>50 cm (127vs. 250) relative to the unthinned stands (Figures 5a and 5b). In contrast, the heaviest thin produced slightly more mortality trees >100 cm, a cumulative average production of 42 mortality trees >100 cm for the heaviest thin, relative to 37 mortality trees>100 cm for the unthinned stands (Figure 5a).
>
> Relative to the no thin scenario, thinning reduced the mortality peak of boles in the 30-50 cm and 50-100 cm size classes that occurred 10-60 years posttreatment in the passively managed stands, with the reduction in mortality proportional to the intensity of the thin (Figure 4).
>
> In summary, thinning minimally increased the production of large diameter deadwood >100 cm, while causing substantial losses in deadwood 30- 50 cm and 50-100 cm diameter, with no acceleration in the production of these size classes (Figure 5). This suggests that the thinning regimes we examined are not an effective approach for increasing the abundance of ecologically functional deadwood. The no thin scenario produced substantially more deadwood across a wide range of sizes useful to a variety of vertebrate species (Table 1).
>
> …
>
> Examination of Table 1 suggests that deadwood >30 cm diameter creates habitat that is used by many species, but that deadwood >50 cm provides even more habitat benefits, and that maximizing the production of deadwood>50 cm diameter may be a suitable management target if the goal is to benefit the most vertebrates. There were far fewer species that preferred live trees or deadwood >100 cm, , but larger diameter dead trees

will take longer to decompose, extending the length of time that habitat benefits are provided.

Pollock, Michael M. and Timothy J. Beechie, 2014. Does Riparian Forest Restoration Thinning Enhance Biodiversity? The Ecological Importance of Large Wood. Journal of the American Water Resources Association (JAWRA) 50(3): 543-559. DOI: 10.1111/jawr.12206. http://oregon-stream-protection-coalition.com/wp-content/uploads/2014/07/Pollock-and-Beechie.-2014.-Riparian-thinning-and-biodiversity.pdf. This paper provides a nice graphic showing mortality recruitment per decade under various thinning scenarios and showing that no-treatment performs best:

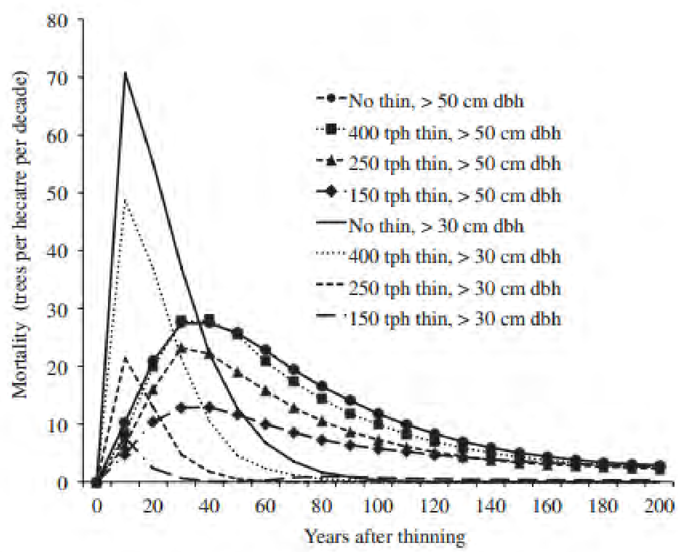


FIGURE 4. Graph Showing Projected Average Mortality Rates (number of trees dying per decade) of Trees >30 cm Diameter and Trees >50 cm Diameter, for each of the Four Simulated Treatments. The 10-year mortality rate of trees >100 cm diameter is low for all treatments throughout the length of the simulation and is not shown in the figure.

In January 2013, the Science Review Team Wood Recruitment Subgroup reported their "Key Points" regarding the effects of commercial thinning on wood recruitment in riparian reserves [text in red below is my commentary]:

> … In general, there is very little published science about the effects of thinning on dead wood recruitment and virtually none on thinning effects on wood recruitment in riparian zones. We conducted some limited simulation modeling to illustrate some of the relationships between thinning and dead wood recruitment. The simulations (and comparison of models) were not comprehensive or a rigorous analysis of thinning effects and should be viewed as preliminary. Below we provide 15 key points from our efforts:
>
> Key Points

1. Thinning is most beneficial in dense young stands. Existing literature and stand development theory suggest that the greatest potential ecological benefits of thinning to accelerate the development of older forest structure (e.g. large trees, large dead trees, spatial structural and compositional heterogeneity, etc.) comes in dense uniform plantations less than 80 years and especially less than 50 years old. The benefits of thinning for older forest ecological objectives are less clear in stands over 80 years of age. Hence, our report focused primarily on plantations less than 50 years of age.

2. Results may not be applicable to all stand conditions. For this synthesis, many of our conclusions were based on modeling the effects of thinning 30 to 40 year old Douglas-fir plantation stands that range in density from 200 to 270 trees per acre (tpa). We consider such stands moderately dense, as young plantation stand densities range from less than 100 to greater than 450 tpa. In terms of dead wood production, higher density stands are likely to see more benefits from thinning, and lower density stands less benefits. [Portions of this project are probably less dense and less in need of thinning, compared to the very dense, very young stands addressed in this report.]

3. Accurate assessments of thinning effects requires site-specific information. The effects of thinning regimes on dead wood creation and recruitment (relative to no-thinning) will depend on many factors including initial stand conditions, particularly stand density, and thinning prescription—it is difficult to generalize about the effects of thinning on dead wood without specifying the particulars of the management regime and stand conditions. [The analysis needs to provide a site-specific, quantitative analysis to show that silviculture is needed to meet ACS objectives in these riparian reserves.]

4. Conventional [i.e., commercial] thinning generally produces fewer large dead trees. Thinning with removal of trees (conventional thinning) will generally produce fewer large dead trees across a range of sizes over the several decades following thinning and the life-time of the stand relative to equivalent stands that are not thinned. Generally, recruitment of dead wood to streams would likewise be reduced in conventionally thinned stands relative to unthinned stands. [This result is highly relevant to the proposed logging to meet ACS objectives.]

5. Conventional [i.e., commercial] thinning can accelerate the development of very large diameter trees. In stands that are conventionally thinned, the appearance of very large diameter dead trees (greater than 40”) may be accelerated by 1 to 20 years relative to unthinned plantations, depending on thinning intensity and initial stand conditions. Trees of such sizes typically begin to appear 5 to 10 decades after thinning 30 to 40 year old stands. [Note: The appearance of a few “very large” trees in the decades after thinning

comes with the loss of a much larger volume of "large functional" trees that were exported from the site before they were allowed to grow and recruit to the stream. Any small gains in *very large* trees, comes at the expense of large numbers of *large* trees, so net benefits to ACS objectives are highly unlikely.]

6. Nonconventional [i.e., non-commercial] thinning can substantially accelerate dead wood production. Stands thinned with prescriptions that leave some or all of the dead wood may more rapidly produce both large diameter dead trees in the short-term and very large diameter dead trees (especially greater than 40") in the long-term, relative to unthinned stands. Instream wood placement gets wood into streams much sooner than by natural recruitment, and can offset negative effects of thinning on dead wood production.

7. Assessments of thinning effects may vary depending on the forest growth model. The previous statements are supported by three stand simulation models (FVS, ORGANON, and ZELIG). However, the magnitude and timing of effects of thinning on dead wood recruitment and stand growth varied among models.

8. Dead wood in streams comes from multiple sources. Dead wood in streams is primarily recruited through near-stream inputs (e.g. tree mortality and bank erosion) and landslides and debris flows. All types of recruitment are important and the relative importance varies with site and stream characteristics.

9. 95% of near-stream wood inputs come from within 82 to 148 feet of a stream. The distance of near-stream inputs to streams varies with forest conditions and geomorphology. Empirical studies indicate that 95% of total instream wood (from near-stream sources) comes from distances of 82 to 148 feet. Shorter distances occur in young, shorter stands and longer distances occur in older and taller stands. [Don't forget: riparian reserves were established to serve both aquatic and terrestrial objectives, and many terrestrial wildlife depend on abundant snags and dead wood.]

10. Thinning can increase the amount of pool-forming wood under certain conditions. Thinning can increase the amount of pool-forming wood only when the thinned trees are smaller in diameter than the average diameter of pool-forming wood (which varies with stream size). [Smaller wood is functional in smaller streams, which means that thinning any commercial-sized trees near small streams is unlikely to advance ACS objectives.]

11. The function of instream wood varies with size and location. Large instream wood can serve as stable "key" pieces that create instream obstructions and form wood jams by racking up numerous smaller pieces of wood that are mobile during high flows. Such

wood jams typically consist of a wide range of piece sizes and provide multiple ecological functions that vary with stream size and gradient.

12. Effects of thinning on instream wood needs to be placed in a watershed context. Assessing the relative effect of riparian thinning on instream wood loads at a site and over the long term requires an estimation of the likely wood recruitment that will occur from the opposite bank, from upstream transport, and the rate of decay and downstream transport of wood from the site.

13. The ecological effects of thinning needs to be placed in a watershed context. Watershed-scale perspectives are needed to restore streams and riparian vegetation. The ecological effects of thinning on instream habitat will vary depending upon location in the stream network. Riparian management practices can be varied to match the ecological functions of streams.

14. Variation in thinning is essential (i.e. don't do the same thing everywhere). Variation in thinning prescriptions will produce more variable forest and wood recruitment conditions, which may more closely mimic natural forest conditions. Using a variety of treatments is also consistent with the tenets of adaptive management in situations where the outcomes of treatments are uncertain.

15. Healthy, diverse forests contain many dead trees. Numerous terrestrial forest species require large dead or dying trees as essential habitat. Some directly, others indirectly; to support the food web within which they exist. Abundant large snags and large down wood on the forest floor are common features of natural forests and essential for the maintenance of biological diversity.

Thomas Spies, Michael Pollock, Gordon Reeves, and Tim Beechie 2013. Effects of Riparian Thinning on Wood Recruitment: A Scientific Synthesis - Science Review Team Wood Recruitment Subgroup. Jan 28, 2013, p 36.
http://www.mediate.com/DSConsulting/docs/FINAL%20wood%20recruitment%20document.pdf

The statement in #5 that "thinning can accelerate development of very large diameter trees" should be kept in proper perspective:

- The alleged gain in very large trees is very minor, compared to not logging;
- The alleged gain in very large trees is overwhelmed by the significant loss of functional wood in smaller size classes (including "large" wood), and even "medium " and "small" wood that serves vital functions in small streams that are typical in most projects; and
- The alleged gain in very large trees is in the distant future and more speculative; while the loss of smaller functional wood is in the near-term and more certain. Predicting future mortality in thinned stands is difficult. If the trees do not die and fall down there is no benefit in terms of down wood.

The apparent dissonance between the fact that thinning reduces wood recruitment (#4), but also has the potential to increase production of the very large trees (#5) might be resolved by looking to the right mix of different treatments as suggested in #14 – with some riparian reaches left unthinned to provide for recruitment of large amounts of wood in a range of sizes, some areas thinned non-commercially, and some riparian patches thinned to produce those very large trees. Also, the statement in #10 that thinning can increase pool-forming wood depending on stream size, needs more explanation. Most riparian thinning occurs near small streams where small wood can be pool-forming.

Thinning to produce very large wood in the distant future at the expense of more abundant wood recruited over time is not advised. The SAT Report, upon which the ACS is founded, was clear that continuous input of wood is important. "Riparian zones along larger channels need protection to limit bank erosion due to trampling, grazing, and compaction, to ensure an adequate and continuous supply of large wood to channels …" 1993 SAT Report. Ch 5, p 455. Commercial removal of pool forming wood creates a gap in the wood recruitment process and is inconsistent with the goal of continuous wood recruitment.

Analyses by National Marine Fisheries Service experts are consistently showing that thinning riparian reserves is adverse to dead wood recruitment, so, rather than accelerating desired riparian habitat conditions, it should be accurately seen as an adverse effect that must be limited and mitigated. A recent analysis done for the Coos Bay BLM's Lone Pine Project says:

> The Bureau of Land Management (BLM) proposes to harvest timber on a series of tracts (1832 acres) in the Coquille watershed in southwestern Oregon details of which are described in the Lone Pine Biological Assessment (LPBA) (BLM 2013). These lands are managed under the Northwest Forest Plan …
> The BLM (2013) proposes to thin stands estimated to be between 30-80 years of age …
>
> In this analysis, I utilized data provided by BLM (Appendix A) to assess the effects of the proposed RT and CT thinning treatments on the development of late-successional forest characteristics, with an emphasis on large dead wood production, particularly the production of large dead wood that can fall into streams. The importance of dead wood as habitat components of late-successional forest and stream ecosystems is widely recognized …
>
> The proposed BLM harvest units … are relatively diverse forests, with a mix of conifer and deciduous species. Douglas-fir is the most common species, followed by bigleaf maple, red alder and grand fir.

I was able to consolidate the treatments into two basic types, a commercial thin (CT) and a riparian thin (RT). I also added an additional simulation, which was a no thin or natural thin option (NT), so as to be able to compare the effect of the proposed artificial thinning treatments against what would happen if the stands were allowed to naturally self-thin (i.e. a no treatment control).

Live tree and mortality outputs from the FVS simulations were tabulated and categorized to compare large live tree and dead wood production under the CT, RT sand NT scenarios for trees 12-24' and trees > 24" in diameter. The mortality outputs were also used to estimate instream dead wood production over the 50 year period …

RESULTS

Both the RT and CT treatments substantially reduced the number of large diameter dead trees relative to the NT treatment (Table 2). For example, the RT and CT treatments reduced production of dead trees > 24" diameter by 52% and 67%, respectively, and reduced production of 12-24" diameter dead trees by 69% and 83%, respectively. The thinning treatments did not increase the abundance of large diameter live trees. Relative to the NT treatment, large live trees > 24" diameter were reduced by 6% and 17% for the RT and CT treatments, respectively. Fifty years post-treatment, the two thinning regimes also reduced tree species diversity and structural diversity (Table 2). …

Instream dead wood production is directly related to the dead wood production in the forest and thus followed a similar trend (Table 3). Relative to the NT treatment, a 30 ft no-cut buffer followed by the RT or CT treatment for the remainder of the SPTH distance, reduced the abundance of instream wood by an average of 38% and 47%, respectively. For a 50 foot no-cut buffer, under similar scenarios, instream wood abundance was reduced by 24% and 31% for the RT and CT treatments, respectively. …

DISCUSSION

The results from this analysis support a growing body of evidence that indicates riparian thinning, as practiced on federal lands managed under Northwest Forest Plan, delays the recovery of late-successional structure in riparian forests and delays the recovery of instream habitat. Such restoration thinning, as currently practiced, delays rather than accelerates ecosystem recovery, primarily because it reduced the production of large diameter dead wood and reduces the abundance of large diameter live trees, most of which will later die to become large dead wood at some point in the future if left uncut. The thinning regimes proposed in the [Lone Pine] BA are typical of thinning regimes on federal lands in Oregon …

> Of the management options examined, the quickest path to recovery, consistent with the Northwest Forest Plan (USDA and USDI 1994, 2004), is to allow the stands to continue to develop naturally. …
>
> In general, thinning is most likely to accelerate the recovery of structurally complex forests when applied to dense stands of small diameter trees of approximately the same height, and mostly of the same species (e.g. Douglas fir). Diverse stands that have species with different shade tolerances, growth forms and water needs and stands that may be less diverse but have a wide distribution of tree sizes and have already differentiated into competitive dominants and subordinants, are not good candidates for restoration thinning.

Pollock, M. 2013. An analysis of the effects of riparian forest harvest on the development of late-successional forest structure and instream wood production - A review of timber harvest in Riparian Reserves proposed by the Bureau of Land Management for federal lands in the Coquille watershed in southwest Oregon as part of the Lone Pine Biological Assessment; v.08.23.2013. NMFS.

See also, Frissell, Christopher A., Baker, Rowan. J., DellaSala, Dominick A., Hughes, Robert M., Karr, James R., McCullough, Dale A., Nawa, Richard. K., Rhodes, Jon, Scurlock, Mary C., Wissmar, Robert C. 2014. CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE PACIFIC NORTHWEST: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan, FINAL REPORT, July 30, 2014. http://coastrange.org/documents/ACS-Finalreport-44pp-0808.pdf This report summarizes the available information and concludes that non-commercial thinning in very young stands might advance aquatic objectives, but that commercial logging is unlikely to provide net benefits due to wood removal, road requirements, soil impacts, etc.

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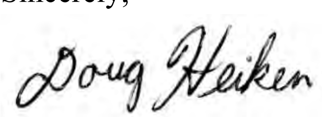
Sincerely,



Doug Heiken
dh@oregonwild.org

SENECA
Our legacy is growing

Comments of Seneca on NOAA-NMFS-2021-0019
Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

My name is Cameron Krauss and I serve as the Senior Vice President of the Seneca Family of Companies. I am writing today to provide comments to NOAA Fisheries and U.S. Fish and Wildlife Service (the Services) as you prepare to develop the Environmental Impact Statement (EIS) for the Western Oregon State Forests Habitat Conservation Plan (HCP).

Seneca is a family-owned company that has been operating in Western Oregon since 1953. Seneca owns and operates 4 sawmills, a 20-megawatt renewable electricity biomass plant and 175,000 acres of timberland. Seneca directly employs 475 employees in family wage jobs. Since our founding Seneca has had a high reliance on public timber to keep our mills operating. Seneca is an active purchaser of timber sales from the State of Oregon.

With regard to the Habitat Conservation Plan proposed by the state of Oregon it is our belief that the state unnecessarily reduced acres and timber harvest levels. We believe other alternatives should be considered and analyzed and that an economic analysis is also undertaken.

Most importantly the Council of Forest Trust Land Counties ("CFTLC") has developed a very thoughtful and detailed proposal that would lead to better outcomes for all stakeholders. Importantly the proposal reduces the amount of acres set aside in Habitat Conservation Areas and then couples management with an aggressive barred owl control program. This proposed alternative will lead to more rural jobs, more county revenues and more spotted owls. The proposal is a true win-win.

It is our sincere hope that the Services will fully analyze the CFTLC alternative.

WILD SALMON CENTER

To: National Oceanic and Atmospheric Administration

From: Bob Van Dyk, on behalf of Wild Salmon Center (bvandyk@wildsalmoncenter.org)

Date: April 19, 2021

RE: NMFS-2021-0019 Notice of Intent to Prepare Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

I am pleased to submit comments for Wild Salmon Center regarding the notice of intent to prepare an EIS on the Western Oregon State Forests Habitat Conservation Plan. We welcome the opportunity to provide these comments.

Wild Salmon Center works with partners to support the conservation and sustainable use of our Oregon fisheries. Because forested habitats are a vital part of salmon and steelhead life history, we closely follow the work of the Oregon Board of Forestry as it relates to both state and private forests. The Western Oregon state forests have long been of interest to our organization, because these public lands provide extensive habitat for comparatively healthy salmon and steelhead populations.

We welcome Oregon's pursuit of a Habitat Conservation Plan, and the draft documents produced to date are encouraging.

We offer several suggestions for improvements and for the consideration of alternatives:

1) Include an alternative that models the use of the Western Oregon BLM riparian strategy for this HCP. As public lands that aim to conserve similar species, while also generating revenue that benefits local taxing districts, the BLM strategy would be helpful to consider. The BLM strategy has undergone extensive review as part of its approval, so the potential effects are better understood.

2) Include an alternative that provides longer temperature buffers on the non-fish reaches upstream of fish reaches. Davis et. al. (Hydrological Processes, 2015) found that on average significant temperature effects remained 300m below harvest. A 1500-foot buffer is worth consideration to further diminish potential upstream warming. Similarly, the 35-foot buffer on many non-fish streams above the temperature buffer may also be inadequate, per the recent hardrock study in Washington State. We suggest modeling 50 feet.

3) Include an alternative that designates several watersheds for aquatic conservation as the primary purpose. These watersheds should be ones where ODF owns the vast majority of the watershed, so that the effect of ODF management presents a clear signal in aquatic processes. These should be areas where some deleterious practices, such as clear cutting and road construction, are prohibited, and where aquatic conservation is the driving management goal. A subset of the Aquatic Anchor Habitats that now guide policy are worth considering as places to implement such an approach, which might be done by concentrating HCA designations and other restrictions that limit clear cutting. Such areas could also be locations of active efforts to restore and protect stream systems. Such designated areas would help establish

the potential of some forested watersheds to recover with protection and restoration as their primary purpose, rather than to do so while increasing stressors on the aquatic system from harvest-related activities. In this way such aquatic reserves could serve as a control against which more intensive forest management watersheds could be measured.

5) The section on adaptive management and monitoring could be bolstered in regards to water quality. In particular, hydrological connectivity of the road system can provide an indicator and compliance target. Because hydrological connectivity is a well-recognized cause of water quality degradation, setting a target and tracking the change in the level of connectivity allows for compliance monitoring and effectiveness monitoring. Currently Section 6.4.1.3 discusses tracking miles of road improved to eliminate or reduce hydrological connectivity, but miles of treated road alone reveals little absent the context of the total number of miles in need of treatment and the percentage goal for the road system to attain. We recommend setting a goal of 5% of the total ODF road network to be hydrologically connected at the HUC 10 scale. Certainly this indicator would need to be assessed in the initial inventory and then reported on regularly. The *Geomorphic Road Analysis and Inventory Package* provides a model for tracking hydrological connectivity and other key road attributes.

6) Stakeholder conversations with ODF have put considerable focus on the management of steep slopes. We are pleased to see some signs of increased clarifications regarding ODF strategies, but we remain concerned about what to expect, exactly, in practice, when it comes to management of higher risk sites. We look forward to gaining greater clarity on the steep slope strategy, so that we can better assess likely effects.

Please let us know if we can clarify these comments.

OREGON FOREST &
INDUSTRIES COUNCIL
SUSTAINABILITY. SCIENCE. INNOVATION. GROWTH.

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April 21, 2021

Submitted via www.regulations.gov

RE: NOAA_NMFS-2021-0019 Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

Dear Tere O'Rourke, Paul Henson, and Peter Daugherty,

Thank you for the opportunity to provide National Environmental Policy Act (NEPA) scoping comments. The Oregon Forest & Industries Council (OFIC) is a statewide trade association representing more than 50 Oregon forestland owners and forest products manufacturers. Our members own more than 90 percent of Oregon's large, privately owned forestland. OFIC's core mission is to advocate on behalf of its members to maintain a positive, stable business operating environment for Oregon's forest products sector that fosters long-term investments in healthy forests; to ensure a reliable timber supply from Oregon's public and private forestlands; and to promote stewardship and sustainable management of forestlands that protect environmental values and maintain productive uses on all forestlands.

As we seek to provide relevant feedback at this point in the planning process, OFIC uses the March 2021 Western Oregon State Forests Habitat Conservation Plan Administrative Draft (draft HCP) as our document of reference. That document can be found here:
https://www.oregon.gov/odf/board/Documents/fmp-hcp/western-oregon-state-forests-hcp-draft-march2021.pdf.

Purpose and need

We believe it is completely within reason to conduct a take avoidance program on non-federal lands. This is a viable approach to Endangered Species Act (ESA) compliance as evidenced by the overwhelming number of non-federal forest lands throughout the country being adequately managed in such a manner. Nonetheless, the current Forest Management Plan (FMP) employed within the Western Oregon State Forests (WOSF) was never designed to be a take avoidance plan, it was designed to be coupled with an Incidental Take Permit (ITP), although that pursuit was ultimately abandoned. Therefore, when presented with a binary choice of adhering to the current FMP or supporting the effort to develop a new FMP coupled with a Habitat Conservation Plan (HCP) on State Forests, OFIC supports the latter. It is our understanding that the National Marine Fisheries Services (NMFS) and the Fish and Wildlife Services (FWS) (together referenced here as "the Services") have identified the need to issue an Incidental Take Permit (ITP) to the Oregon Department of Forestry (ODF) for the protection of "covered species and their habitat while allowing the applicant to manage WOSF lands in compliance with the ESA" as the purpose and need. OFIC supports the pursuit of the HCP in this instance but feels that the HCP must work in concert with all applicable state statutes and mandates governing the management of these state forest lands. Oregon Revised Statute (ORS) requires that state forests be managed to secure "greatest permanent value" (GPV)(ORS530.050). These statutes are clear that the primary purpose of these lands is for their management, it lists twelve specific management actions that can be conducted on state forests, all are consistent with creating revenue streams for the counties in which the lands reside. It is material that ODF and the Board of Forestry cannot acquire new lands without the prior approval of the county court or board of county commissioners of the county within which the lands are situated (ORS 530.010(2)). OFIC advises the Services and ODF to ensure that the county interests in this process be understood and considered with more weight than a mere stakeholder. Furthermore, the purpose and need statement should be revised to reflect the state statutes governing these lands. We would suggest a modest revision such as, ..." while allowing the applicant to manage WOSF lands in compliance with the ESA <u>and all applicable state statutes and rules pertaining to these lands.</u>"

Species identified for coverage

The draft HCP should only provide coverage for species currently listed under the federal Endangered Species Act (ESA). Six of the 17 species proposed for coverage in the draft HCP are not federally listed species. Four of those species are not listed on either Federal or Oregon State threatened or endangered species lists. It is our understanding that several of the restrictions envisioned under the draft HCP have been proposed as conservation measures for the express benefit of these six non-listed species. Creating measures that further reduce harvest or restrict management of state lands in exchange for "coverage" for species that appear to be thriving without these protections measures is irresponsible to the fiduciary obligation of the agency to manage these lands for trust beneficiaries. Stronger consideration should be given to this list and the vast amount of professional and scientific rigor that has gone into the recent ESA listing decisions. The recent FWS decision not to list the red tree vole (RTV) also provides sufficient rational for excluding the species for coverage within this draft HCP.

> "We have carefully assessed the best scientific and commercial data regarding the past, present, and future threats to the north Oregon coast population of the red tree vole, and we evaluated all relevant factors under the five listing factors, including any regulatory mechanisms and conservation measures addressing these stressors. Since the development of our 2016 CNOR, tree vole habitat was modeled across the DPS, and we were able to use that spatial data to more robustly assess existing habitat conditions, population resiliency, and associated future trends in a way that had been previously unattainable. Specifically, the spatial habitat layer allowed us to consider distribution of habitat and model clusters of occupied habitat to serve as proxies for red tree vole subpopulations or management units on which to do an analysis of resiliency, redundancy, and representation for the status assessment. This modeling indicated that 26 percent of the DPS area was suitable habitat, as compared to the 11 percent that the model we used in our previous status reviews had predicted. By projecting habitat trends in future scenarios, we developed a more informed picture of the future than had been available for the 2016 CNOR.
>
> The primary stressors affecting the north Oregon coast population of the red tree vole include habitat loss and fragmentation due to timber harvest and wildfire. Despite impacts from these stressors and some observed decline in abundance, the red tree vole in this area has maintained resilient populations over time, primarily in the two large habitat clusters under Federal management, the Nestucca Block and South Block. Although we predict some continued impacts from these stressors in the future, we anticipate these two large habitat clusters will continue to maintain resiliency and provide redundancy across

a large portion of the DPS. Furthermore, it is reasonable to expect the Tillamook State Forest and Kilchis River clusters to increase and expand their areas based on habitat succession in the adjoining landscape. A portion of the State Forest land adjoining these two clusters will likely mature into red tree vole habitat (80 years old or older) over the coming years, thereby increasing the footprint of these two clusters, and even connecting them. With respect to future representation of the red tree vole, the two large habitat clusters will continue to maintain both the Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) vegetation zones even in light of climate change.

For these reasons, we find that these stressors do not, alone or in combination, rise to a level that causes the north Oregon coast population of the red tree vole to meet the definition of an endangered species or a threatened species. Therefore, we find that listing the north Oregon coast DPS of the red tree vole as an endangered species or threatened species is not warranted."
(https://federalregister.gov/d/2019-27334)

Given these and similar findings for species not listed in the ESA, we strongly encourage a pairing down of the list of species being considered for coverage under the draft HCP.

Terrestrial Conservation Strategy
Setting aside 275,000 acres or approximately 43% of ODF managed lands in terrestrial Habitat Conservation Areas (HCAs) goes too far. According to ODF information, these acres, when combined with other administratively designated set asides as well as conservation acres associated with riparian areas equates to well over 50% of the land base being set aside with little to no long-term sustainable harvest. ODFs modeling efforts accounting for these very large set asides confirms a dramatic decrease in available harvest and revenues resulting from these measures. To our knowledge, no other non-federal landowner has been expected to shoulder such a disproportionate burden.

The amount of land set aside in the State's draft HCP exceeds similar set asides in other HCPs. A recent review of approved HCPs across ownership types demonstrates an inequity in the conservation measures envisioned under this draft HCP. It is unclear to us why these lands should be expected to carry a disproportionately larger burden of habitat relative to the size of ownership than all other non-federal landowners.

The amount of land is not justifiable under the notion of GPV, and the three pillars of social, environmental, and financial considerations. This draft plan, with its very large HCAs disproportionately favors the environmental portion of the equation and leaves a noticeable imbalance that shortchanges both the social aspect of the local community and the financial returns to the state and county beneficiaries. This imbalance is glaring evidence that certain interests have been excluded within the planning effort of the draft HCP up to this point.

It is our understanding that these very large set asides are proposed primarily to aid the recovery of northern spotted owl (NSO), and to a lesser extent marbled murrelet. Setting aside large swaths of land in order to develop old forest habitat is a well-known strategy in the effort to recover NSO on federal lands. Unfortunately, these draconian measures have been found wholly inadequate at halting the decline of the species despite the overwhelming social costs that ensued. Over the decades, despite dramatic reductions in harvest, and abundant aging forests, NSO occupancy consistently decreased

(Figure 1, right). This sustained decline strongly indicates efforts to conserve large amounts of mature habitat is not affective in recovering the species.

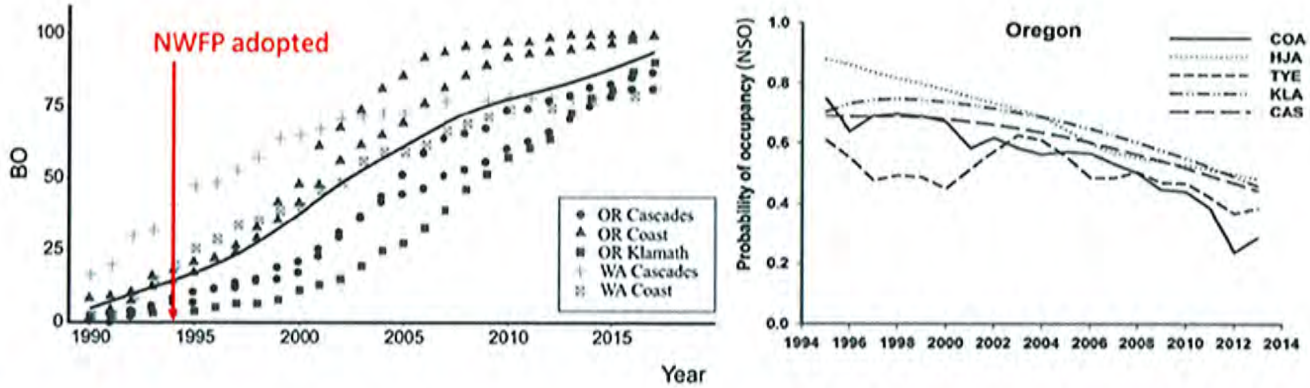

Figure 1. Trend in percent of NSO territories where at least one barred owl (BO) was detected each year (left), coinciding with sustained decline in NSO occupancy in suitable habitats (right). Adapted from Figure 2 in Jenkins et al. 2019 (left) and from Figure 8 in Dugger et al. 2019 (right).

These trends led researchers at FWS to begin barred owl removal experiments across the region. Results from these removal experiments has demonstrated that at all three locations, barred owl removal has stabilized NSO populations (Figure 2).

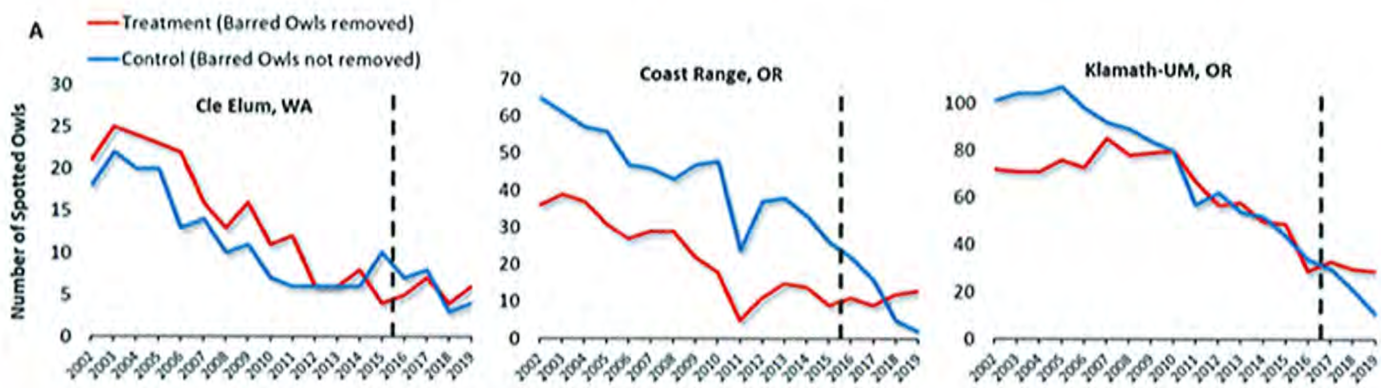

Figure 2. NSO populations stabilize after four years of sustained barred owl removal (red lines), whereas NSO populations continue to decline (blue lines) when barred owls are not removed. Adapted from Figure 6 in Weins et al. 2019.

These results introduce a novel approach to NSO conservation. While novel for this species, predator control is a well-documented and effective tool in species conservation and management for myriad wildlife species. From big game to aquatic mammals, the Services are familiar with these effective tools. Armed with this new information, we are now on the precipice of deploying a tool with far greater prospects in NSO conservation efforts. While habitat is still an important component of any species conservation effort including NSO, OFIC implores the Services and ODF to recognize the opportunity to advance a more aggressive predator control program in exchange for a decrease in the size of the HCA set asides for these species. Adjusting these conservation 'knobs' as described above will surely provide better outcomes for NSO while allowing a more equitable approach to GPV.

Even as NSO populations continue to decline, and research concludes that the only way to recover the species is through predation management of the invasive barred owl, the socio-economic impacts of those decisions in the 1990s continue to be felt by communities across Oregon. Historic data from the Oregon Department of Forestry shows that three-quarters of all Oregon mills closed between 1980 and 2010, and half of the primary wood product manufacturing jobs were lost during that same time as a result of dramatic reductions in federal harvest levels following the listing of the NSO. OFIC strongly recommends a robust socioeconomic analysis of the draft HCP within this process that includes direct and indirect employment considerations, health and vitality of county and special district revenue streams and subsequent services as well as impacts to compounding beneficiaries as a result of proposed alternatives considered in this planning process.

Aquatic Conservation Strategy

Riparian Conservation Areas (RCAs) should allow more opportunity for management activity in proximity to streams. Research documenting fish populations following contemporary timber harvest has revealed a complex response. For example, streams flowing through recent harvest areas are often found to produce higher fish biomass (Murphy and Hall 1981; Kaylor and Warren 2018; Moring and Lantz 1975; Bilby and Bisson 1992) due to increased solar exposure of surface water, causing increases in primary productivity (McClain et al. 1998). Furthermore, fast colonizing riparian tree species, such as Red Alder, increase insect abundance in streams, and can support four times more juvenile salmonids than colonizing young conifers after harvesting (Piccolo and Wipfli 2002). Moreover, similar to fish biomass, fish production (mg/m^2/day) increases after harvests. Bisson and Bilby (1992) found that salmonid production was 1.7 – 4.0 times higher in a harvested site compared to an old growth site. Salmonid growth in forested streams is dependent on primary production (Bilby and Bisson 1992; Kaylor and Warren 2018), which is positively correlated to light availability. Consequently, growth (% per day) of Coho salmon was shown to be 30% higher in a stream near a recent harvest compared with an old growth site (Bilby and Bisson 1987). Fish growth is also influenced by temperature, such that small increases in temperature within artificially dense forests associated with created openings in forest canopy causes increases in fish growth (Holtby 1988; Bilby and Bisson 1992; Bateman et al. 2018). These results suggest that canopy gaps are important regulators of fish growth rates and underscores the importance of management activities in close proximity to streams. The RCAs outlined in the draft HCP do not reflect the findings from these studies.

Monitoring and Adaptive Management

The draft HCP describes an adaptive management program that will track the progress of the HCP in attaining the goals envisioned at the outset. Specifically, effectiveness monitoring is described as a process that will assess "habitat development as estimated by species habitat models". At least in terms of the NSO, if the goal of the HCP is conservation of the species where feasible on state forest lands, OFIC encourages the Services and ODF to adjust monitoring efforts towards accounting for the vitality of the species themselves as opposed to only its habitat. As evidenced and discussed above, abundant NSO habitat across federal lands has not resulted in a successful outcome for NSO. The goal should be the conservation of the species and not habitat for the sake of habitat. This recommendation is most applicable to species residing withing contiguous blocks of state forest. Species with life cycles both within AND outside of the forest setting (salmonids, marbled murrelet, etc.) are more difficult and complex in terms of tying successful conservation to the efforts deployed in the state forest setting alone. In acknowledging these limitations, however, OFIC does not wish to diminish the point made above. It has been said that you cannot manage or improve something unless you measure it, this adage seems quite applicable to managing for NSO. Failure to accurately account for progress in this manner will lead to false conclusions of success and continued implementation of imprudent policy.

Implementation, Cost, and Funding

A HCP only has value for conservation if the tenants of the plan are implemented across the landscape. There is a serious question of financial viability that jeopardizes this draft HCP effort. According to ODF's most recent information, their draft HCP will produce an annual budget shortfall of $12-$24 million. The State's draft HCP must identify long-term dependable funding to be viable. The only source of identified controllable, dependable long-term funding is through timber harvest and forest management. ODF's projections of diminishing harvest over time because of the draft HCP will result in a HCP that the State cannot afford to implement, and thus a wasted effort. OFIC strongly urges all parties to recognize this foundational aspect of the process and reconcile the draft HCP to the financial realities facing the State.

Participation on the State's Steering Committee

The draft HCP contains a section expounding the pre-planning process that took place in developing the draft HCP, but the lack of representation from foundational stakeholders has created a fundamental flaw of compounding oversites. The draft HCP accurately describes the current engagement between the State and the Services; engaged in substantive dialogue which resulted in the State's draft HCP. Problematically, the process excluded a relevant government entity representing the direct financial beneficiaries for which these lands are managed, a gross oversight evidenced within the State's draft HCP. The draft HCP states that these two parties "worked together" to achieve "a mutually acceptable outcome that satisfies, *to the greatest degree possible*, the interest of *all participants*" (emphasis added). We would strongly assert that by excluding county government officials who represent the social welfare of their communities, and who are in fact the direct financial beneficiaries for which these lands are held in trust, this project was handicapped from the beginning and could therefore not live up to the goal of satisfying "*to the greatest degree possible*" the interest of "*all participants.*" We firmly believe that this situation must be remedied, and the alternative submitted by the counties be analyzed on its merits and included in the draft Environmental Impact Statement (EIS) being prepared by the services.

Alternative Approach

It is our understanding that the Trust Land Counties have proposed an alternative that better achieves both financial returns and species conservation, through targeted predator control coupled with reductions in the size of the HCAs. As noted above, OFIC supports these concepts and would expect the Services and the State to support the formal analysis of this alternative.

Thank you for the opportunity to provide comments.

Sincerely,

Seth A Barnes
Director of Forest Policy
Oregon Forest & Industries Council

Literature Cited

Bateman, D. S., R. E. Gresswell, D. Warren, D. P. Hockman-Wert, D. W. Leer, J. T. Light, and J. D. Stednick. 2018. Fish response to contemporary timber harvest practices in a second-growth forest from the central Coast Range of Oregon. Forest Ecology and Management 411:142–157. Elsevier.

Bilby, R. E., and P. A. Bisson. 1992. Allochthonous versus autochthonous organic matter contributions to the trophic support of fish populations in clear-cut and old-growth forested streams. Canadian journal of fisheries and aquatic sciences 49(3):540–551. NRC Research Press.

Bilby, R. E., and P. A. Bisson. 1987. Emigration and production of hatchery coho salmon (Oncorhynchus kisutch) stocked in streams draining an old-growth and a clear-cut watershed. Canadian Journal of Fisheries and Aquatic Sciences 44:1397–1407.

Dugger et al 2016. http://dx.doi.org/ 10.1650/CONDOR-15-24.1

Holtby, L. B. 1988. Effects of logging on stream temperatures in Carnation Creek, British Columbia, and associated impacts on the coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences 45:502–515.

Jenkins et al. 2019 https://doi.org/10.1093/condor/duz055

Kaylor, M. J., and D. R. Warren. 2018. Canopy closure after four decades of postlogging riparian forest regeneration reduces cutthroat trout biomass in headwater streams through bottom-up pathways. Canadian Journal of Fisheries and Aquatic Sciences 75(4):513–524. NRC Research Press.

Murphy, M. L., and J. D. Hall. 1981. Vaired effects of clear-cut logging on predators and their habitat in small streams of the Cascade Mountains, Oregon. Canadian journal of fisheries and aquatic sciences 38(2):137–145. NRC Research Press.

Moring, J. R., and R. L. Lantz. 1975. The Alsea Watershed Study: effects of logging on the aquatic resources of three headwater stream of the Alsea River, Oregon. Part 1 - biological studies. Corvalis, Oregon.

McClain, M. E., R. E. Bilby, and F. J. Triska. 1998. Nutrient cycles and responses to disturbance. River ecology and management: lessons from the Pacific Coastal ecoregion. New York NY: Springer:347–372.

Piccolo, J. J., and M. S. Wipfli. 2002. Does red alder (Alnus rubra) in upland riparian forests elevate macroinvertebrate and detritus export from headwater streams to downstream habitats in southeastern Alaska? Canadian Journal of Fisheries and Aquatic Sciences 59(3):503–513. NRC Research Press.

Weins et al. 2019 https://doi.org/10.3133/ofr20201089

SUZANNE WEBER
STATE REPRESENTATIVE
HOUSE DISTRICT 32

HOUSE OF REPRESENTATIVES

April 20, 2021

Dear Board of Forestry Members and State Forester Daugherty:

I am writing you today out of concern and frustration with the Oregon Department of Forestry's (ODF) draft habitat conservation plan (HCP). As the former mayor of Tillamook, I know how important state forests are to North Coast communities. As presently drafted, I fear this HCP will have devastating impacts on the people and communities I represent. I'm urging you to consider alternatives that would provide better outcomes.

I have lived in Tillamook for over 50 years. As a business owner, educator, and public servant, I have seen first-hand how working public forests provide economic, environmental, and social benefits to timber-dependent communities. When federal timber harvests all but disappeared in the 1990s, communities suffered long-term devastation. Crime increased, graduation rates declined, and ultimately many people had no choice but to move away from the places they were once proud to call home. The sawmills in Tillamook generate hundreds of millions of dollars in direct and indirect economic activity for Northwest Oregon. If log supply from state forests decreases, that jeopardizes entire communities, not just those who work directly in the forest sector. As a member of the House Committee on Housing and Vice-Chair of the Committee on Education, I can assure you that housing and educational needs of our north coast communities are significant and will only increase in the coming years. The funding our schools and other public services receive through state forest timber revenue is essential to our ability to meet current and future challenges.

I am also deeply concerned that any agency would knowingly pursue a plan that would lead to its own insolvency and hinder its ability to fulfill its mission and contractual obligations. The current HCP, if implemented, would amount to gross financial mismanagement. We have a number of pressing social and environmental needs in this state; I for one do not have an appetite to support the use of scarce General Fund dollars to subsidize an agency that should, by right and responsibility, be able to harvest enough timber to cover its own operating costs.

Needless to say, I was surprised to learn the Board of Forestry voted to allow the HCP to move into the National Environmental Policy Act (NEPA) process without first obtaining approval from the Forest Trust Land Counties. The state has a contractual obligation to the counties to manage state forestland for their benefit. Their absence in this process effectively disenfranchises rural residents—my constituents—from state forest management decisions. The Forest Trust Land Counties and the people they represent will bear all of the social and economic costs of this HCP (not to mention the additional risk of wildfire that will inevitably follow when forests are

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left unmanaged and ODF's budget shrinks further). Their absence at the table thus far is inexcusable.

We simply can't afford the HCP as currently drafted. Thankfully, the Trust Land counties are developing an alternative that could lead to more effective protections for threatened species while also increasing acres available for harvest. I urge the Board, ODF, and federal agencies to give the counties' alternative the consideration it deserves and come up with a plan that better suits the needs of all involved.

Respectfully,

Suzanne Weber

Suzanne Weber
State Representative

Capitol Address: 900 Court St. NE, H-483, Salem, OR 97301 – Phone (503) 986-1432
District Address: PO Box 983, Tillamook, OR 97141 – Phone: (503) 300-4493 – rep.suzanneweber@oregonlegislature.gov

April 21, 2021
Submitted via www.regulations.gov

RE: NOAA_NMFS-2021-0019 Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

Please see attached 512 letters sent to the Oregon Department of Forestry and the Oregon Board of Forestry by Oregonians urging for better balance in the 2021 Western Oregon State Forests Habitat Conservation Plan Administrative Draft (draft HCP). A summary of their comments can be found below.

- The current draft HCP falls significantly short. It sacrifices rural Oregon communities – jobs and dollars needed to support local services -- in the effort to protect the spotted owl and other threatened species.
- We already know the so-called set-aside "solutions" proposed within this plan don't work to save the spotted owl, but we do know they cost jobs.
- For decades, Oregonians have seen that setting aside massive amounts of forest lands is not an effective way to protect threatened species but it certainly is an effective way to derail timber harvest and destroy jobs.
- Please don't set aside 60 percent of our state forest trust lands for habitat – we've already seen that method fail to save the spotted owl since it was listed in the 90s.
- The state should be considering alternate plans that accomplish what's best for our communities *and* the owl.
- Putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably and creates unhealthy forests that contribute to catastrophic megafires.

In addition to the letters, we have also attached the full list of the 512 Oregonians who submitted comments on the draft HCP.

We ask that you please hear their request.

Sara Duncan
Oregon Forests Forever

Oregon Forests Forever is growing statewide coalition of individuals, organizations and businesses – led by the Oregon Forest & Industries Council — who support active, sustainable management of Oregon's forests.

-- *Sent from **Dean Carlisle** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Dean Carlisle

-- *Sent from **Dean Carlisle** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Bret Mahoney** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Bret Mahoney

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Thank you,
Bret Mahoney

-- *Sent from **Shirley Usher** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to r this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Shirley Usher

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Shirley Usher

*-- Sent from **randy kallio** to **Board of Forestry** on Apr 6, 2021 --*

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Thanks,
randy kallio

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to r this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
randy kallio

-- *Sent from **Robert Vance** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Robert Vance

-- *Sent from **Robert Vance** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
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-- *Sent from **Harold Tiernan** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Harold Tiernan

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Thank you,
Harold Tiernan

-- *Sent from **John Ernst** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
John Ernst

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-- *Sent from **Rebecca Morrill** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Rebecca Morrill

-- *Sent from **Rebecca Morrill** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Rebecca Morrill

-- *Sent from **Brad Fry** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Brad Fry

-- *Sent from* ***Brad Fry*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **John Bonnar** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
John Bonnar

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Sincerely,
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-- *Sent from* ***David Officer*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

Dear [@legislatorName],

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Thanks,
David Officer

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Thanks,
David Officer

-- *Sent from **Cindy Smith** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Cindy Smith

-- *Sent from **Cindy Smith** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from* ***Michelle Paul*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Michelle Paul

-- *Sent from **Michelle Paul** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Michelle Paul

-- *Sent from* ***Barbara Taylor*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
Barbara Taylor

-- *Sent from* ***Barbara Taylor*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from* ***Brandon Epling*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from* ***Claudette Hills*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
Claudette Hills

-- *Sent from **Claudette Hills** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Ulrich Lau** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Ulrich Lau

-- *Sent from **Ulrich Lau** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Theodore Evertz** to **Board of Forestry** on Apr 6, 2021* --

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Theodore Evertz

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-- *Sent from **Nickie Gaylord** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Nickie Gaylord

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Thank you,
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-- *Sent from **Lisa Samuelson** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Lisa Samuelson

-- *Sent from **Lisa Samuelson** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Lisa Samuelson

-- *Sent from* ***Ms Morrison*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Ms Morrison

-- *Sent from **Ms Morrison** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Bill Ocumpaugh** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Bill Ocumpaugh

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-- *Sent from **Thomas Hardesty** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **John Perkins** to **Board of Forestry** on Apr 6, 2021* --

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Thanks,
John Perkins

-- *Sent from **Linda Parker** to **Board of Forestry** on Apr 6, 2021* --

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Linda Parker

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Thank you,
Linda Parker

-- *Sent from **Debra Fromdahl** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Debra Fromdahl

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-- *Sent from **ken ezell** to **Board of Forestry** on Apr 6, 2021* --

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Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
ken ezell

-- *Sent from* ***ken ezell*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **Richard Sutherlin** to **Board of Forestry** on Apr 6, 2021* --

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

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Please consider alternatives to r this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

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-- *Sent from **John Hawthorne** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **James Pointer** to **Board of Forestry** on Apr 6, 2021* --

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Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
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-- *Sent from* ***Linda Westlake*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thanks,
Linda Westlake

-- *Sent from* ***Linda Westlake*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Linda Westlake

-- *Sent from **Jacqueline Ingalls** to **Board of Forestry** on Apr 6, 2021* --

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Jacqueline Ingalls

-- *Sent from* ***Jacqueline Ingalls*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **Eileen Moresi** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Eileen Moresi

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-- *Sent from **Don Anderson** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
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-- *Sent from **Jeff Mallonee** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Joe West** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Pat Bognar** to **Board of Forestry** on Apr 6, 2021* --

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Pat Bognar

-- *Sent from **Pat Bogner** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Bonnie Bingler** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **John McMurtray** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from* ***Karen Lackner*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **Jim Rabe** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Robert Teran** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Walter Kennick** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from* ***Dorothy Taylor*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **Henry Mendazona** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Sharon Pointer** to **Board of Forestry** on Apr 6, 2021* --

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Sharon Pointer

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Sharon Pointer

-- *Sent from **Michelle Foltz** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Michelle Foltz

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Thank you,
Michelle Foltz

-- *Sent from **James Morton** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Christine Hurd** to **Board of Forestry** on Apr 6, 2021* --

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By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Christine Hurd

-- *Sent from* ***Keith Woung*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Sincerely,
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-- *Sent from **Virginia Gerstner** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Virginia Gerstner

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Sincerely,
Virginia Gerstner

-- *Sent from **Alexandria flores** to* ***Board of Forestry*** *on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to r this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
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Thanks,
Alexandria flores

-- *Sent from **Scott Mahood** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Scott Mahood

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Scott Mahood

-- *Sent from **Mark Baumgartner** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Mark Baumgartner

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-- *Sent from* ***Linda Peacock*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Sincerely,
Linda Peacock

-- *Sent from* ***Linda Peacock*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Sincerely,
Linda Peacock

-- *Sent from* ***Alison Kingsberry*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
Alison Kingsberry

-- *Sent from **Alison Kingsberry** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Alison Kingsberry

-- *Sent from* ***Frank Wildgrube*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Frank Wildgrube

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Frank Wildgrube

-- *Sent from* ***Stanislav Aksenov*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Stanislav Aksenov

-- *Sent from* ***Stanislav Aksenov*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Stanislav Aksenov

-- *Sent from **ellen nieminen** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
ellen nieminen

-- *Sent from **ellen nieminen** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from* ***billie ambrose*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Sincerely,
billie ambrose

-- *Sent from **billie ambrose** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Chris Johnson** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from **Jack LeRoy** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Jack LeRoy

-- *Sent from* ***Jack LeRoy*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
Jack LeRoy

-- *Sent from **Teresa Tyler** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Teresa Tyler

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-- *Sent from* ***Pat wright*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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-- *Sent from **Marsha Ferry** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
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-- *Sent from **Marsha Ferry** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
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-- *Sent from **Renee Harris** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Renee Harris

-- *Sent from **Renee Harris** to **Board of Forestry** on Apr 6, 2021* --

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Renee Harris

-- *Sent from* ***John ward*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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John ward

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Sincerely,
John ward

-- *Sent from **Rebecca Cowley** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

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Thanks,
Rebecca Cowley

*-- Sent from **Rebecca Cowley** to **Board of Forestry** on Apr 6, 2021 --*

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Thanks,
Rebecca Cowley

-- *Sent from* ***Karen Neal*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
Karen Neal

-- *Sent from **Karen Neal** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Karen Neal

*-- Sent from **Monte Gingerich** to **Board of Forestry** on Apr 6, 2021 --*

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Thank you,
Monte Gingerich

-- *Sent from **Monte Gingerich** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
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-- *Sent from* ***Ursula Walters*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thanks,
Ursula Walters

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Thanks,
Ursula Walters

-- *Sent from **Bill Grable** to **Board of Forestry** on Apr 6, 2021* --

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Sincerely,
Bill Grable

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Sincerely,
Bill Grable

-- *Sent from* ***arthur schieffer*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thank you,
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-- *Sent from **Frank Ambrusko** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
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-- *Sent from* ***Patrice Kerstetter*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Patrice Kerstetter

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Thank you,
Patrice Kerstetter

-- *Sent from **John Kendall** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to r this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
John Kendall

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-- *Sent from **Michael Bodewitz** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Michael Bodewitz

-- *Sent from **Michael Bodewitz** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Michael Bodewitz

-- *Sent from **Terri Adair** to **Board of Forestry** on Apr 6, 2021* --

Dear [@legislatorName],

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Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Terri Adair

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-- *Sent from **Gerald Palanuk** to **Board of Forestry** on Apr 6, 2021* --

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Thank you,
Gerald Palanuk

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Thank you,
Gerald Palanuk

-- *Sent from* ***Shirley Benson*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Thanks,
Shirley Benson

-- *Sent from **Shirley Benson** to **Board of Forestry** on Apr 6, 2021* --

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-- *Sent from* ***Brenda Toschik*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
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-- *Sent from* ***Brian Conover*** *to* ***Board of Forestry*** *on Apr 6, 2021* --

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Brian Conover

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-- *Sent from **Kathryn McMichael** to **Board of Forestry** on Apr 7, 2021* --

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Thank you,
Kathryn McMichael

-- *Sent from* ***Kathryn McMichael*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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-- *Sent from **Daniel Radke** to **Board of Forestry** on Apr 7, 2021* --

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Daniel Radke

-- *Sent from **Daniel Radke** to **Board of Forestry** on Apr 7, 2021* --

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-- *Sent from **jim nylund** to **Board of Forestry** on Apr 7, 2021* --

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-- *Sent from **Maryann Russell** to **Board of Forestry** on Apr 7, 2021* --

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Maryann Russell

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Maryann Russell

-- *Sent from* ***Ervine Nelson*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Ervine Nelson

-- *Sent from **Ervine Nelson** to **Board of Forestry** on Apr 7, 2021* --

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-- *Sent from* ***Rita Castillo*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Thank you,
Rita Castillo

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Thank you,
Rita Castillo

-- *Sent from **Dalton Walker** to **Board of Forestry** on Apr 7, 2021* --

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Dalton Walker

-- *Sent from **Dalton Walker** to **Board of Forestry** on Apr 7, 2021* --

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-- *Sent from* ***Kathy Heitz*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Thank you,
Kathy Heitz

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*-- Sent from **Chris Silbernagel** to **Board of Forestry** on Apr 7, 2021 --*

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Sincerely,
Chris Silbernagel

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-- *Sent from **Mark Holland** to **Board of Forestry** on Apr 7, 2021* --

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Mark Holland

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Thank you,
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-- *Sent from **Caleb Brown** to **Board of Forestry** on Apr 7, 2021* --

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Caleb Brown

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-- *Sent from **Jennifer Miller** to **Board of Forestry** on Apr 7, 2021* --

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Thanks,
Jennifer Miller

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-- *Sent from **Sally Cadonau** to **Board of Forestry** on Apr 7, 2021* --

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Thanks,
Sally Cadonau

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-- *Sent from* ***Anne Pratt*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Anne Pratt

-- *Sent from* ***Anne Pratt*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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-- *Sent from **Fredrick Weaver** to **Board of Forestry** on Apr 7, 2021* --

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

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-- *Sent from **Dyann McCollum** to **Board of Forestry** on Apr 7, 2021* --

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Thanks,
Dyann McCollum

-- *Sent from* ***Dyann McCollum*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Dyann McCollum

-- *Sent from **Barbara Korsmo** to **Board of Forestry** on Apr 7, 2021* --

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Barbara Korsmo

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Thanks,
Barbara Korsmo

-- *Sent from* ***Noel Crabtree*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

Dear [@legislatorName],

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Noel Crabtree

-- *Sent from **Noel Crabtree** to **Board of Forestry** on Apr 7, 2021* --

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-- *Sent from **Richard Braatz** to **Board of Forestry** on Apr 7, 2021* --

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Richard Braatz

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Richard Braatz

-- *Sent from* ***Eric Bufka*** *to* ***Board of Forestry*** *on Apr 7, 2021* --

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Eric Bufka

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Thanks,
Eric Bufka

-- *Sent from **Larry McLaughlin** to **Board of Forestry** on Apr 7, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Larry McLaughlin

-- *Sent from **Larry McLaughlin** to **Board of Forestry** on Apr 7, 2021* --

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Thank you,
Larry McLaughlin

-- *Sent from* ***Lise Hull*** *to* ***Board of Forestry*** *on Apr 8, 2021* --

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Thank you,
Lise Hull

-- *Sent from **Lise Hull** to **Board of Forestry** on Apr 8, 2021* --

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Thank you,
Lise Hull

-- *Sent from* ***Alice Colby*** *to* ***Board of Forestry*** *on Apr 8, 2021* --

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Thanks,
Alice Colby

-- *Sent from **Alice Colby** to **Board of Forestry** on Apr 8, 2021* --

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Thanks,
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-- *Sent from **Diann Washburn** to **Board of Forestry** on Apr 8, 2021* --

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Sincerely,
Diann Washburn

-- *Sent from **Diann Washburn** to **Board of Forestry** on Apr 8, 2021* --

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-- *Sent from **Douglas littlejohn** to **Board of Forestry** on Apr 8, 2021* --

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Douglas littlejohn

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-- *Sent from **Darline Brundage** to **Board of Forestry** on Apr 9, 2021* --

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-- *Sent from* ***William Higby*** *to* ***Board of Forestry*** *on Apr 12, 2021* --

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Thank you,
William Higby

-- *Sent from* ***William Higby*** *to* ***Board of Forestry*** *on Apr 12, 2021* --

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Thank you,
William Higby

-- *Sent from **Jeffrey Frank** to **Board of Forestry** on Apr 12, 2021* --

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-- *Sent from **Brenda Anderson** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from* ***Frances Herber*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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Frances Herber

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-- *Sent from* ***Brittney Stephen*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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Sincerely,
Brittney Stephen

-- *Sent from **Brittney Stephen** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Martha Smith** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Martha Smith

-- *Sent from **Martha Smith** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Martha Smith

-- *Sent from **JolÃ© Davidson** to **Board of Forestry** on Apr 16, 2021* --

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Thanks,
Jole Davidson

-- *Sent from* ***JolÃ© Davidson*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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-- *Sent from* ***Kris Jakubowski*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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Sincerely,
Kris Jakubowski

-- *Sent from **Kris Jakubowski** to **Board of Forestry** on Apr 16, 2021* --

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Sincerely,
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-- *Sent from **Taomi Reynolds** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Taomi Reynolds

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-- *Sent from **Jeramy Ritter** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Jeramy Ritter

*-- Sent from **Jeramy Ritter** to **Board of Forestry** on Apr 16, 2021 --*

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-- *Sent from **Debra Rehn** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from* ***Melissa Deuerling*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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-- *Sent from **Victoria Murray** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Victoria Murray

-- *Sent from **Richard Ziegler** to **Board of Forestry** on Apr 16, 2021* --

Dear [@legislatorName],

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And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

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-- *Sent from **Manuel Orellana** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from* ***Timothy Shiel*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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-- *Sent from **Kathleen Sitton** to **Board of Forestry** on Apr 16, 2021* --

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Thanks,
Kathleen Sitton

-- *Sent from **Kathleen Sitton** to **Board of Forestry** on Apr 16, 2021* --

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Thanks,
Kathleen Sitton

-- *Sent from **June Lundgren** to **Board of Forestry** on Apr 16, 2021* --

Dear [@legislatorName],

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
June Lundgren

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-- *Sent from* ***Karen Carmichael*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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Karen Carmichael

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Karen Carmichael

-- *Sent from **David Erickson** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Valdek Parik** to **Board of Forestry** on Apr 16, 2021* --

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Valdek Parik

-- *Sent from* ***Jeanene Brownell*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Jeanene Brownell

-- *Sent from* ***Jeanene Brownell*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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-- *Sent from* ***Evelyn Meadows*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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Sincerely,
Evelyn Meadows

-- *Sent from **Evelyn Meadows** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Lavern Dean** to **Board of Forestry** on Apr 16, 2021* --

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Lavern Dean

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-- *Sent from **Collin Edwards** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Melissa Hathaway** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Margaret Mills** to **Board of Forestry** on Apr 16, 2021* --

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Margaret Mills

-- *Sent from **Margaret Mills** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from* ***CAROLYN REYNOLDS*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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*-- Sent from **Daniel Olson** to **Board of Forestry** on Apr 16, 2021 --*

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-- *Sent from **Steven Dietrich** to **Board of Forestry** on Apr 16, 2021* --

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-- *Sent from **Marian Schmaltz** to **Board of Forestry** on Apr 16, 2021* --

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Thank you,
Marian Schmaltz

-- *Sent from **Marian Schmaltz** to **Board of Forestry** on Apr 16, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

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-- *Sent from* ***Douglas Little*** *to* ***Board of Forestry*** *on Apr 16, 2021* --

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-- *Sent from **MICHELLE CHOCKTOOT** to **Board of Forestry** on Apr 17, 2021* --

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MICHELLE CHOCKTOOT

-- *Sent from **Charles Harper** to **Board of Forestry** on Apr 17, 2021* --

Dear [@legislatorName],

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Charles Harper

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-- *Sent from* ***Rachel Janzen*** *to* ***Board of Forestry*** *on Apr 17, 2021* --

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Thank you,
Rachel Janzen

-- *Sent from **Rachel Janzen** to **Board of Forestry** on Apr 17, 2021* --

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Thank you,
Rachel Janzen

-- *Sent from **Jerry Chetock** to **Board of Forestry** on Apr 17, 2021* --

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-- *Sent from **Curtis Bruenn** to **Board of Forestry** on Apr 17, 2021* --

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Curtis Bruenn

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-- *Sent from* ***Chad Murrow*** *to* ***Board of Forestry*** *on Apr 17, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Chad Murrow

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-- *Sent from* ***Steve Stricker*** *to* ***Board of Forestry*** *on Apr 17, 2021* --

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Steve Stricker

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Steve Stricker

-- *Sent from **Judi Mosteller** to **Board of Forestry** on Apr 17, 2021* --

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Sincerely,
Judi Mosteller

-- *Sent from **Judi Mosteller** to **Board of Forestry** on Apr 17, 2021* --

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Judi Mosteller

-- *Sent from **Leslie Kimmel Ledbetter** to **Board of Forestry** on Apr 17, 2021* --

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Thank you,
Leslie Kimmel Ledbetter

-- *Sent from **Leslie Kimmel Ledbetter** to **Board of Forestry** on Apr 17, 2021* --

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Thank you,
Leslie Kimmel Ledbetter

-- *Sent from **David Drago** to **Board of Forestry** on Apr 17, 2021* --

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-- *Sent from **Connie Giese** to **Board of Forestry** on Apr 18, 2021* --

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-- *Sent from **Sharon Catania** to **Board of Forestry** on Apr 18, 2021* --

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Thanks,
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-- *Sent from **Raymond Grant** to **Board of Forestry** on Apr 19, 2021* --

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-- *Sent from **Craig Zanni** to **Board of Forestry** on Apr 19, 2021* --

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-- *Sent from **Douglass Lindsay** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Jeff Gates*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Jeff Gates

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-- *Sent from **Linda Watson** to **Board of Forestry** on Apr 20, 2021* --

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Sincerely,
Linda Watson

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-- *Sent from* ***Tasha Schuetze*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thanks,
Tasha Schuetze

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-- *Sent from **Patricia Engelmann** to **Board of Forestry** on Apr 20, 2021* --

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Thanks,
Patricia Engelmann

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-- *Sent from* ***Brenda Lokan*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
Brenda Lokan

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-- *Sent from **Ralph Saperstein** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Martin Lopez** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Martin Lopez

-- *Sent from **Martin Lopez** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **clarence mitchell** to **Board of Forestry** on Apr 20, 2021* --

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
clarence mitchell

-- *Sent from **clarence mitchell** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Colt Hunt*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Colt Hunt

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-- *Sent from **David DeSau** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Patty Dunn** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Ruben Garmyn*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Ruben Garmyn

-- *Sent from **Ruben Garmyn** to **Board of Forestry** on Apr 20, 2021* --

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Sincerely,
Ruben Garmyn

-- *Sent from **Iris Butler** to **Board of Forestry** on Apr 20, 2021* --

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Iris Butler

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-- *Sent from* ***Ralph Koozer*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from **Steve Schmunk** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **BOB SCHULZ** to **Board of Forestry** on Apr 20, 2021* --

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Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
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-- *Sent from **Tiffany Roddy** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
Tiffany Roddy

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-- *Sent from **Rick Tibbetts** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Gregory Miller*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Gregory Miller

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-- *Sent from* ***Clinton Bailey*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Clinton Bailey

-- *Sent from* ***Clinton Bailey*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from* ***Ted Meier*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from* ***Sandra Pope*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Sandra Pope

-- *Sent from **Sandra Pope** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **James Peterson** to **Board of Forestry** on Apr 20, 2021* --

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Thanks,
James Peterson

-- *Sent from **John Robertson** to **Board of Forestry** on Apr 20, 2021* --

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John Robertson

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-- *Sent from **Kristi Kreamer** to **Board of Forestry** on Apr 20, 2021* --

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Kristi Kreamer

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Thanks,
Kristi Kreamer

-- *Sent from **Laura Harvey** to **Board of Forestry** on Apr 20, 2021* --

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Thanks,
Laura Harvey

-- *Sent from **Laura Harvey** to **Board of Forestry** on Apr 20, 2021* --

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Thanks,
Laura Harvey

*-- Sent from **Rick Rolfe** to **Board of Forestry** on Apr 20, 2021 --*

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Sincerely,
Rick Rolfe

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-- *Sent from **Cristy Murray** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **steve scott** to **Board of Forestry** on Apr 20, 2021* --

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In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
steve scott

-- *Sent from* ***steve scott*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from **Karen Roldan** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Karen Roldan

-- *Sent from **Karen Roldan** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***James Dudley*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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James Dudley

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James Dudley

-- *Sent from **SI Koubele** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
SI Koubele

-- *Sent from* ***Sl Koubele*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
Sl Koubele

-- *Sent from* ***Michael Zachery*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

Dear [@legislatorName],

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We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Michael Zachery

-- *Sent from **Michael Zachery** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Matthew Wade** to **Board of Forestry** on Apr 20, 2021* --

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Sincerely,
Matthew Wade

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*-- Sent from **Elizabeth Brooks** to **Board of Forestry** on Apr 20, 2021 --*

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Thank you,
Elizabeth Brooks

-- *Sent from* ***Elizabeth Brooks*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
Elizabeth Brooks

-- *Sent from **Casey Roscoe** to **Board of Forestry** on Apr 20, 2021* --

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Casey Roscoe

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-- *Sent from **Ron Trembly** to **Board of Forestry** on Apr 20, 2021* --

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Ron Trembly

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Sincerely,
Ron Trembly

-- *Sent from **Staci Sexton** to **Board of Forestry** on Apr 20, 2021* --

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Staci Sexton

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-- *Sent from **Suzanne Warren** to **Board of Forestry** on Apr 20, 2021* --

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Suzanne Warren

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-- *Sent from **Kimberley Lopez** to **Board of Forestry** on Apr 20, 2021* --

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Kimberley Lopez

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-- *Sent from* ***Zeb Olsen*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from **Cynthia Kenagy** to **Board of Forestry** on Apr 20, 2021* --

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Cynthia Kenagy

-- *Sent from **JOHN SCHNEIDER** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Megan Vanderpool*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Megan Vanderpool

-- *Sent from **Megan Vanderpool** to **Board of Forestry** on Apr 20, 2021* --

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Megan Vanderpool

-- *Sent from **Virgil Tilden** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Virgil Tilden** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Melvin Lardy** to **Board of Forestry** on Apr 20, 2021* --

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Melvin Lardy

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-- *Sent from **Robert Messinger** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
Robert Messinger

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-- *Sent from **Jim Benvie** to **Board of Forestry** on Apr 20, 2021* --

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*-- Sent from **Cathy Steere** to **Board of Forestry** on Apr 20, 2021 --*

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-- *Sent from **Dianna Paz** to **Board of Forestry** on Apr 20, 2021* --

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Dianna Paz

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-- *Sent from* ***Angela Frye*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Angela Frye

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Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Dennis Ricksgers

-- *Sent from **Russell Gallup** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Russell Gallup

-- *Sent from* ***Russell Gallup*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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*-- Sent from **Mary O'Neil** to **Board of Forestry** on Apr 20, 2021 --*

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

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Thank you,
Mary O'Neil

-- *Sent from **Mary O'Neil** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Kellen Copeland** to **Board of Forestry** on Apr 20, 2021* --

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Kellen Copeland

-- *Sent from **Kellen Copeland** to **Board of Forestry** on Apr 20, 2021* --

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Kellen Copeland

-- *Sent from **Susan Johnson** to **Board of Forestry** on Apr 20, 2021* --

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Susan Johnson

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Susan Johnson

-- *Sent from **Leigh Aguilar** to **Board of Forestry** on Apr 20, 2021* --

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Leigh Aguilar

-- *Sent from **Leigh Aguilar** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
Leigh Aguilar

-- *Sent from **Hattie Mead** to **Board of Forestry** on Apr 20, 2021* --

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Hattie Mead

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-- *Sent from* ***Joan Anderson*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
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-- *Sent from **Gayle Davis** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Gayle Davis

*-- Sent from **Gayle Davis** to **Board of Forestry** on Apr 20, 2021 --*

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-- *Sent from **Barbara Tesdal** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Waylon Mobley** to **Board of Forestry** on Apr 20, 2021* --

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Waylon Mobley

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-- *Sent from **Renee Clark** to **Board of Forestry** on Apr 20, 2021* --

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Renee Clark

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Renee Clark

-- *Sent from **Melvin Walter** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Marsha Eiding** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
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-- *Sent from* ***Erik Colville*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Erik Colville

-- *Sent from **Edwin Cochran** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Linda Buser** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
Linda Buser

*-- Sent from **Linda Buser** to **Board of Forestry** on Apr 20, 2021 --*

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Thank you,
Linda Buser

-- *Sent from **Linda Ruth** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Dan Daly** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from **Ronald Housley** to **Board of Forestry** on Apr 20, 2021* --

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Sincerely,
Ronald Housley

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-- *Sent from* ***Jerry Chetock*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from* ***Margaret Nava*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
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Thank you,
Rick Kriege

*-- Sent from **Rick Kriege** to **Board of Forestry** on Apr 20, 2021 --*

Dear [@legislatorName],

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-- *Sent from* ***Nicholas Martin*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Nicholas Martin

-- *Sent from **Nicholas Martin** to **Board of Forestry** on Apr 20, 2021* --

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Thank you,
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-- *Sent from **Rita Lindell** to **Board of Forestry** on Apr 20, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Rita Lindell

-- *Sent from **Rita Lindell** to **Board of Forestry** on Apr 20, 2021* --

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Sincerely,
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-- *Sent from* ***Judy Kennedy*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Sincerely,
Judy Kennedy

-- *Sent from **Judy Kennedy** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***Ralph Wiley*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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Thank you,
Ralph Wiley

-- *Sent from **Ralph Wiley** to **Board of Forestry** on Apr 20, 2021* --

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Ralph Wiley

-- *Sent from **Keith Sweeney** to **Board of Forestry** on Apr 20, 2021* --

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-- *Sent from* ***chester epperson*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from* ***Fred Guldager*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

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-- *Sent from* ***Connor Amundsen-Kuester*** *to* ***Board of Forestry*** *on Apr 20, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

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Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

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Connor Amundsen-Kuester

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Connor Amundsen-Kuester

-- *Sent from **Marie Hutchens** to **Board of Forestry** on Apr 21, 2021* --

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Sincerely,
Marie Hutchens

-- *Sent from* ***Marie Hutchens*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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Sincerely,
Marie Hutchens

-- *Sent from* ***Carol Lometo*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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Sincerely,
Carol Lometo

-- *Sent from* ***Carol Lometo*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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-- *Sent from **Deborah Swenson** to **Board of Forestry** on Apr 21, 2021* --

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Sincerely,
Deborah Swenson

-- *Sent from **Deborah Swenson** to **Board of Forestry** on Apr 21, 2021* --

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Sincerely,
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-- *Sent from **Clarence Cullop** to **Board of Forestry** on Apr 21, 2021* --

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Clarence Cullop

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-- *Sent from **Lisa Read** to **Board of Forestry** on Apr 21, 2021* --

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Thank you,
Lisa Read

-- *Sent from **Lisa Read** to **Board of Forestry** on Apr 21, 2021* --

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Thank you,
Lisa Read

-- *Sent from* ***Harold Still*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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Thank you,
Harold Still

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-- *Sent from **James Phelan** to **Board of Forestry** on Apr 21, 2021* --

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-- *Sent from* ***Brenda Davis*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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Thank you,
Brenda Davis

*-- Sent from **Brenda Davis** to **Board of Forestry** on Apr 21, 2021 --*

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Thank you,
Brenda Davis

-- *Sent from **Lance Shinkle** to **Board of Forestry** on Apr 21, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

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Lance Shinkle

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Thanks,
Lance Shinkle

-- *Sent from **Stephen A** to **Board of Forestry** on Apr 21, 2021* --

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Thank you,
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-- *Sent from **Karen Edmonds** to **Board of Forestry** on Apr 21, 2021* --

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Thank you,
Karen Edmonds

-- *Sent from **Karen Edmonds** to **Board of Forestry** on Apr 21, 2021* --

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Thank you,
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-- *Sent from **Curtis Wright** to **Board of Forestry** on Apr 21, 2021* --

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Thanks,
Curtis Wright

-- *Sent from **Curtis Wright** to **Board of Forestry** on Apr 21, 2021* --

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Curtis Wright

-- *Sent from* ***Donna Grubbs*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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*-- Sent from **Aura Wright** to **Board of Forestry** on Apr 21, 2021 --*

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Sincerely,
Aura Wright

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Sincerely,
Aura Wright

-- *Sent from **Amy Drugg** to **Board of Forestry** on Apr 21, 2021* --

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Thanks,
Amy Drugg

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-- *Sent from* ***Ryan Parish*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

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And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Ryan Parish

-- *Sent from **Ryan Parish** to **Board of Forestry** on Apr 21, 2021* --

Dear [@legislatorName],

I am writing to make sure you hear from Oregonians who would be directly affected by the Habitat Conservation Plan under consideration for our state forest lands.

In my view, it takes a leap of faith: Create habitat and wildlife will thrive. Unfortunately, we know all too well, that isn't always true.

And, unfortunately, we also know that putting huge swaths of forestlands off limits to harvest or other activities hurts nearby communities considerably.

Please consider alternatives to this approach. A lot of good science has been done in the last 30 years - there are better ways to save the owl. We can have sustainable timber harvest (and therefore sustainable communities) and protect threatened species. Let's find a balanced management plan for our state forests.

Thanks,
Ryan Parish

*-- Sent from **Ilene Vogel** to **Board of Forestry** on Apr 21, 2021 --*

Dear [@legislatorName],

I am writing to ask you to make sure Oregon's Habitat Conservation Plan for state forests effectively balances the needs of rural communities and timber harvest with habitat protection.

Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Ilene Vogel

-- *Sent from* ***Ilene Vogel*** *to* ***Board of Forestry*** *on Apr 21, 2021* --

Dear [@legislatorName],

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Many communities in rural Oregon cannot survive if timber harvest on state lands declines by another 30 percent as this plan proposes. We've already lost one million acres in this state to last year's fires. Enough is enough.

Please consider alternate proposals that balance all the needs of threatened species and our threatened communities.

Thank you,
Ilene Vogel

-- *Sent from **Karen Byers** to **Board of Forestry** on Apr 21, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

Please don't set aside 60 percent of our state forest trust lands for habitat - we've already seen that method fail to save the spotted owl since it was listed in the 90s. There's a better way to achieve our goals. The state should be considering alternate plans that accomplish what's best for our communities and the owl. I believe we can achieve sustainable timber harvest and protect threatened species.

Thank you,
Karen Byers

-- *Sent from **Karen Byers** to **Board of Forestry** on Apr 21, 2021* --

Dear [@legislatorName],

I'm writing to remind you that the state of Oregon has an obligation to manage county trust lands to meet environmental, economic and social needs.

The current Habitat Protection Plan is not balanced. In fact, it falls short by risking rural economies while not doing what's needed to protect the spotted owl and other threatened species.

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Thank you,
Karen Byers

*-- Sent from **Greg Miller** to **Board of Forestry** on Apr 21, 2021 --*

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Greg Miller

-- *Sent from **Greg Miller** to **Board of Forestry** on Apr 21, 2021* --

Dear [@legislatorName],

I feel like the latest Habitat Conservation Plan drafted for our state forest trust lands by the Department of Forestry and federal agencies is a bit of deja vu.

By setting aside huge swaths of lands from timber harvest, this plan applies the failed principles we saw in the 1990s. What did that get us? Unhealthy forests that burn easily and species that are still threatened.

We need to learn from the past and be smarter about how we manage forestlands in Oregon. Please consider alternate plans that reflect today's science, and that includes sustainable harvest.

Sincerely,
Greg Miller

Date	First Name	Last Name	City	State	Email Address
2021-04-06 12:05:04	Dean	Carlisle	Salem	OR	dhcarlisle@yahoo.com
2021-04-06 12:05:04	Dean	Carlisle	Salem	OR	dhcarlisle@yahoo.com
2021-04-06 12:06:26	Bret	Mahoney	Medford	OR	bdtwerps3@msn.com
2021-04-06 12:06:26	Bret	Mahoney	Medford	OR	bdtwerps3@msn.com
2021-04-06 12:07:02	Shirley	Usher	Grants Pass	OR	rcusher@frontier.com
2021-04-06 12:07:02	Shirley	Usher	Grants Pass	OR	rcusher@frontier.com
2021-04-06 12:07:19	randy	kallio	Clatskanie	OR	randykallio@hotmail.com
2021-04-06 12:07:19	randy	kallio	Clatskanie	OR	randykallio@hotmail.com
2021-04-06 12:08:34	Robert	Vance	Portland	OR	rvance@pacfibre.com
2021-04-06 12:08:34	Robert	Vance	Portland	OR	rvance@pacfibre.com
2021-04-06 12:10:31	Harold	Tiernan	Dallas	OR	hstiernan@charter.net
2021-04-06 12:10:31	Harold	Tiernan	Dallas	OR	hstiernan@charter.net
2021-04-06 12:11:17	John	Ernst	Bend	OR	jsewizard@hotmail.com
2021-04-06 12:11:17	John	Ernst	Bend	OR	jsewizard@hotmail.com
2021-04-06 12:11:18	Rebecca	Morrill	Albany	OR	becksmorrill@yahoo.com
2021-04-06 12:11:18	Rebecca	Morrill	Albany	OR	becksmorrill@yahoo.com
2021-04-06 12:12:45	Brad	Fry	Rogue River	OR	jbsf@charter.net
2021-04-06 12:12:46	Brad	Fry	Rogue River	OR	jbsf@charter.net
2021-04-06 12:12:48	John	Bonnar	Yachats	OR	usafretired93@yahoo.com
2021-04-06 12:12:48	John	Bonnar	Yachats	OR	usafretired93@yahoo.com
2021-04-06 12:13:34	David	Officer	Lake Oswego	OR	doffs@aol.com
2021-04-06 12:13:34	David	Officer	Lake Oswego	OR	doffs@aol.com
2021-04-06 12:16:31	Cindy	Smith	Vida	OR	cindysmckenzie@msn.com
2021-04-06 12:16:31	Cindy	Smith	Vida	OR	cindysmckenzie@msn.com
2021-04-06 12:17:40	Michelle	Paul	Medford	OR	alohamichelle1@outlook.com
2021-04-06 12:17:40	Michelle	Paul	Medford	OR	alohamichelle1@outlook.com
2021-04-06 12:22:38	Barbara	Taylor	Cloverdale	OR	barbbt@centurylink.net
2021-04-06 12:22:38	Barbara	Taylor	Cloverdale	OR	barbbt@centurylink.net
2021-04-06 12:25:10	Brandon	Epling	Cornelius	OR	eplogger@hotmail.com
2021-04-06 12:25:10	Brandon	Epling	Cornelius	OR	eplogger@hotmail.com
2021-04-06 12:27:24	Claudette	Hills	Brookings	OR	claudettehills@hotmail.com
2021-04-06 12:27:24	Claudette	Hills	Brookings	OR	claudettehills@hotmail.com
2021-04-06 12:29:53	Ulrich	Lau	Bandon	OR	ulrich@ootci.com

2021-04-06 12:29:53	Ulrich	Lau	Bandon	OR	ulrich@ootci.com
2021-04-06 12:30:34	Theodore	Evertz	Canby	OR	david.evertz@astralloy.com
2021-04-06 12:30:34	Theodore	Evertz	Canby	OR	david.evertz@astralloy.com
2021-04-06 12:34:26	Nickie	Gaylord	Damascus	OR	jngaylord@comcast.net
2021-04-06 12:34:26	Nickie	Gaylord	Damascus	OR	jngaylord@comcast.net
2021-04-06 12:34:54	Lisa	Samuelson	Oakridge	OR	carwoman6ls@yahoo.com
2021-04-06 12:34:54	Lisa	Samuelson	Oakridge	OR	carwoman6ls@yahoo.com
2021-04-06 12:37:17	Ms	Morrison	Florence	OR	annamorrison55@aol.com
2021-04-06 12:37:17	Ms	Morrison	Florence	OR	annamorrison55@aol.com
2021-04-06 12:42:25	Bill	Ocumpaugh	Oakland	OR	ocumpaugh@taesbeeville.com
2021-04-06 12:42:26	Bill	Ocumpaugh	Oakland	OR	ocumpaugh@taesbeeville.com
2021-04-06 12:47:51	Thomas	Hardesty	Coquille	OR	forme2c@hotmail.com
2021-04-06 12:47:51	Thomas	Hardesty	Coquille	OR	forme2c@hotmail.com
2021-04-06 12:48:08	John	Perkins	Cottage Grove	OR	japerkins47@yahoo.com
2021-04-06 12:48:08	John	Perkins	Cottage Grove	OR	japerkins47@yahoo.com
2021-04-06 12:55:41	Linda	Parker	Hermiston	OR	mrsparkerlinda@yahoo.com
2021-04-06 12:55:41	Linda	Parker	Hermiston	OR	mrsparkerlinda@yahoo.com
2021-04-06 12:57:47	Debra	Fromdahl	Roseburg	OR	roseburg@roseburgareachamber.org
2021-04-06 12:57:47	Debra	Fromdahl	Roseburg	OR	roseburg@roseburgareachamber.org
2021-04-06 13:02:16	ken	ezell	Eugene	OR	lapinebsezell@q.com
2021-04-06 13:02:16	ken	ezell	Eugene	OR	lapinebsezell@q.com
2021-04-06 13:07:54	Richard	Sutherlin	Albany	OR	rsuther223@comcast.net
2021-04-06 13:07:55	Richard	Sutherlin	Albany	OR	rsuther223@comcast.net
2021-04-06 13:11:07	John	Hawthorne	Creswell	OR	y2jdot1@gmail.com
2021-04-06 13:11:07	John	Hawthorne	Creswell	OR	y2jdot1@gmail.com
2021-04-06 13:11:53	James	Pointer	Monmouth	OR	jamesharon6721@gmail.com
2021-04-06 13:11:53	James	Pointer	Monmouth	OR	jamesharon6721@gmail.com
2021-04-06 13:18:31	Linda	Westlake	Albany	OR	lkwestlake@yahoo.com
2021-04-06 13:18:31	Linda	Westlake	Albany	OR	lkwestlake@yahoo.com
2021-04-06 13:27:01	Jacqueline	Ingalls	Oregon City	OR	ingalls.rose@yahoo.com
2021-04-06 13:27:01	Jacqueline	Ingalls	Oregon City	OR	ingalls.rose@yahoo.com
2021-04-06 13:32:50	Eileen	Moresi	Klamath Falls	OR	emoresi@charter.net
2021-04-06 13:32:50	Eileen	Moresi	Klamath Falls	OR	emoresi@charter.net
2021-04-06 13:34:33	Don	Anderson	Lebanon	OR	puernatura@gmail.com

2021-04-06 13:34:34	Don	Anderson	Lebanon	OR	puernatura@gmail.com
2021-04-06 13:39:20	Jeff	Mallonee	Gresham	OR	jmallonee3@yahoo.com
2021-04-06 13:39:20	Jeff	Mallonee	Gresham	OR	jmallonee3@yahoo.com
2021-04-06 13:42:19	Joe	West	Bend	OR	joewestyoungmanjoewest@yahoo.com
2021-04-06 13:42:20	Joe	West	Bend	OR	joewestyoungmanjoewest@yahoo.com
2021-04-06 13:55:37	Pat	Bognar	Portland	OR	bognar@up.edu
2021-04-06 13:55:37	Pat	Bognar	Portland	OR	bognar@up.edu
2021-04-06 13:57:42	Bonnie	Bingler	Portland	OR	bonannieb@yahoo.com
2021-04-06 13:57:43	Bonnie	Bingler	Portland	OR	bonannieb@yahoo.com
2021-04-06 14:02:07	John	McMurtray	St. Helens	OR	jlmacmicmac@yahoo.com
2021-04-06 14:02:07	John	McMurtray	St. Helens	OR	jlmacmicmac@yahoo.com
2021-04-06 14:02:43	Karen	Lackner	Lyons	OR	jkltrees@wvi.com
2021-04-06 14:02:43	Karen	Lackner	Lyons	OR	jkltrees@wvi.com
2021-04-06 14:09:52	Jim	Rabe	Lake Oswego	OR	jimrabe1@aol.com
2021-04-06 14:09:52	Jim	Rabe	Lake Oswego	OR	jimrabe1@aol.com
2021-04-06 14:14:30	Robert	Teran	Tillamook	OR	teran56@hotmail.com
2021-04-06 14:14:30	Robert	Teran	Tillamook	OR	teran56@hotmail.com
2021-04-06 14:18:48	Walter	Kennick	Independence	OR	walt_kennick@yahoo.com
2021-04-06 14:18:48	Walter	Kennick	Independence	OR	walt_kennick@yahoo.com
2021-04-06 14:24:47	Dorothy	Taylor	Boring	OR	maitaidot@msn.com
2021-04-06 14:24:47	Dorothy	Taylor	Boring	OR	maitaidot@msn.com
2021-04-06 14:27:09	Henry	Mendazona	Powell Butte	OR	hmendazona@yahoo.com
2021-04-06 14:27:09	Henry	Mendazona	Powell Butte	OR	hmendazona@yahoo.com
2021-04-06 14:36:48	Sharon	Pointer	Monmouth	OR	jamesharon6722@gmail.com
2021-04-06 14:36:48	Sharon	Pointer	Monmouth	OR	jamesharon6722@gmail.com
2021-04-06 15:00:30	Michelle	Foltz	Salem	OR	meshell1210@hotmail.com
2021-04-06 15:00:30	Michelle	Foltz	Salem	OR	meshell1210@hotmail.com
2021-04-06 15:02:24	James	Morton	Sweet Home	OR	jcsalpacas@aol.com
2021-04-06 15:02:24	James	Morton	Sweet Home	OR	jcsalpacas@aol.com
2021-04-06 15:14:20	Christine	Hurd	Beaverton	OR	hurd.christine@gmail.com
2021-04-06 15:14:20	Christine	Hurd	Beaverton	OR	hurd.christine@gmail.com
2021-04-06 15:14:46	Keith	Woung	Colton	OR	kwoung@comcast.net
2021-04-06 15:14:46	Keith	Woung	Colton	OR	kwoung@comcast.net
2021-04-06 15:24:09	Virginia	Gerstner	Fox	OR	gmdg1367@yahoo.com

2021-04-06 15:24:09	Virginia	Gerstner	Fox	OR	gmdg1367@yahoo.com
2021-04-06 15:29:11	Alexandria	flores	Portland	OR	flores_ally@yahoo.com
2021-04-06 15:29:11	Alexandria	flores	Portland	OR	flores_ally@yahoo.com
2021-04-06 15:53:42	Scott	Mahood	Portland	OR	scottmahood@hotmail.com
2021-04-06 15:53:42	Scott	Mahood	Portland	OR	scottmahood@hotmail.com
2021-04-06 15:54:42	Mark	Baumgartner	Albany	OR	mark.baumgartner@weyerhaeuser.com
2021-04-06 15:54:42	Mark	Baumgartner	Albany	OR	mark.baumgartner@weyerhaeuser.com
2021-04-06 15:59:13	Linda	Peacock	Brookings	OR	linda.peacock@uihs.org
2021-04-06 15:59:13	Linda	Peacock	Brookings	OR	linda.peacock@uihs.org
2021-04-06 15:59:55	Alison	Kingsberry	Lebanon	OR	lebanon000@centurytel.net
2021-04-06 15:59:55	Alison	Kingsberry	Lebanon	OR	lebanon000@centurytel.net
2021-04-06 16:05:50	Frank	Wildgrube	Forest Grove	OR	flwild@juno.com
2021-04-06 16:05:50	Frank	Wildgrube	Forest Grove	OR	flwild@juno.com
2021-04-06 16:36:41	Stanislav	Aksenov	Medford	OR	sstass@startmail.com
2021-04-06 16:36:41	Stanislav	Aksenov	Medford	OR	sstass@startmail.com
2021-04-06 16:59:18	ellen	nieminen	Clatskanie	OR	reniemin@clatskanie.com
2021-04-06 16:59:18	ellen	nieminen	Clatskanie	OR	reniemin@clatskanie.com
2021-04-06 17:20:26	billie	ambrose	Gresham	OR	bj.ambrose@icloud.com
2021-04-06 17:20:26	billie	ambrose	Gresham	OR	bj.ambrose@icloud.com
2021-04-06 17:42:46	Chris	Johnson	Sunriver	OR	chris.johnson@shanda.com
2021-04-06 17:42:46	Chris	Johnson	Sunriver	OR	chris.johnson@shanda.com
2021-04-06 18:33:23	Jack	LeRoy	Central Point	OR	jackleroy1@aol.com
2021-04-06 18:33:23	Jack	LeRoy	Central Point	OR	jackleroy1@aol.com
2021-04-06 18:58:21	Teresa	Tyler	Mount Hood Village	OR	thtyler@yahoo.com
2021-04-06 18:58:21	Teresa	Tyler	Mount Hood Village	OR	thtyler@yahoo.com
2021-04-06 19:05:32	Pat	wright	Dayton	OR	patrick.wright61@frontier.com
2021-04-06 19:05:32	Pat	wright	Dayton	OR	patrick.wright61@frontier.com
2021-04-06 19:23:27	Marsha	Ferry	Coos Bay	OR	marshaferry@frontier.com
2021-04-06 19:23:27	Marsha	Ferry	Coos Bay	OR	marshaferry@frontier.com
2021-04-06 19:41:37	Renee	Harris	Gold Hill	OR	harrisfamilyiii@msn.com
2021-04-06 19:41:37	Renee	Harris	Gold Hill	OR	harrisfamilyiii@msn.com
2021-04-06 19:48:14	John	ward	Klamath Falls	OR	jjwardelk@yahoo.com
2021-04-06 19:48:14	John	ward	Klamath Falls	OR	jjwardelk@yahoo.com
2021-04-06 19:50:40	Rebecca	Cowley	Portland	OR	thecowleys@comcast.net

2021-04-06 19:50:40	Rebecca	Cowley	Portland	OR	thecowleys@comcast.net
2021-04-06 20:35:02	Karen	Neal	Roseburg	OR	oregonalleykat47@yahoo.com
2021-04-06 20:35:02	Karen	Neal	Roseburg	OR	oregonalleykat47@yahoo.com
2021-04-06 20:40:50	Monte	Gingerich	Corvallis	OR	montegingerich@icloud.com
2021-04-06 20:40:50	Monte	Gingerich	Corvallis	OR	montegingerich@icloud.com
2021-04-06 20:54:30	Ursula	Walters	Klamath Falls	OR	urs95@aol.com
2021-04-06 20:54:30	Ursula	Walters	Klamath Falls	OR	urs95@aol.com
2021-04-06 21:04:29	Bill	Grable	Mapleton	OR	grablecpa@yahoo.com
2021-04-06 21:04:29	Bill	Grable	Mapleton	OR	grablecpa@yahoo.com
2021-04-06 21:14:49	arthur	schieffer	Grants Pass	OR	ayscleaning@aol.com
2021-04-06 21:14:49	arthur	schieffer	Grants Pass	OR	ayscleaning@aol.com
2021-04-06 21:34:31	Frank	Ambrusko	Eugene	OR	ambrusko545@hotmail.com
2021-04-06 21:34:31	Frank	Ambrusko	Eugene	OR	ambrusko545@hotmail.com
2021-04-06 21:51:21	Patrice	Kerstetter	Roseburg	OR	pek1951@yahoo.com
2021-04-06 21:51:21	Patrice	Kerstetter	Roseburg	OR	pek1951@yahoo.com
2021-04-06 21:51:55	John	Kendall	Cornelius	OR	johnkendall05@icloud.com
2021-04-06 21:51:55	John	Kendall	Cornelius	OR	johnkendall05@icloud.com
2021-04-06 21:51:59	Michael	Bodewitz	Springfield	OR	mbodewitz25@yahoo.com
2021-04-06 21:51:59	Michael	Bodewitz	Springfield	OR	mbodewitz25@yahoo.com
2021-04-06 21:53:00	Terri	Adair	Cottage Grove	OR	tadair@senecasawmill.com
2021-04-06 21:53:00	Terri	Adair	Cottage Grove	OR	tadair@senecasawmill.com
2021-04-06 22:20:14	Gerald	Palanuk	Sweet Home	OR	jernuk01@yahoo.com
2021-04-06 22:20:15	Gerald	Palanuk	Sweet Home	OR	jernuk01@yahoo.com
2021-04-06 22:43:54	Shirley	Benson	Wilsonville	OR	jmbjr1@comcast.net
2021-04-06 22:43:54	Shirley	Benson	Wilsonville	OR	jmbjr1@comcast.net
2021-04-06 22:58:17	Brenda	Toschik	Klamath Falls	OR	recoveryzonept@yahoo.com
2021-04-06 22:58:17	Brenda	Toschik	Klamath Falls	OR	recoveryzonept@yahoo.com
2021-04-06 23:12:35	Brian	Conover	Mcminnville	OR	shadow52572@gmail.com
2021-04-06 23:12:35	Brian	Conover	Mcminnville	OR	shadow52572@gmail.com
2021-04-07 00:53:28	Kathryn	McMichael	Vida	OR	tandkate@sbcglobal.net
2021-04-07 00:53:28	Kathryn	McMichael	Vida	OR	tandkate@sbcglobal.net
2021-04-07 01:02:23	Daniel	Radke	Portland	OR	danielradke@aol.com
2021-04-07 01:02:23	Daniel	Radke	Portland	OR	danielradke@aol.com
2021-04-07 01:36:16	jim	nylund	Springfield	OR	nylundjim@yahoo.com

2021-04-07 01:36:16	jim	nylund	Springfield	OR	nylundjim@yahoo.com
2021-04-07 01:36:33	Maryann	Russell	Salem	OR	maryann144russell@yahoo.com
2021-04-07 01:36:33	Maryann	Russell	Salem	OR	maryann144russell@yahoo.com
2021-04-07 01:58:21	Ervine	Nelson	Beaverton	OR	grandmaclaus1@comcast.net
2021-04-07 01:58:21	Ervine	Nelson	Beaverton	OR	grandmaclaus1@comcast.net
2021-04-07 02:36:35	Rita	Castillo	Springfield	OR	itouchedthewire@yahoo.com
2021-04-07 02:36:35	Rita	Castillo	Springfield	OR	itouchedthewire@yahoo.com
2021-04-07 06:37:29	Dalton	Walker	Eugene	OR	walka111320@yahoo.com
2021-04-07 06:37:29	Dalton	Walker	Eugene	OR	walka111320@yahoo.com
2021-04-07 07:50:18	Kathy	Heitz	Baker City	OR	kjheitz750@q.com
2021-04-07 07:50:18	Kathy	Heitz	Baker City	OR	kjheitz750@q.com
2021-04-07 08:28:53	Chris	Silbernagel	La Grande	OR	chris@silbernagelinc.com
2021-04-07 08:28:53	Chris	Silbernagel	La Grande	OR	chris@silbernagelinc.com
2021-04-07 09:32:52	Mark	Holland	Silverton	OR	mbh4224@yahoo.com
2021-04-07 09:32:52	Mark	Holland	Silverton	OR	mbh4224@yahoo.com
2021-04-07 09:54:34	Caleb	Brown	Lebanon	OR	caleb@franklumberco.com
2021-04-07 09:54:34	Caleb	Brown	Lebanon	OR	caleb@franklumberco.com
2021-04-07 10:01:40	Jennifer	Miller	Sheridan	OR	hab3.171819@icloud.com
2021-04-07 10:01:40	Jennifer	Miller	Sheridan	OR	hab3.171819@icloud.com
2021-04-07 10:10:26	Sally	Cadonau	Aloha	OR	cadhawks9883@icloud.com
2021-04-07 10:10:26	Sally	Cadonau	Aloha	OR	cadhawks9883@icloud.com
2021-04-07 10:17:59	Anne	Pratt	Springfield	OR	mcriverrat@aol.com
2021-04-07 10:17:59	Anne	Pratt	Springfield	OR	mcriverrat@aol.com
2021-04-07 11:07:21	Fredrick	Weaver	Portland	OR	flweaver1@aol.com
2021-04-07 11:07:21	Fredrick	Weaver	Portland	OR	flweaver1@aol.com
2021-04-07 11:51:56	Dyann	McCollum	Sweet Home	OR	dymccollum@yahoo.com
2021-04-07 11:51:56	Dyann	McCollum	Sweet Home	OR	dymccollum@yahoo.com
2021-04-07 12:17:04	Barbara	Korsmo	Gresham	OR	korsmobj@hevanet.com
2021-04-07 12:17:04	Barbara	Korsmo	Gresham	OR	korsmobj@hevanet.com
2021-04-07 14:35:45	Noel	Crabtree	Tillamook	OR	noel_782@hotmail.com
2021-04-07 14:35:45	Noel	Crabtree	Tillamook	OR	noel_782@hotmail.com
2021-04-07 17:17:30	Richard	Braatz	Oakridge	OR	braatzrichardjp@gmail.com
2021-04-07 17:17:31	Richard	Braatz	Oakridge	OR	braatzrichardjp@gmail.com
2021-04-07 17:25:41	Eric	Bufka	Dallas	OR	ebufka@aol.com

2021-04-07 17:25:41	Eric	Bufka	Dallas	OR	ebufka@aol.com
2021-04-07 21:24:58	Larry	McLaughlin	Oregon City	OR	mclaughlin@ccgmail.net
2021-04-07 21:24:58	Larry	McLaughlin	Oregon City	OR	mclaughlin@ccgmail.net
2021-04-08 01:59:06	Lise	Hull	Bandon	OR	castlesu@aol.com
2021-04-08 01:59:06	Lise	Hull	Bandon	OR	castlesu@aol.com
2021-04-08 12:39:35	Alice	Colby	Astoria	OR	alcolby2@charter.net
2021-04-08 12:39:36	Alice	Colby	Astoria	OR	alcolby2@charter.net
2021-04-08 14:41:39	Diann	Washburn	Dallas	OR	diann@ofsonline.org
2021-04-08 14:41:39	Diann	Washburn	Dallas	OR	diann@ofsonline.org
2021-04-08 21:19:12	Douglas	littlejohn	Willamina	OR	littlejohndoug@aol.com
2021-04-08 21:19:12	Douglas	littlejohn	Willamina	OR	littlejohndoug@aol.com
2021-04-09 01:08:40	Darline	Brundage	La Pine	OR	dotsybobo@msn.com
2021-04-09 01:08:40	Darline	Brundage	La Pine	OR	dotsybobo@msn.com
2021-04-12 12:53:40	William	Higby	Albany	OR	bill.higby@comcast.net
2021-04-12 12:53:40	William	Higby	Albany	OR	bill.higby@comcast.net
2021-04-12 16:42:15	Jeffrey	Frank	Mill City	OR	jeff@franklumberco.com
2021-04-12 16:42:16	Jeffrey	Frank	Mill City	OR	jeff@franklumberco.com
2021-04-16 15:12:58	Brenda	Anderson	Glide	OR	auntieugly@yahoo.com
2021-04-16 15:12:58	Brenda	Anderson	Glide	OR	auntieugly@yahoo.com
2021-04-16 15:13:05	Frances	Herber	Eugene	OR	fherber@yahoo.com
2021-04-16 15:13:06	Frances	Herber	Eugene	OR	fherber@yahoo.com
2021-04-16 15:14:40	Brittney	Stephen	Albany	OR	irisheyes525@comcast.net
2021-04-16 15:14:40	Brittney	Stephen	Albany	OR	irisheyes525@comcast.net
2021-04-16 15:15:58	Martha	Smith	Grants Pass	OR	jaspunkin.mas@gmail.com
2021-04-16 15:15:58	Martha	Smith	Grants Pass	OR	jaspunkin.mas@gmail.com
2021-04-16 15:22:49	Jolé	Davidson	La Grande	OR	jelizabeth1223sunny@yahoo.com
2021-04-16 15:22:49	Jolé	Davidson	La Grande	OR	jelizabeth1223sunny@yahoo.com
2021-04-16 15:26:37	Kris	Jakubowski	Albany	OR	randkjakubowski@yahoo.com
2021-04-16 15:26:37	Kris	Jakubowski	Albany	OR	randkjakubowski@yahoo.com
2021-04-16 15:27:44	Taomi	Reynolds	Port Orford	OR	taomireynolds@outlook.com
2021-04-16 15:27:44	Taomi	Reynolds	Port Orford	OR	taomireynolds@outlook.com
2021-04-16 15:28:13	Jeramy	Ritter	Springfield	OR	jeramy1981@yahoo.com
2021-04-16 15:28:13	Jeramy	Ritter	Springfield	OR	jeramy1981@yahoo.com
2021-04-16 15:49:02	Debra	Rehn	Portland	OR	bibleeogirl@aol.com

2021-04-16 15:49:03	Debra	Rehn	Portland	OR	bibleeogirl@aol.com
2021-04-16 15:50:23	Melissa	Deuerling	Eugene	OR	mdeuerling@mfcpinc.com
2021-04-16 15:50:24	Melissa	Deuerling	Eugene	OR	mdeuerling@mfcpinc.com
2021-04-16 15:52:33	Victoria	Murray	Roseburg	OR	vickimurray53@hotmail.com
2021-04-16 15:52:33	Victoria	Murray	Roseburg	OR	vickimurray53@hotmail.com
2021-04-16 15:59:54	Richard	Ziegler	Coos Bay	OR	rkziegler25@yahoo.com
2021-04-16 15:59:54	Richard	Ziegler	Coos Bay	OR	rkziegler25@yahoo.com
2021-04-16 16:15:19	Manuel	Orellana	Gresham	OR	manuelorellana4545@yahoo.com
2021-04-16 16:15:19	Manuel	Orellana	Gresham	OR	manuelorellana4545@yahoo.com
2021-04-16 16:17:13	Timothy	Shiel	Cornelius	OR	7of8oshiel@gmail.com
2021-04-16 16:17:14	Timothy	Shiel	Cornelius	OR	7of8oshiel@gmail.com
2021-04-16 16:29:42	Kathleen	Sitton	Carlton	OR	katsitton@embarqmail.com
2021-04-16 16:29:42	Kathleen	Sitton	Carlton	OR	katsitton@embarqmail.com
2021-04-16 16:25:44	June	Lundgren	Oregon City	OR	june91c@hotmail.com
2021-04-16 16:25:44	June	Lundgren	Oregon City	OR	june91c@hotmail.com
2021-04-16 16:27:35	Karen	Carmichael	Hillsboro	OR	carlandkaren1@frontier.com
2021-04-16 16:27:35	Karen	Carmichael	Hillsboro	OR	carlandkaren1@frontier.com
2021-04-16 16:29:45	David	Erickson	Eagle Point	OR	derickson@lrtco.com
2021-04-16 16:29:46	David	Erickson	Eagle Point	OR	derickson@lrtco.com
2021-04-16 16:35:03	Valdek	Parik	Aloha	OR	parik@sbcglobal.net
2021-04-16 16:35:03	Valdek	Parik	Aloha	OR	parik@sbcglobal.net
2021-04-16 17:25:29	Jeanene	Brownell	Salem	OR	brownellj@comcast.net
2021-04-16 17:25:29	Jeanene	Brownell	Salem	OR	brownellj@comcast.net
2021-04-16 17:27:16	Evelyn	Meadows	Roseburg	OR	bellarags@sbcglobal.net
2021-04-16 17:27:16	Evelyn	Meadows	Roseburg	OR	bellarags@sbcglobal.net
2021-04-16 17:55:53	Lavern	Dean	Coos Bay	OR	lrdean33@yahoo.com
2021-04-16 17:55:53	Lavern	Dean	Coos Bay	OR	lrdean33@yahoo.com
2021-04-16 18:53:12	Collin	Edwards	Sublimity	OR	cedwar2@wavecable.com
2021-04-16 18:53:12	Collin	Edwards	Sublimity	OR	cedwar2@wavecable.com
2021-04-16 19:27:33	Melissa	Hathaway	Portland	OR	infomavn@teleport.com
2021-04-16 19:27:33	Melissa	Hathaway	Portland	OR	infomavn@teleport.com
2021-04-16 19:56:54	Margaret	Mills	Molalla	OR	mmills49@gmail.com
2021-04-16 19:56:54	Margaret	Mills	Molalla	OR	mmills49@gmail.com
2021-04-16 21:23:07	CAROLYN	REYNOLDS	Estacada	OR	carolwomandancingeyesreynolds@yahoo.com

2021-04-16 21:23:08	CAROLYN	REYNOLDS	Estacada	OR	carolwomandancingeyesreynolds@yahoo.com
2021-04-16 21:35:20	Daniel	Olson	Bend	OR	dnolsonny@msn.com
2021-04-16 21:35:20	Daniel	Olson	Bend	OR	dnolsonny@msn.com
2021-04-16 21:48:11	Steven	Dietrich	Gresham	OR	sadietrich@frontier.com
2021-04-16 21:48:11	Steven	Dietrich	Gresham	OR	sadietrich@frontier.com
2021-04-16 22:03:13	Marian	Schmaltz	Roseburg	OR	hootowogurl@gmail.com
2021-04-16 22:03:13	Marian	Schmaltz	Roseburg	OR	hootowogurl@gmail.com
2021-04-16 23:13:45	Douglas	Little	Wilsonville	OR	ddite5little@comcast.net
2021-04-16 23:13:45	Douglas	Little	Wilsonville	OR	ddite5little@comcast.net
2021-04-17 00:27:59	MICHELLE	CHOCKTOOT	Hillsboro	OR	sassyprincess10980@yahoo.com
2021-04-17 00:27:59	MICHELLE	CHOCKTOOT	Hillsboro	OR	sassyprincess10980@yahoo.com
2021-04-17 01:17:02	Charles	Harper	Newberg	OR	caharpo@yahoo.com
2021-04-17 01:17:02	Charles	Harper	Newberg	OR	caharpo@yahoo.com
2021-04-17 02:10:25	Rachel	Janzen	Happy Valley	OR	rjanzen@comcast.net
2021-04-17 02:10:25	Rachel	Janzen	Happy Valley	OR	rjanzen@comcast.net
2021-04-17 09:45:44	Jerry	Chetock	Salem	OR	jerrychetock@gmail.com
2021-04-17 09:45:44	Jerry	Chetock	Salem	OR	jerrychetock@gmail.com
2021-04-17 10:28:14	Curtis	Bruenn	Grass Valley	OR	bruennscorp69@aol.com
2021-04-17 10:28:14	Curtis	Bruenn	Grass Valley	OR	bruennscorp69@aol.com
2021-04-17 11:49:18	Chad	Murrow	Sheridan	OR	chad_murrow@yahoo.com
2021-04-17 11:49:18	Chad	Murrow	Sheridan	OR	chad_murrow@yahoo.com
2021-04-17 11:51:35	Steve	Stricker	Boring	OR	stevnsylv@hotmail.com
2021-04-17 11:51:35	Steve	Stricker	Boring	OR	stevnsylv@hotmail.com
2021-04-17 12:16:52	Judi	Mosteller	Portland	OR	judimosteller@comcast.net
2021-04-17 12:16:52	Judi	Mosteller	Portland	OR	judimosteller@comcast.net
2021-04-17 18:23:16	Leslie	Kimmel Ledbetter	Molalla	OR	valleygram@yahoo.com
2021-04-17 18:23:16	Leslie	Kimmel Ledbetter	Molalla	OR	valleygram@yahoo.com
2021-04-17 18:50:42	David	Drago	Blachly	OR	dragobrothers@gmail.com
2021-04-17 18:50:42	David	Drago	Blachly	OR	dragobrothers@gmail.com
2021-04-18 14:45:23	Connie	Giese	St. Helens	OR	conniejog@live.com
2021-04-18 14:45:23	Connie	Giese	St. Helens	OR	conniejog@live.com
2021-04-18 23:51:26	Sharon	Catania	Redmond	OR	sharbrat_1999@yahoo.com
2021-04-18 23:51:26	Sharon	Catania	Redmond	OR	sharbrat_1999@yahoo.com
2021-04-19 09:35:00	Raymond	Grant	Roseburg	OR	dgrant@lrtco.com

2021-04-19 09:35:00	Raymond	Grant	Roseburg	OR	dgrant@lrtco.com
2021-04-19 19:53:39	Craig	Zanni	Coquille	OR	craigzanni@co.coos.or.us
2021-04-19 19:53:39	Craig	Zanni	Coquille	OR	craigzanni@co.coos.or.us
2021-04-20 00:05:43	Douglass	Lindsay	Sandy	OR	dlindsay@zoho.com
2021-04-20 00:05:43	Douglass	Lindsay	Sandy	OR	dlindsay@zoho.com
2021-04-20 12:34:12	Jeff	Gates	Springfield	OR	jeffg@americanocnco.com
2021-04-20 12:34:12	Jeff	Gates	Springfield	OR	jeffg@americanocnco.com
2021-04-20 12:34:36	Linda	Watson	Portland	OR	lindalvu2@yahoo.com
2021-04-20 12:34:36	Linda	Watson	Portland	OR	lindalvu2@yahoo.com
2021-04-20 12:34:37	Tasha	Schuetze	Cottage Grove	OR	tashaemail@gmail.com
2021-04-20 12:34:38	Tasha	Schuetze	Cottage Grove	OR	tashaemail@gmail.com
2021-04-20 12:37:35	Patricia	Engelmann	Springfield	OR	macsbest13@gmail.com
2021-04-20 12:37:35	Patricia	Engelmann	Springfield	OR	macsbest13@gmail.com
2021-04-20 12:37:38	Brenda	Lokan	Oakridge	OR	blokan@aol.com
2021-04-20 12:37:38	Brenda	Lokan	Oakridge	OR	blokan@aol.com
2021-04-20 12:38:04	Ralph	Saperstein	Wilsonville	OR	ralphsaperstein@gmail.com
2021-04-20 12:38:04	Ralph	Saperstein	Wilsonville	OR	ralphsaperstein@gmail.com
2021-04-20 12:38:24	Martin	Lopez	Medford	OR	tablerockforestry@gmail.com
2021-04-20 12:38:24	Martin	Lopez	Medford	OR	tablerockforestry@gmail.com
2021-04-20 12:38:53	clarence	mitchell	Riddle	OR	1mitch2@frontiernet.net
2021-04-20 12:38:53	clarence	mitchell	Riddle	OR	1mitch2@frontiernet.net
2021-04-20 12:39:32	Colt	Hunt	Stayton	OR	oregonman57@gmail.com
2021-04-20 12:39:33	Colt	Hunt	Stayton	OR	oregonman57@gmail.com
2021-04-20 12:40:01	David	DeSau	Neskowin	OR	ddesau@embarqmail.com
2021-04-20 12:40:01	David	DeSau	Neskowin	OR	ddesau@embarqmail.com
2021-04-20 12:41:31	Patty	Dunn	Warrenton	OR	2dunns@reagan.com
2021-04-20 12:41:31	Patty	Dunn	Warrenton	OR	2dunns@reagan.com
2021-04-20 12:41:47	Ruben	Garmyn	Bend	OR	rubengarmyn@gmail.com
2021-04-20 12:41:47	Ruben	Garmyn	Bend	OR	rubengarmyn@gmail.com
2021-04-20 12:43:10	Iris	Butler	Roseburg	OR	iris.butler6@gmail.com
2021-04-20 12:43:10	Iris	Butler	Roseburg	OR	iris.butler6@gmail.com
2021-04-20 12:44:35	Ralph	Koozer	Newberg	OR	rkoozer@ipns.com
2021-04-20 12:44:35	Ralph	Koozer	Newberg	OR	rkoozer@ipns.com
2021-04-20 12:45:07	Steve	Schmunk	Springfield	OR	spschmunk@comcast.net

2021-04-20 12:45:08	Steve	Schmunk	Springfield	OR	spschmunk@comcast.net
2021-04-20 12:51:20	BOB	SCHULZ	Hillsboro	OR	bsfx@aol.com
2021-04-20 12:51:20	BOB	SCHULZ	Hillsboro	OR	bsfx@aol.com
2021-04-20 12:55:37	Tiffany	Roddy	Cottage Grove	OR	tiffanyroddy@gmail.com
2021-04-20 12:55:37	Tiffany	Roddy	Cottage Grove	OR	tiffanyroddy@gmail.com
2021-04-20 12:56:06	Rick	Tibbetts	Hillsboro	OR	rrrickyyyt@yahoo.com
2021-04-20 12:56:06	Rick	Tibbetts	Hillsboro	OR	rrrickyyyt@yahoo.com
2021-04-20 12:57:34	Gregory	Miller	Coos Bay	OR	glmill85@frontier.com
2021-04-20 12:57:34	Gregory	Miller	Coos Bay	OR	glmill85@frontier.com
2021-04-20 13:00:29	Clinton	Bailey	Cloverdale	OR	misskiawanda@yahoo.com
2021-04-20 13:00:30	Clinton	Bailey	Cloverdale	OR	misskiawanda@yahoo.com
2021-04-20 13:00:34	Ted	Meier	Sublimity	OR	ted40mary42@gmail.com
2021-04-20 13:00:35	Ted	Meier	Sublimity	OR	ted40mary42@gmail.com
2021-04-20 13:01:00	Sandra	Pope	Winston	OR	pope968@aol.com
2021-04-20 13:01:01	Sandra	Pope	Winston	OR	pope968@aol.com
2021-04-20 13:03:47	James	Peterson	Eugene	OR	jjoepete@aol.com
2021-04-20 13:03:48	James	Peterson	Eugene	OR	jjoepete@aol.com
2021-04-20 13:04:23	John	Robertson	Sisters	OR	jwrobertson61@gmail.com
2021-04-20 13:04:23	John	Robertson	Sisters	OR	jwrobertson61@gmail.com
2021-04-20 13:05:33	Kristi	Kreamer	Dallas	OR	khkreamer@gmail.com
2021-04-20 13:05:33	Kristi	Kreamer	Dallas	OR	khkreamer@gmail.com
2021-04-20 13:06:46	Laura	Harvey	Roseburg	OR	sevenhlinc@outlook.com
2021-04-20 13:06:46	Laura	Harvey	Roseburg	OR	sevenhlinc@outlook.com
2021-04-20 13:10:51	Rick	Rolfe	Creswell	OR	rickrolfe@yahoo.com
2021-04-20 13:10:51	Rick	Rolfe	Creswell	OR	rickrolfe@yahoo.com
2021-04-20 13:12:34	Cristy	Murray	Oregon City	OR	doglady8@gmail.com
2021-04-20 13:12:34	Cristy	Murray	Oregon City	OR	doglady8@gmail.com
2021-04-20 13:15:04	steve	scott	Camas Valley	OR	dsscott@wildblue.net
2021-04-20 13:15:04	steve	scott	Camas Valley	OR	dsscott@wildblue.net
2021-04-20 13:15:28	Karen	Roldan	St. Helens	OR	karenaroldan@gmail.com
2021-04-20 13:15:28	Karen	Roldan	St. Helens	OR	karenaroldan@gmail.com
2021-04-20 13:22:45	James	Dudley	Roseburg	OR	jim.dudley@swansongroup.biz
2021-04-20 13:22:45	James	Dudley	Roseburg	OR	jim.dudley@swansongroup.biz
2021-04-20 13:23:38	Sl	Koubele	Bend	OR	slkoubele@hotmail.com

2021-04-20 13:23:38	Sl	Koubele	Bend	OR	slkoubele@hotmail.com
2021-04-20 13:25:55	Michael	Zachery	Springfield	OR	mike.zachery70@yahoo.com
2021-04-20 13:25:55	Michael	Zachery	Springfield	OR	mike.zachery70@yahoo.com
2021-04-20 13:27:07	Matthew	Wade	Portland	OR	mbrpj@comcast.net
2021-04-20 13:27:07	Matthew	Wade	Portland	OR	mbrpj@comcast.net
2021-04-20 13:30:30	Elizabeth	Brooks	Monroe	OR	brooksl@peak.org
2021-04-20 13:30:31	Elizabeth	Brooks	Monroe	OR	brooksl@peak.org
2021-04-20 13:30:41	Casey	Roscoe	Eugene	OR	croscoe@senecasawmill.com
2021-04-20 13:30:42	Casey	Roscoe	Eugene	OR	croscoe@senecasawmill.com
2021-04-20 13:31:19	Ron	Trembly	Salem	OR	rhowardtrembly@comcast.net
2021-04-20 13:31:20	Ron	Trembly	Salem	OR	rhowardtrembly@comcast.net
2021-04-20 13:40:49	Staci	Sexton	Camas Valley	OR	stacisexton7@gmail.com
2021-04-20 13:40:49	Staci	Sexton	Camas Valley	OR	stacisexton7@gmail.com
2021-04-20 13:47:43	Suzanne	Warren	Eagle Point	OR	mikesuzanne96@yahoo.com
2021-04-20 13:47:43	Suzanne	Warren	Eagle Point	OR	mikesuzanne96@yahoo.com
2021-04-20 14:02:16	Kimberley	Lopez	Alsea	OR	lopezkimberley9@gmail.com
2021-04-20 14:02:16	Kimberley	Lopez	Alsea	OR	lopezkimberley9@gmail.com
2021-04-20 14:06:27	Zeb	Olsen	Alsea	OR	zebolsen33@yahoo.com
2021-04-20 14:06:27	Zeb	Olsen	Alsea	OR	zebolsen33@yahoo.com
2021-04-20 14:11:14	Cynthia	Kenagy	Salem	OR	cynthia@kenagyrealestate.com
2021-04-20 14:11:14	Cynthia	Kenagy	Salem	OR	cynthia@kenagyrealestate.com
2021-04-20 14:23:02	JOHN	SCHNEIDER	Bend	OR	jfscpa@bendbroadband.com
2021-04-20 14:23:02	JOHN	SCHNEIDER	Bend	OR	jfscpa@bendbroadband.com
2021-04-20 14:30:42	Megan	Vanderpool	Cottage Grove	OR	vanderfamily5@aol.com
2021-04-20 14:30:43	Megan	Vanderpool	Cottage Grove	OR	vanderfamily5@aol.com
2021-04-20 14:32:49	Virgil	Tilden	Mcminnville	OR	virgt57@yahoo.com
2021-04-20 14:32:50	Virgil	Tilden	Mcminnville	OR	virgt57@yahoo.com
2021-04-20 14:35:02	Melvin	Lardy	Gaston	OR	stumpbranchlogging75@gmail.com
2021-04-20 14:35:03	Melvin	Lardy	Gaston	OR	stumpbranchlogging75@gmail.com
2021-04-20 14:40:07	Robert	Messinger	Summerville	OR	cbmessing05@yahoo.com
2021-04-20 14:40:08	Robert	Messinger	Summerville	OR	cbmessing05@yahoo.com
2021-04-20 14:40:36	Jim	Benvie	Springfield	OR	forestryinspections@comcast.net
2021-04-20 14:40:37	Jim	Benvie	Springfield	OR	forestryinspections@comcast.net
2021-04-20 14:42:25	Cathy	Steere	Grand Ronde	OR	cak5050@yahoo.com

2021-04-20 14:42:26	Cathy	Steere	Grand Ronde	OR	cak5050@yahoo.com
2021-04-20 14:50:01	Dianna	Paz	Springfield	OR	dianna@wffsp.com
2021-04-20 14:50:02	Dianna	Paz	Springfield	OR	dianna@wffsp.com
2021-04-20 14:52:55	Angela	Frye	Silverton	OR	afrye6@aol.com
2021-04-20 14:52:56	Angela	Frye	Silverton	OR	afrye6@aol.com
2021-04-20 14:53:29	Dennis	Ricksgers	Woodburn	OR	hotspiret@q.com
2021-04-20 14:53:30	Dennis	Ricksgers	Woodburn	OR	hotspiret@q.com
2021-04-20 15:12:48	Russell	Gallup	Grants Pass	OR	russ@oregoncaliforniasupply.com
2021-04-20 15:12:48	Russell	Gallup	Grants Pass	OR	russ@oregoncaliforniasupply.com
2021-04-20 15:14:43	Mary	O'Neil	Portland	OR	maryonei@comcast.net
2021-04-20 15:14:43	Mary	O'Neil	Portland	OR	maryonei@comcast.net
2021-04-20 15:20:26	Kellen	Copeland	Portland	OR	copeland.kellen@gmail.com
2021-04-20 15:20:26	Kellen	Copeland	Portland	OR	copeland.kellen@gmail.com
2021-04-20 15:24:32	Susan	Johnson	Bend	OR	sustbl@yahoo.com
2021-04-20 15:24:33	Susan	Johnson	Bend	OR	sustbl@yahoo.com
2021-04-20 15:52:03	Leigh	Aguilar	Grants Pass	OR	leigh@kadesign.net
2021-04-20 15:52:03	Leigh	Aguilar	Grants Pass	OR	leigh@kadesign.net
2021-04-20 16:15:29	Hattie	Mead	Portland	OR	kehame@aol.com
2021-04-20 16:15:29	Hattie	Mead	Portland	OR	kehame@aol.com
2021-04-20 16:16:34	Joan	Anderson	Veneta	OR	joane50@aol.com
2021-04-20 16:16:35	Joan	Anderson	Veneta	OR	joane50@aol.com
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April 21, 2020

Submitted via www.regulations.gov

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Oregon Coast Branch Chief	Oregon State Supervisor	Oregon State Forester
National Marine Fisheries Service	U.S Fish and Wildlife Service	Oregon Dept. of Forestry
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RE: Notice of Intent to Prepare an Environmental Impact Statement for the Western Oregon State Forests Habitat Conservation Plan

Dear Ms. O'Rourke, Mr. Henson, and Mr. Daugherty:

Thank you for the opportunity to provide comments to NOAA Fisheries and U.S. Fish and Wildlife Service (the Services) as you prepare to develop the Environmental Impact Statement (EIS) for the Western Oregon State Forests Habitat Conservation Plan (HCP). Hampton Lumber has engaged to the degree possible with the Oregon Department of Forestry (ODF) and key stakeholders during the development of the draft HCP. We have continuously expressed concerns with the ODF predicted outcomes of the HCP as currently drafted. We ask the Services to carefully consider the impacts this HCP will have on rural, timber-dependent communities and to analyze viable alternatives during the EIS process.

Hampton Lumber is a fourth-generation family-owned company that has been operating in Oregon for nearly 80 years. Since the beginning, the Hampton family has developed a deep commitment to people, community, and sustainability. Today those values are the heart of Hampton's company culture. Our four Oregon sawmills employ roughly 800 people, mostly in rural north coast communities, with good, year-round, family-wage jobs. We own and manage roughly 80,000 acres of timberland in northwest Oregon in addition to operating a wholesale lumber business out of our Portland headquarters.

Working public forests are the lifeblood for rural communities. As we have seen play out on our federal forests, mismanagement can have devastating economic and environmental outcomes for forests and communities. Hampton Lumber is not opposed to the state pursuing an HCP, but have serious concerns with the potential impacts the current draft would have on rural communities and wood fiber availability. Furthermore, we are concerned that the conservation strategies will do little to maintain certain species, while also leaving state forests more susceptible to wildfire, disease, and insect infestation.

The comments provided in this letter highlight some of the concerns we have with the current draft HCP that we ask you to address in your analysis, as well as ideas for improvements and support for alternatives that provide better economic, environmental, and social outcomes for the species and for the communities that will be directly impacted by this proposal.

Reduced Timber Harvest

Success or failure in wood manufacturing comes down to timber supply. State forests account for 15-50 percent of the timber supply at our Oregon sawmills. Roughly another 25 sawmills currently purchase timber from Oregon's state forests. Additionally, about 15 veneer, plywood, pulp, paper, particleboard, and pellet manufacturers depend on those mills to provide raw materials for their operations.

When ODF presented the Business Case Analysis (BCA) to the Board of Forestry in 2018, it showed that with an HCP, harvest volume levels would increase and without an HCP, they would decrease. It was with this in mind that the Board directed ODF to move forward with developing the HCP. However, the draft commits vast swaths of productive forestland to habitat, which will result in a staggering decrease in harvest volumes by 25-30 percent from current levels. These conservation commitments far exceed anything other landowners have set aside to obtain similar assurances from the Services. Prioritizing new habitat at all costs and restricting harvest on forestland that will never grow into habitat during the HCP permit period creates harmful imbalances on public lands.

There are other impacts to consider when wood fiber availability is constrained. The entire Pacific Northwest is facing a housing crisis, not to mention the 4,000 homes that burned down during the Labor Day fires in 2020 that need to be rebuilt. This is not the time to reduce sustainable harvest levels that can go to providing quality homes to those in the most need. There is also a growing demand for sustainable building materials. This includes everything from small home projects to manufacturing cross laminated timber for commercial buildings. There is no other building material that is green and renewable other than wood products. These products also store carbon, a key element in the fight against climate change. Finally, despite ample resources, the U.S. currently imports 35 percent of our wood products from overseas. Reducing harvest will force that imports percentage to increase, which harms the economy, not to mention the fact that other counties do not have nearly as strong forest management regulations as Oregon.

Negative Economic Impacts

The State of Oregon has a contractual relationship with 15 forest trust land counties (Benton, Clackamas, Clatsop, Columbia, Coos, Douglas, Josephine, Klamath, Lane, Lincoln, Linn, Marion, Polk, Tillamook, and Washington). The ODF manages the forestland as working forests on behalf of the counties and distributes 64 percent of harvest revenues back to the counties and local taxing districts for schools, roads, law enforcement, and other public services. The remaining 36 percent is retained by ODF to cover the cost of managing and protecting these forests. ODF manages roughly 700,000 acres and while these lands represent just 4 percent of all forestland in Oregon, they make up 41 percent of forestland on the north coast.

As currently drafted, the reduction in timber harvest would result in a $13 million loss in annual revenue to counties and local taxing districts, and hundreds of millions of dollars in lost income and opportunities for local businesses. There are countless small businesses – logging operators, mechanics, truck drivers, supply stores, etc. – that will feel the negative financial impacts of this HCP.

On top of the loss in direct revenue for counties and local taxing districts and indirect economic activity, sawmill jobs will also be in jeopardy. It's a terrible outcome to have to close a sawmill. In 2003, Hampton was forced to shut down our Fort Hill sawmill due to harvest reductions on the Siuslaw National Forest. The loss of one small sawmill like our mill in Banks, a town of less than 2,000 residents, would result in $32 million in direct economic opportunity losses annually, including 130 direct and indirect family-wage jobs. Our Warrenton and Tillamook mills are over twice that size and each generate $100 million worth of economic activity in north coast communities.

Nearly 80 percent of the proposed conservation set asides, and the economic and social losses they inflict, would be borne by north coast communities. However, ODF is also putting itself at financial risk. State forests will become a financial liability for the state and local communities if the current HCP is adopted, leaving the agency with a 50 percent budget deficit. Even the expense of implementing the HCP has increased since the previous draft. This begs the question of how ODF will be able to implement an HCP if the HCP itself puts ODF at risk of becoming financially insolvent.

Most alarming, there was no socio-economic analysis done in conjunction with the HCP. The trust land counties were also excluded from formally participating in the development of the draft HCP. Had the communities that have the most to lose from this HCP been at the table, perhaps the draft outcomes would have looked closer to the BCA outcomes. A socio-economic analysis must be included during the EIS process and considered in the ultimate decision on approving the HCP.

Conservation Shortfalls

In the 1990s, nearly 18 million acres of federal forestland in Oregon were effectively converted into a habitat reserve for the northern spotted owl. Harvest levels on these forests were reduced by 90 percent in the hopes that it would improve conservation outcomes for the threatened species. Dozens of sawmills closed and communities crumbled. Thirty years later, spotted owl numbers continue to decline while the majority of federal forestland grows increasingly over-crowded, diseased, and prone to catastrophic wildfires.

The draft HCP sets aside 317,000 acres of forestland for riparian conservation areas (RCA) and habitat conservation areas (HCA). These acres would almost entirely be prohibited from active management. ODF assumes the number of acres set aside for conservation is an adequate predictor of species recovery. This creates a situation where a multitude of other environmental factors, including competition from invasive species,[1] could continue to harm population numbers

[1] According to the U.S. Fish and Wildlife Service, the barred owl is becoming a significant inhibitor of Northern spotted owl recovery. Source: Oregon Fish and Wildlife, Barred Owl Threat: https://www.fws.gov/oregonfwo/articles.cfm?id=149489615;

regardless of the amount of habitat that is created. Strategies focused on the spotted owl and marbled murrelets that create a modest amount of habitat combined with predation management from barred owls, corvids, and jays, would lead to better conservation outcomes and allow for more acres to be available for harvest. While the draft HCP does commit $250,000 a year to barred owl management, the draft still sets aside 134,000 acres of habitat for spotted owls and commits dispersal-capable landscapes outside of HCAs by maintaining a significant amount of the landscape in stands 60 years and older.

As evidenced by the Northwest Forest Plan,[2] setting aside millions of acres without managing direct threats to the species does little to nothing to protect the species and puts the surrounding communities and businesses in economic and social risk. Despite this set aside, spotted owl populations have been consistently declining over the past few decades. Meanwhile, population monitoring studies from 2000 to 2017 indicate that marbled murrelet populations in Oregon are actually increasing.[3] And yet, the draft HCP sets aside 107,000 acres of suitable habitat and 35,000 acres of highly suitable habitat conserved by the end of the permit term. This is all to say that a plan that focuses on actual population numbers instead of habitat acres created would be a more effective strategy.

We also noted the inclusion of a new fish species – Southern Oregon/Northern California spring-run chinook. However, the species account for the fish is still under development. Again, we are not opposed to covering at risk species, but question why this inclusion was made at the last minute without an explanation.

Forest Health Impacts

As noted above, we are concerned that the lack of active management across state forestland will result in unhealthy forests and eventually unhealthy communities. There are several issues to consider here:

- Wildfire risk – prior to Labor Day fires in 2020, there had not been a significant amount of fire activity on the westside of the Cascades for several years. However, historically, fire played a huge role in what eventually became the Tillamook State Forest. The draft HCP says fuels reduction efforts will be generally avoided in HCAs. While not a current priority for ODF, we should not be taking options off the table to mitigate fire risk, whether inside or outside HCAs.

Dugger et al 2016. http://dx.doi.org/10.1650/CONDOR-15-24.1; Weins et al. 2019 https://doi.org/10.3133/ofr20201089; Jenkins et al. 2019 https://doi.org/10.1093/condor/duz055

[2] Decades after setting aside millions of acres of federal forestland to create habitat for the Northern spotted owl, owl populations continue to decline. Source: Spies et al., 2019. Twenty-five years of the Northwest Forest Plan: what have we learned? Front Ecol Environ; 17(9): 511–520, https://doi.org/10.1002/fee.2101

[3] McIver, W., Pearson, S.F., D. Lynch, N. Johnson, J. Baldwin, M.M. Lance, M.G. Raphael, C. Strong, and R. Young, T. Lorenz, and K Nelson. 2019. Marbled murrelet effectiveness monitoring, Northwest Forest Plan: 2018 summary report. 22 pp. https://www.fs.fed.us/r6/reo/monitoring/marbled-murrelet.php

- Salvage – the draft HCP says that salvage harvest will not occur in RCAs or HCAs unless for safety reasons or after a large disturbance (undefined). Again, ODF should not be removing options to restore forests after fire, windstorms, insect infestation, or other disturbances. Moreover, leaving dead trees standing after an event leaves the forest more susceptible to reburn or insect infestation that could impact nearby healthy stands or private timberlands.[4]

- Buffers – the draft HCP says due to potential changes in water temperature and flow from climate change, ODF may expand stream buffers in key locations. Aquatic buffers in the draft HCP are already substantially larger than current private and public forest management requirements. Again, unmanaged stands could lead to unhealthy forests that are more susceptible to catastrophic events.

- Herbicide application – the draft HCP says ODF will avoid any direct spraying on wildlife, or immediate habitat in use by wildlife for breeding, feeding, or sheltering. In addition, if spraying is proposed within the range of Oregon slender salamander, a buffer of at least 10 feet from large downed wood that could provide habitat for Oregon slender salamander will be maintained as a no-spray zone. This language seems to add additional restrictions that could make it difficult if not impossible to prescribe certain silviculture practices. ODF is once again taking options off the table that could be necessary for healthy forests.

Improvements and Alternatives to Consider

The intense focus on habitat creation puts rural communities at financial and environmental risk. As mentioned above, we think there could be significant reductions in the HCAs if predation is properly managed. The original harvest levels that were modeled in the BCA provided a better and more predicable level of harvest. It is still not clear why so many acres are set aside in this draft, especially when no other HCP that has been approved on the West Coast required similar levels.

HCAs could be reduced in lower habitat suitability index acres or acres unsuitable for habitat. Another place to start would be acres that are set aside for HCAs but were not previously aquatic or terrestrial anchor habitat. The maps that are publicly available do not provide enough detail to analyze specific stands and reconsider HCA locations and sizes. We would ask that more details be made public during the EIS process so that stakeholders may provide further considerations.

We are encouraged by the prospect of alternatives that balance the needs of all Oregonians. We do not believe ODF considered a reasonable amount of options or alternatives before submitting their application. Other public land HCPs have considered a wide range of alternatives, while ODF only considered three options – this draft HCP, the current Forest Management Plan and a draft Forest Management Plan. ODF did not analyze a "take avoidance" alternative that would have mirrored

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[4] Peterson, David W, Dodson, Erich K, Harrod, Richy J. Post-fire logging reduces surface woody fuels up to four decades following wildfire. *Forest Ecology and Management.* 338 (2015) 84-91. https://www.fs.usda.gov/treesearch/pubs/48822

private land management. Such an alternative would have undoubtedly produced vastly better financial returns to the counties and the state.

The Council of Forest Trust Land Counties (CFTLC) submitted their "Three Goal HCP Alternative" to the scoping process on April 19, 2020. As previously mentioned, the trust land counties will be directly and most impacted by this HCP. Since they were denied a seat on the scoping and steering committees, they were not able to address these impacts and concerns as the HCP was being drafted. We believe their alternative would provide better conservation and financial outcomes compared to the current draft and request that the Services analyze this alternative.

Finally, an HCP should not be approved without a socioeconomic analysis. Since ODF did not provide this analysis in their application, we ask the Services to include this in the EIS process. Rural communities need to know what impacts they should expect over the 70-year permit term.

Conclusion

When ODF started the HCP process, they assured stakeholders they would pursue a plan that would maintain or increase harvest levels while improving conservation outcomes for vulnerable species. As currently drafted, this HCP appears to lock-in an unsustainable financial future for north coast forests and generations to come by reducing harvests and revenues below levels needed to sustain the forest and the surrounding manufacturing base.

This HCP reflects a fundamental shift in how these forests are managed. It refocuses priorities away from surrounding communities who use and depend on these resources and toward habitat creation without actually improving population numbers. The Services and ODF now have the ability to consider alternatives and to make critical changes to the current draft to protect rural communities, at-risk species, and improve forest health.

Sincerely,

Laura Wilkeson
State Forest Policy Director
Hampton Lumber

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April 21, 2021

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RE: Scoping Comments re: Western Oregon State Forests Habitat Conservation Plan

To Whom it May Concern:

On behalf of Tillamook County (the "County"), my office is pleased to submit the following scoping comments regarding the environmental impact statement ("EIS") for the proposed Western Oregon State Forests Habitat Conservation Plan ("WOSF HCP"). The County strongly supports the Three Goal HCP Alternative (the "Alternative HCP") proposed by the Council of Forest Trust Land Counties ("CFTLC").

The County has a strong interest in the EIS process because the County receives a substantial portion of its annual revenue from timber sales conducted by the State of Oregon on the Tillamook State Forest. Similar to other counties in the State, the County acquired much of the acreage that now comprises the Tillamook State Forest by tax foreclosure in the 1930s and 1940s, in many cases because the owners had abandoned land during the Great Depression and as a result of forest fires in the 1930s and 1940s. The removal of these forestlands from the County's tax roll created substantial revenue loss, which imperiled its economic welfare.

To address that problem, the State, in cooperation with the County and other counties around the State (collectively, the "Forest Trust Land Counties"), enacted legislation authorizing the counties to convey their forestlands (the "Forest Trust Lands") to the State to manage for the benefit of the Forest Trust Land Counties and local districts within their borders. The State and the Forest Trust Land Counties agreed that the State would be entitled to keep a set portion of the revenues derived from the forestlands as a management fee and would be obligated to return the remaining revenues to the Forest Trust Land Counties, including the County. This agreement is reflected in the Forest Acquisition Act, Oregon Laws, 1939, Ch. 478; Oregon Laws, 1941, Ch. 236; ORS 530.010 to ORS 530.181 (the "Act").

Under the Act, the State is required to return to the Forest Trust Land Counties a specified portion of the revenues derived from the management of the Forest Trust Lands. ORS 530.115(1). The Act specifically requires the State to manage the Forest Trust Lands "so as to secure the greatest permanent value of the lands." ORS 530.050. Oregon courts have determined that this framework creates a binding and enforceable agreement on the part of the State to secure the greatest permanent value of the Forest Trust Lands for the Forest Trust Land Counties, including Tillamook County.

Like the other Forest Trust Land Counties, the County relies heavily on timber revenue to provide basic services for its constituents. Annually, Tillamook County receives millions of dollars in timber revenue, which is distributed to its various taxing districts, including local school, fire, health, port, and conservation districts. In addition, the County retains a portion of the revenue for its general fund, and those funds account for a significant percentage of the County's total general fund budget, which is used to support critical services such as the sheriff's department. The timber industry also provides jobs to County residents, property tax revenue to the County, and support for the underlying service industries within the County.

For all those reasons, it is critical that the negative socioeconomic impacts of the WOSF HCP—and the positive impacts of the Alternative HCP—be considered as part of the EIS process. Notably, the proposed WOSF HCP calls for a substantial decrease in the acreage available for timber management, which will result in a reduction from the current timber harvest of 260 MMbf to approximately 205 MMbf. That reduction will cause a corresponding reduction in revenue to the Forest Trust Land Counties, including the County, and will cause considerable harm to local economies in affected areas. Those and other socioeconomic impacts would be devastating and should be considered as part of the EIS process.

The County supports the Alternative HCP proposed by Council of Forest Trust Land Counties ("CFTLC"). Unlike the WOSF HCP, the Alternative HCP takes into account the State's statutory and contractual obligations and would provide for dependable, predictable levels of harvest and associated revenue to the Trust Land Counties and individual tax district beneficiaries while, at the same time, adequately protecting covered species and covered activities. This would eliminate the negative socioeconomic impacts of the proposed action.

From the County's perspective, it is also imperative that the EIS analyze long-term population trends. In particular, the EIS should quantify the effects of modern logging practices on salmonid habitat and survival relative to other influential factors.

Existing research on the impact of forest management practices on salmonid species are outdated and inconclusive. However, studies show that logging in fishless headwaters has no acute effect on downstream trout populations when compared with un-logged streams.[1] Likewise, in a recent study of 33 timber harvest sites in Oregon, only a few sites exceeded Oregon's regulatory temperature thresholds for cold-water fish, and only three were associated with timber harvest when compared with pre-treatment or unlogged upstream temperatures.[2] These and other studies suggest that the impact of modern logging practices on salmonid populations and habitat has been greatly exaggerated.

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[1] Bateman, D. S., M. R. Sloat, R. E. Gresswell, A. M. Berger, D. P. Hockman-Wert, D. W. Leer, and A. E. Skaugset. 2016. Effects of stream-adjacent logging in fishless headwaters on downstream coastal cutthroat trout. Canadian Journal of Fisheries and Aquatic Sciences 73(12):1898–1913. NRC Research Press.
[2] Groom, J. D., S. L. Johnson, J. D. Seeds, and G. G. Ice. 2017. Evaluating links between forest harvest and stream temperature threshold exceedances: The value of spatial and temporal data. JAWRA Journal of the American Water Resources Association 53(4):761–773. Wiley Online Library.

To accurately quantify the impact of contemporary forest management practices on salmonid populations, the EIS should use a control–treatment field study based on surveys taken before and after logging events occur adjacent to streams of interest. This will allow the EIS to assess changes in adult spawner abundance, juvenile density, habitat features, and water quality parameters and to isolate the specific impact, if any, logging has on those variables. Any measures that affect timber harvest should be considered only if statistically significant evidence suggests a causal relationship between harvest operations and salmonid abundance and habitat.

Along the same lines, the EIS should also consider broad-scale trends in salmonid survival to determine whether climactic processes or other oceanic variables—as opposed to forest management practices—are the true cause of the mortality and decline of salmonid populations inhabiting this region. If that analysis reveals that ocean conditions are the primary driver of salmonid abundance, as indicated by the research of Dr. David Welch, the EIS should adopt an alternative that omits harvest-reducing interventions geared toward protecting salmonid populations.

Tillamook County appreciates the opportunity to provide the foregoing scoping comments and looks forward to working with the federal agencies throughout the EIS process, including with respect to the benefits of the Alternative HCP.

Best regards,

/s/ Jay T. Waldron

Jay T. Waldron

JTW:grv

cc: David Yamamoto, Tillamook County Commissioner
Joel W. Stevens, Tillamook County Counsel
Jessica A. Schuh, Schwabe, Williamson & Wyatt

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April 21, 2021

I write to you today regarding the version of the Habitat Conservation Plan presented to you by Oregon Department of Forestry. As a lifetime Clatsop County resident and a 4th generation Oregonian, I come from a family of conservationist that work in the forest, on the ocean, and also serve in the military and fire service to protect human life, property, and liberty. You will not find someone that loves the forest more than those chose to work in it and for it. Those of us that have grown up in it and serve within our community recognize the balance of the environment, the economy, and the community as a necessity to sustain each of those three tenants. One cannot exist without balancing with the other.

The current proposed HCP has a purpose and goals that we all can agree need to be met. However, these goals can be met without devastating an economy, and community.

We speak of equity all over the country, but who is looking at the equity of taking 20-30% of our harvest away from the citizens of my county? Clatsop county is one of the largest timber producers in the state. We do not grow wheat and barley here; we grow and harvest timber because that is what our county is best suited for and we provide that to the people of our country. The revenue loss to our special districts will be tragic and will bring on much worse consequences to the forest we want to manage and protect. How would 20-30% revenue reduction impact those that work in our special district like schools, rural fire service, public safety, health district and rural law enforcement? While we cut their budget, we continue to underserve the local community. We haven't even begun the conversation about the actual timber-related jobs and the economic trickle-down from those.

Let’s consider the environmental and habitat impact of homelessness, and low-income families just trying to survive. Have you seen what those that just are trying to live through today do to our forest and habitat? When they are just trying to survive, the environment and habitat are the least of their concerns. While the country cries a mantra that even one life matters and talks about affordable housing this type of HCP would impactfully raise the cost of housing through lumber costs and make affordable housing even more unattainable. The tax burden on the housing processes already so high that affordable housing as a concept is laughable in Oregon. But this will create an even larger divide between those that can be under a roof at night and those that will have none.

I was saddened to learn that the BOF board of forestry voted to move this version of an HCP into the National Environmental Policy Act Process without consulting and seeking approval from the Forest Trust Land Advisory Committee members. In fact, I am to understand our committee entrusted with ensuring the contractual obligation of the state to manage our forestlands to our benefit has a version of an HCP that would meet the goals set forth without devastating our communities.

If the real goal is to impactfully protect more habitat and species there should be greater consideration for other options beyond this ODF version of HCP that has been presented to you. Please reject it on the basis that they can do better for all concerned and that there are other plans available to consider.

If you will give consideration to the habitat of the people as well as that of the environment then the community can thrive along with the species you seek to protect. But if you place one above the other it will impact them all negatively in the long run.

Thank you for your time and consideration,

Katy Pritchard
Astoria, Oregon
503.440.0010

Appendix 2-A
Alternatives Screening

The National Marine Fisheries Service (NMFS) conducted an alternatives screening process based on the requirements defined in the Council on Environmental Quality's regulations implementing the National Environmental Policy Act (40 Code of Federal Regulations [CFR] 1502.14) to identify a reasonable range of alternatives to the Western Oregon State Forests Habitat Conservation Plan (proposed action) to study in detail in the environmental impact statement. As a cooperating agency, the U.S. Fish and Wildlife Service (FWS) provided input throughout the alternatives screening process. This report documents the process and its outcomes.

Alternatives Screening Process

NMFS implemented a screening process to select the action alternatives to study in detail in the EIS. NMFS consulted FWS and the Oregon Department of Forestry (ODF) throughout the process for their expertise and input on technical issues such as feasibility. NMFS also led numerous workshops with FWS and ODF during the alternatives screening process, which were used to define the alternatives considered in the screening process, develop screening criteria, and apply the screening criteria to determine whether to analyze the potential alternatives in detail in the EIS.

The potential alternatives considered are described in the section below called *Potential Alternatives*. Each of these alternatives was screened for further detailed study by applying the screening criteria shown in Tables 1 and 2. These criteria were derived from the CEQ regulations' definition of a reasonable alternative, which means a reasonable range of alternatives that are technically and economically feasible, meet the purpose and need for the proposed federal action, and, where applicable, meet the goals of the applicant (40 CFR 1508.1(z)).

As shown in Table 1, if the potential alternative did not meet the purpose and need for the federal action, it was eliminated from detailed study in the EIS. If a potential alternative did meet the purpose and need, it was advanced for evaluation against the remaining screening criteria shown in Table 2. If the answer to any of these screening criteria questions was "no," NMFS eliminated the alternative from detailed study in the EIS. The section below called *Alternatives Screening Results* provides a brief description of why an alternative was dismissed.

If the answers to all of the screening criteria questions were "yes" or "maybe", NMFS advanced the potential alternative for detailed analysis in the EIS (see Table 2 and the section, *Selected EIS Alternatives*). After completing the screening process, NMFS worked internally and in consultation with FWS and ODF to further define the selected alternatives, which are described in Chapter 2, *Proposed Action and Alternatives*, of this EIS.

Potential Alternatives

NMFS considered the 17 potential alternatives briefly described below, based on the scoping process, which included discussions with federal and state agencies and a review of public comments. NMFS considered all suggested alternatives. In cases where a suggested alternative was not described in enough detail to properly evaluate and screen, NMFS attempted to define the suggested alternative more fully based on the perceived intent of the comment.

- **Alternative A: Reduced Permit Term of 30 Years.** This alternative would have a reduced permit term of 30 years.
- **Alternative B: Reduced Permit Term of 50 Years.** This alternative would have a reduced permit term of 50 years.
- **Alternative C: Reduced Covered Species—Exclude Non-Listed Fish Species.** This alternative would exclude Oregon Coast spring Chinook and Southern Oregon/Northern California Coastal spring Chinook (fish species currently not listed as threatened or endangered under the Endangered Species Act [ESA]) from incidental take permit (ITP) coverage.
- **Alternative D: Reduced Covered Species—Exclude Non-Listed Amphibian Species.** This alternative would exclude Oregon slender salamander, Columbia torrent salamander, and Cascade torrent salamander (amphibian species currently not listed as threatened or endangered under the ESA) from ITP coverage.
- **Alternative E: Reduced Covered Species—Exclude Eulachon.** This alternative would exclude eulachon from ITP coverage.
- **Alternative F: Reduced Covered Species—Exclude Coastal Marten.** This alternative would exclude coastal marten from ITP coverage.
- **Alternative G: Reduced Covered Species—Exclude Red Tree Vole (Non-Listed).** This alternative would exclude red tree vole from ITP coverage.
- **Alternative H: Modified Aquatic Conservation Strategy—Western Oregon Bureau of Land Management Riparian Strategy.** This alternative would model the riparian conservation strategy on the Western Oregon Bureau of Land Management (BLM) Resource Management Plan (RMP) riparian strategy.
- **Alternative I: Modified Aquatic Conservation Strategy—Increased Temperature Protections.** This alternative would modify Conservation Action 1 by extending the process protection zone[1] on non-fish-bearing streams from 500 to 1,500 feet upstream of fish-bearing reaches and increase the width of riparian conservation areas (RCAs) on these streams above the process protection zone from 35 to 50 feet.
- **Alternative J: Modified Aquatic Conservation Strategy—Increased Protection of Landslide Initiation Sites.** This alternative would modify Conservation Action 1 by retaining trees at all landslide initiation sites above areas identified by ODF as likely to deliver to fish-bearing streams instead of just high hazard upland landslide initiation sites.
- **Alternative K: Modified Aquatic Conservation Strategy—Aquatic Reserves.** This alternative would designate several key watersheds as aquatic reserves and manage them for the primary purpose of aquatic conservation (e.g., no clear cutting, no road construction).
- **Alternative L: Modified Aquatic Conservation Strategy—Increased Management in Riparian Conservation Areas.** This alternative would allow increased stand management and harvest activity near streams to increase production of fish biomass.

[1] The process protection zone consists of the first 500 feet upstream from the end of fish use on perennial fish-bearing streams and, under the HCP, would be included in RCAs.

- **Alternative M: Modified Terrestrial Conservation Strategy—Increased Protections.** This alternative would modify Conservation Action 7 to exclude clearcutting or retention harvest, heavy or moderate thinning, and removal or sale of downed trees from habitat conservation areas (HCAs). It would also modify Conservation Action 8 by increasing protective management standards for harvested areas above those required by the Oregon Forests Protection Act, including management "prescriptions"; reducing uniform, heavy logging and implementing variable-density thinning; and including buffer stands around the old-growth patches on non-HCP lands.
- **Alternative N: Modified Terrestrial Conservation Strategy—Reduced Habitat Conservation Areas and Increased Predator/Competitor Control.** This alternative would modify Conservation Action 6 by reducing HCAs and would compensate for that reduction in conservation by increasing control or removal of barred owls and other nonnative species. Control or removal of species that prey on or compete with covered species may occur under the proposed action as part of Conservation Action 9, which addresses factors that limit the ability of covered species to take advantage of the new habitat and for populations to increase.
- **Alternative O: Modified Terrestrial Conservation Strategy—Increased Timber Harvest**. This alternative would modify Conservation Action 6 by changing HCA boundaries to allow greater potential harvest volume and Conservation Action 7 by increasing allowable harvest within HCAs.
- **Alternative P: Modified Terrestrial Conservation Strategy—Increased Management in Habitat Conservation Areas.** This alternative would modify Conservation Action 7 by increasing forest management within HCAs by applying disturbance-based management principles, such as partial-harvest forestry and commercial thinning in HCAs.
- **Alternative Q: Increased Conservation.** This alternative would modify Conservation Action 1 by increasing the width of RCAs from 35 to 50 feet above the process protection zone on small perennial non-fish-bearing streams, seasonal non-fish-bearing streams that have potential to deliver wood to fish-bearing streams (potential debris flow tracts and high energy streams) and leaving trees on landslide initiation sites likely to deliver debris to a fish-bearing stream on moderate and high-hazard upland slopes.

Alternatives Screening Results

The goal of alternatives screening is to identify a reasonable range of alternatives to be considered in detail in the EIS. The alternatives screening process also provides a structure for explaining and documenting the reasons why some alternatives were considered but eliminated from detailed study in the EIS. As shown in Table 1, the following seven alternatives were eliminated from further review because they did not meet the purpose and need for the reasons described below.

- Alternatives C, D, E, F, and G, which would exclude non-listed fish species, non-listed amphibian species, eulachon, coastal marten, and red tree vole, respectively, do not fully respond to the applicant's request for ITP coverage for the covered species included in the HCP.
- Alternative L, which would modify the aquatic conservation strategy to increase management in RCAs to increase production of fish biomass, would be reliant on primary productivity and would not increase or improve natural functions and processes of habitat in riparian areas for aquatic covered species.

- Alternative N would reduce HCAs and compensate for that reduction in conservation by increasing control or removal of barred owls and other nonnative species. Reduced HCAs were considered in Alternative 5, which was moved forward for detailed analysis in the EIS. Control or removal of species that prey on or compete with covered species may occur under the proposed action as part of Conservation Action 9, which addresses factors that limit the ability of covered species to take advantage of the new habitat and for populations to increase. While barred owl control experiments have indicated positive response by northern spotted owls, not all treatment areas observed significant responses. An alternative further reliant on this form of management would not adequately address the covered terrestrial species' reliance on availability of suitable habitat.

The alternatives that passed the screening for purpose and need were screened against additional criteria. Table 2 presents the results of this screening process. Of the remaining alternatives, seven were eliminated from detailed analysis in the EIS for the reasons briefly described below.

- Alternative A, which would reduce the permit term to 30 years, was eliminated because it did not provide for long-term assurances to provide for the conservation of listed species. The shorter permit term does not provide the time needed to develop habitat to meet the biological goals and objectives and would provide fewer long-term conservation benefits to the covered species.
- Alternative H, which would model the riparian conservation strategy on the Western Oregon BLM RMP riparian strategy, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. This alternative would not provide predictable revenue outcomes to the counties in the permit area or predictable timber outcomes to support jobs and rural economies. It would not represent a cost-effective means of complying with the federal ESA, as compared to current management practices, or be a cost-effective strategy at the operational level.
- Alternative I, which would increase the length of the process protection zone and expand the RCAs above this zone on small perennial non-fish-bearing streams, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. This alternative would not be a cost-effective strategy at the operational level. Elements of this alternative were incorporated into Alternative Q, which was moved forward for detailed analysis in the EIS as Alternative 3.
- Alternative J, which would retain trees at all landslide initiation sites, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. It would not provide predictable revenue outcomes to the counties in the permit area or predictable timber outcomes to support jobs and rural economies. Additionally, it would not represent a cost-effective means of complying with the ESA, as compared to current management practices. Elements of this alternative were incorporated into Alternative Q, which was moved forward for detailed analysis in the EIS as Alternative 3.
- Alternative K, which would revise the conservation strategy based on designation of key watersheds as aquatic reserves and would manage them for the primary purpose of aquatic conservation, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. It would not provide a cost-effective strategy at the operational level.
- Alternative M, which would increase protections for terrestrial species, was eliminated because it would not meet the goals of the applicant regarding economic feasibility. The modifications to

Conservation 7 would not represent a cost-effective means of complying with the ESA, as compared to current management practices, or be a cost-effective strategy at the operational level. Modifications to Conservation Action 8 to meet protective management standards above those required by the Oregon Forests Protection Act and implement variable-density thinning are already part of the proposed action.

- Alternative P, which would apply disturbance-based management principles in HCAs, such as partial-harvest forestry and commercial thinning, was eliminated because it is largely similar to the proposed action, which would implement these principles in HCAs.

Selected EIS Alternatives

Based on the alternatives screening, NMFS selected the following alternatives for detailed study in the EIS. Chapter 2 provides a more detailed description of each alternative.

- Alternative B. Reduced Permit Term of 50 Years is analyzed in the EIS as Alternative 4.
- Alternative O. Modified Terrestrial Conservation Strategy—Increased Timber Harvest is analyzed in the EIS as Alternative 5.
- Alternative Q. Increased Conservation is analyzed in the EIS as Alternative 3.

Table 1. Alternatives Screening for Purpose and Need—Western Oregon State Forests Habitat Conservation Plan EIS

Criteria	A. Reduced Permit Term of 30 Years	B. Reduced Permit Term of 50 Years	C. Reduced Covered Species—Exclude Non-Listed Fish Species	D. Reduced Covered Species—Exclude Non-Listed Amphibian Species	E. Reduced Covered Species—Exclude Eulachon	F. Reduced Covered Species—Exclude Coastal Marten	G. Reduced Covered Species—Exclude Red Tree Vole	H. Modified Aquatic Conservation Strategy—Western Oregon BLM Riparian Strategy	I. Modified Aquatic Conservation Strategy—Increased Temperature Protections	J. Modified Aquatic Conservation Strategy—Increased Protection of Landslide Initiation Sites	K. Modified Aquatic Conservation Strategy—Aquatic Reserves	L. Modified Aquatic Conservation Strategy—Increased Management in RCAs	M. Modified Terrestrial Conservation Strategy—Increased Protections	N. Modified Terrestrial Conservation Strategy—Reduced HCAs/Increased Predator Control	O. Modified Terrestrial Conservation Strategy— Increased Timber Harvest	P. Modified Terrestrial Conservation Strategy—Increased Management in HCAs	Q. Modified Aquatic Conservation Strategy—Increased Conservation
Does it meet the purpose and need?	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	Maybe	No	Yes	No	Yes	Maybe	Yes

Table 2. Alternatives Screening for Remaining Criteria—Western Oregon State Forests Habitat Conservation Plan EIS

Criteria	A. Reduced Permit Term of 30 Years	B. Reduced Permit Term of 50 Years	H. Modified Aquatic Conservation Strategy—Western Oregon BLM Riparian Strategy	I. Modified Aquatic Conservation Strategy—Increased Temperature Protections	J. Modified Aquatic Conservation Strategy—Increased Protection of Landslide Initiation Sites	K. Modified Aquatic Conservation Strategy—Aquatic Reserves	M. Modified Terrestrial Conservation Strategy—Increased Protections	O. Modified Terrestrial Conservation Strategy—Increased Timber Harvest	P. Modified Terrestrial Conservation Strategy—Increased Management in HCAs	Q. Modified Aquatic Conservation Strategy—Increased Conservation
Is it technically feasible?	Yes	Yes	Yes	Yes	Maybe	Yes	Yes	Yes	Yes	Yes
Is it economically feasible?	Maybe	Yes	No	No	Maybe	Maybe	No	Yes	Yes	Yes
Does it meet the goals of the applicant?	Maybe	Yes	No	No	No	No	No	Yes	Yes	Yes
Is it based on biologically and technically sound management aimed at conserving listed species?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes
Does it provide for long-term assurances to provide for the conservation of listed species?	No	Yes	Yes	Yes	Yes	Maybe	Yes	Yes	Maybe	Yes

BLM = Bureau of Land Management; RCA = riparian conservation area; HCA = habitat conservation area

Appendix 3.1-A
Regulatory Environment

This appendix provides information on the regulatory context for the EIS resource analyses.

Geology and Soils

Law, Regulation, or Program	Description
Federal	
National Landslide Preparedness Act	Directs the Secretary of the Interior, acting through the Director of the U.S. Geological Survey, to establish a program to identify risks and hazards from landslides, reduce losses, protect communities at risk, and improve communication and emergency preparedness. The act requires the program to map and assess landslide hazards; respond to landslide events; coordinate with nonfederal entities to identify regional and local priorities; and develop and implement landslide hazard guidelines for geologists, engineers, emergency managers, and land-use decision makers.
State	
Oregon Forest Practices Act (OAR Chapter 629)	Governs forest management on all state-owned and private lands in the state. The Board of Forestry has the responsibility to interpret the Oregon FPA and set rules for forest practices. ODF enforces the requirements of the Oregon FPA, which are set by the Board of Forestry. Requirements relevant to geology and soils include stream buffer widths to limit sediment transport to water channels, standards for the distribution of leave trees, including along streams, and for replanting forests following harvest; and practices to minimize erosion and landslide minimization from road construction and harvest.
Oregon Administrative Rules Chapter 629, Division 623	Describes shallow, rapidly moving landslides and public safety. Its purpose is to reduce the risk of serious bodily injury or death caused by shallow, rapidly moving landslides directly related to forest practices. The rules contained in this division consider the exposure of the public to these safety risks and include appropriate practices designed to reduce the occurrence, timing, or effects of shallow, rapidly moving landslides.
Oregon Revised Statute 527.710	Directs the Board of Forestry to adopt rules to reduce risk of serious bodily injury or death caused by a rapidly moving landslide directly related to forest practices.

EPA = U.S Environmental Protection Agency; FPA = Forest Practices Act; NPDES = National Pollutant Discharge Elimination System; ORS = Oregon Revised Statute; OAR = Oregon Administrative Rules; USC = United States Code

Water Resources

Law, Regulation, or Program	Description
Federal	
Clean Water Act (33 USC 1251 et seq.)	Authorizes EPA to establish the basic structure for regulating discharges of pollutants into waters of the United States and regulates water quality standards for surface waters. Elements of the CWA specifically applicable to water resources include the following: • Section 303 of the CWA addresses the development of water quality standards and implementation plans for interstate waters by individual states; Section 303(d) includes requirement for states to identify and list waters where current water pollution control regulations and controls alone cannot meet the water quality standards set for those waters. • Section 401 of the CWA requires Water Quality Certification from the state for activities requiring a federal permit or license to discharge pollutants into a water of the United States. Certification attests the state has reasonable assurance the proposed activity will meet state water quality standards. • Section 402 establishes the NPDES program, under which certain discharges of pollutants into waters of the United States are regulated. • Section 404 regulates the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands. Section 404 exempts certain forestry activities, including the maintenance of forest roads, from the permitting process for discharges of dredged or fill material in wetlands, streams and/or other jurisdictional waters of the US.
Section 10, Rivers and Harbors Act of 1899 (33 USC 403)	Applies to activities that could affect navigable waters of the United States.
National Flood Insurance Act of 1968	Establishes the NFIP, a federal floodplain management program designed to reduce future flood losses nationwide through the implementation of community-enforced building and zoning ordinances in return for the provision of affordable, federally backed flood insurance to property owners. The NFIP is a program in which counties and cities can voluntarily participate. FEMA is the agency responsible for enforcing the NFIP. The program is implemented at the city and county level.
Flood Plain Management Criteria for Flood-Prone Areas (44 CFR 60.3(d)(3))	Requires FEMA to review any construction within a mapped floodway to ensure that the work will not increase flood levels. Any actions taken within a designated floodway area require a rise analysis, with review and approval by FEMA.
Executive Order 11988/13690, Floodplain Management	Requires federal agencies to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative (42 FR 26951). FEMA is responsible for enforcement.

Law, Regulation, or Program	Description
State	
ORS 196.795–990	Governs removal and fill permits. Ensures the protection and the best use of Oregon's water resources for home, commercial, wildlife habitat, public navigation, fishing, and recreational uses.
ORS 568.900 to 568.933; ORS 561.191	Serves as the Oregon Department of Agriculture authority for water quality.
Water Rights Act, ORS 537.010 et. seq.	Provides that all water within the state belongs to the public and establishes state regulation of appropriation of water for beneficial use consistent with the act.
ORS Chapter 527	Serves as the ODF authority for water quality, including but not limited to the following: 527.710 duty to consult with the Department of Environmental Quality on water pollution programs, the Department of State Lands on removal and fill programs, Oregon Health Authority on the Federal Safe Drinking Water Act, and Water Resources Department on water resource programs prior to adopting rules that establish standards for forest practices; 527.724 requirement to comply with rules and standards of the Environmental Quality Commission and subject violations to all remedies and sanctions available under statute or rule to the Department of Environmental Quality or the Environmental Quality Commission; 527.765 (1) requirement to establish forest BMP rules to prevent or reduce pollution of waters of the state in accordance such that forest practices do not impair the achievement or maintenance of water quality standards established by the Environmental Quality Commission, (2) requirement to consult with Environmental Quality Commission in adoption and review of BMPs and other rules to address pollutants resulting from forest operations, (3) procedural requirements to review BMP upon written petition, revise, and implement revised BMPs to protect water quality; and 527.770 duties to enforce operator compliance with water quality BMP rules.
ORS 468B.030, 468B.035	Acknowledges that the State of Oregon is responsible for implementing the NPDES program under the CWA.
Ground Water Act of 1955 (ORS 537.505 to 537.795)	Provides for state regulation of groundwater.
Water Protection Rules of the Forest Practices Act (OAR 629, Divisions 635, 642, 645, 650, 655, 660)	Protects, maintains, and improves the functions and values of streams, lakes, wetlands, and riparian management areas.
Forest Practices Act (OAR 629, Division 620)	Prevents and controls leaks and spills of chemicals and other petroleum products.
Oregon Groundwater Quality Protection Act of 1989 (ORS 468B.150–190)	Sets a goal for Oregon to prevent contamination of Oregon's groundwater resource, to conserve and restore it, and to maintain quality for present and future uses. All state agencies' rules and programs are to be consistent with the goal. Oregon DEQ is primarily responsible for implementation.
Water Distribution Rules, OAR Chapter 690, Division250	Guides the administration of Oregon water laws related to regulatory actions.

BMP = best management practice; CWA = Clean Water Act; DEQ = Department of Environmental Quality; EPA = U.S Environmental Protection Agency; FEMA = Federal Emergency Management Agency; FR = Federal Register;

NFIP = National Flood Insurance Program; NPDES = National Pollutant Discharge Elimination System; ORS = Oregon Revised Statute; OAR = Oregon Administrative Rules

Vegetation

Law, Regulation, or Program	Description
Federal	
Clean Water Act (33 USC 1251 et seq.)	Authorizes EPA to establish the basic structure for regulating discharges of pollutants into the waters of the United States and regulates water quality standards for surface waters. Section 404 exempts certain forestry activities, including the maintenance of forest roads, from the permitting process for discharges of dredged or fill material in wetlands, streams and/or other jurisdictional waters of the US. The CWA regulates many activities in surface waters, including vegetated components.
Endangered Species Act (16 USC 1531–1544)	Provides for the conservation of species listed as threatened or endangered and their critical habitat. Section 9 of the Act prohibits certain activities that directly or indirectly affect endangered species.
State	
Removal-Fill Law (ORS 196.800–196.990)	Requires private landowners and public agencies planning to remove or fill material from a wetland or waterway to obtain a permit for such activities from the Oregon Department of State Lands.
Oregon Endangered Species Act Consultation (ORS 496.002–496.192)	Requires consultation with ODFW for activities on state lands that may affect state-listed threatened and endangered species.
Oregon Forest Practices Act (OAR Chapter 629)	Governs forest management on all state-owned and private lands in the state. The Board of Forestry has the responsibility to interpret the Oregon FPA and set rules for forest practices. ODF enforces the requirements of the Oregon FPA, which are set by the Board of Forestry. Requirements relevant to vegetation include specific guidelines for tree harvesting; road design and construction; and protection of wildlife habitat, riparian vegetation, wetlands, and slopes.
Oregon Weed Control Policy (ORS Chapter 569)	Establishes noxious weed control boards, which designate certain plant species as noxious weeds. Authorizes the management, control, and/or elimination of noxious weed populations in the state.

CWA = Clean Water Act; EPA = U.S. Environmental Protection Agency; FPA = Forest Practices Act; OAR = Oregon Administrative Rules; ODFW = Oregon Department of Fish and Wildlife; ORS = Oregon Revised Statute; USC = United States Code

Fish and Wildlife

Law, Regulation, or Program	Description
Federal	
Endangered Species Act (16 USC 1531 et seq.)	Provides for the conservation of species listed as threatened or endangered and their critical habitat. Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. Section 10 of the ESA provides for permitting of incidental take of listed species with an approved HCP.

Law, Regulation, or Program	Description
Magnuson-Stevens Conservation and Management Act (16 USC 1801 et seq.)	Requires an essential fish habitat consultation to document potential harm to essential habitats used by fish species that are managed under federal fisheries management plans, measures for avoiding and minimizing adverse effects, and any conservation measures used to offset these effects.
Fish and Wildlife Coordination Act (16 USC 661–666)	Applies to activities affecting general fish and wildlife resources.
Clean Water Act (33 USC 1251 et seq.)	Authorizes EPA to establish the basic structure for regulating discharges of pollutants into the waters of the United States and regulates quality standards for surface waters. According to Section 101, a broader goal of the CWA is restoring and maintaining integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."
State	
Oregon's Sensitive Species Rule (OAR 635-100-0040)	Designates sensitive fish and wildlife species and focuses fish and wildlife conservation, management, research, and monitoring activities on identified sensitive species.
Oregon Endangered Species Act (ORS 496.002–496.192)	Triggers internal state consultations when activities taken by state agencies on state lands may affect state-listed threatened or endangered species.
Oregon Policy to Recovery and Sustain Native Stocks (ORS 496.435)	Sets policy to achieve goals to achieve recovery and sustainability of native stocks of salmon and trout.
Oregon Screening Statutes (ORS 498.306)	Contains the State of Oregon policy for water diversions; to install, operate, and maintain screening or by-pass devices screening water diversions to protect fish populations present at the water diversion.
Oregon Fish Passage Statutes (ORS Chapter 509)	Contains the State of Oregon policy to provide for upstream and downstream passage at artificial barriers for native migratory fish.
OAR 629-035-0020	Provides policy direction for management of fish and wildlife resources on Board of Forestry lands.
ORS 536.300	Establishes WRC as responsible for development of an integrated, coordinated state program for managing Oregon's waters.
OAR Chapter 690	Contains rules developed by WRC to address Oregon water management.
Oregon Forest Practices Act (ORS Chapter 527)	Regulates forest operations, including control of activities around all types of waterbodies and stream channels.
Oregon Plan for Salmon and Watersheds (Oregon Watershed Enhancement Board 2021)	Provides a comprehensive plan for recovery of salmon and steelhead in much of Oregon, and plan for preserving water quality in many "water quality-limited streams".

CWA = Clean Water Act; ESA = Endangered Species Act; OAR = Oregon Administrative Rules; ORS = Oregon Revised Statute; USC = United States Code; WRC = Water Resources Commission

Air Quality

Law, Regulation, or Program	Description
Federal	
Clean Air Act and National Ambient Air Quality Standards	Establishes federal air quality standards, known as NAAQS, for six criteria pollutants and specifies future dates for achieving compliance. The CAA also mandates that the states submit and implement a State Implementation Plan for local areas not meeting those standards.
Regional Haze Rule	Requires that states, in coordination with other responsible agencies, develop and implement air quality protection plans to reduce the pollution that causes visibility impairment in identified national parks and wilderness areas that are designated "Class I" areas.
State	
Visibility Protection Plan (OAR 340-200-040, Section 5.2)	Specifies Class I visibility protection areas in Oregon, none of which overlap with the air quality study area or are the immediate vicinity.
Smoke Management Plan (OAR 629-048-0130)	Ensures that ODF complies with the Oregon Visibility Protection Plan to minimize smoke emissions and visibility impairments from controlled burns.
Requirements for Fugitive Emissions (OAR 340-208-0210)	Requires use of water or chemical for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land, unpaved roads, materials stockpiles, and other surface which can create airborne dust

CAA = Clean Air Act; NAAQS = national ambient air quality standards; OAR = Oregon Administrative Rules

Aesthetics and Visual Resources

Law, Regulation, or Program	Description
Federal	
National Scenic Byways (60 FR 96)	Designates roadways as National Scenic Byways or All-American Roads based on six criteria of scenic, historic, recreational, cultural, archaeological, and/or natural intrinsic qualities.
National Wild and Scenic Rivers Act (16 USC 1271–1287)	Establishes a National Wild and Scenic Rivers System for the protection of certain rivers as designated as wild, scenic, or recreational.
Applicable National Scenic Byway Corridor Management and Interpretive Plans	Establish strategies for the management and protection of scenic corridors.
Applicable Wild and Scenic River Management Plans	Establish strategies for the management and protection of Wild and Scenic Rivers.

Law, Regulation, or Program	Description
State	
Annual Operations Plans for ODF Districts	Establish annual strategies for the management and protection of ODF lands.
Oregon Scenic Waterways Act (ORS 390.805–390.940; State of Oregon 2021a, 2021b)	Designates state scenic rivers that are free-flowing, provide scenic quality as viewed from the river, and offer sustainable natural and recreational resources.
Oregon Scenic Byways and Bikeways (Oregon Tourism Commission and Oregon Department of Transportation 2018)	Designates scenic byways and bikeways that meet key criteria.

FR = Federal Register; ORS = Oregon Revised Statute; USC = United States Code

Recreation

Law, Regulation, or Program	Description
Federal	
National Wild and Scenic River Act (16 USC 1271 et seq.)	Preserves designated rivers with outstanding natural, cultural, and recreational values in free-flowing condition for enjoyment of present and future generations.
National Scenic Byways (86 FR 13337)	Designates roadways as National Scenic Byways or All-American Roads based on six criteria of scenic, historic, recreational, cultural, archaeological, and/or natural intrinsic qualities.
Applicable National Scenic Byway Corridor Management and Interpretive Plans	Establish strategies for the management and protection of scenic corridors.
Applicable Wild and Scenic River Management Plans	Establish strategies for the management and protection of Wild and Scenic Rivers.
State	
Oregon Statewide Comprehensive Outdoor Recreation Plan	Provides guidance to federal, state, and local units of government, as well as the private sector, in delivering quality outdoor recreational opportunities to Oregonians and out-of-state visitors.
Oregon State Parks Master Plans	Provides planning guidance for management of resources and activities within individual state parks in Oregon.
Designated Scenic Waterways (ORS 390.826)	Designates specific lakes, rivers, segments of rivers and adjacent land as scenic waterways in Oregon.
Oregon Scenic Waterway Program (OAR 736-40)	Provides management guidance for activities within 0.25 mile of the bank of designated state scenic waterways. Rules specify protections and allowances for recreation activity within these corridors.
Oregon Statewide Recreation Trails Plan 2016–2025 (Oregon Parks and Recreation Department 2016)	Oregon's 10-year plan for recreation trail management, guiding the Recreation Trails Program and All-Terrain Vehicle funds. Provides information and recommendations to private entities and local, state, and federal governments in making policy and planning decisions.

Law, Regulation, or Program	Description
Oregon Scenic Byways and Bikeways (Oregon Tourism Commission and Oregon Department of Transportation 2018)	Designates scenic byways and bikeways that meet key criteria.

FR = Federal Register; OAR = Oregon Administrative Rules; ORS = Oregon Revised Statute; USC = United States Code

Cultural Resources

Law, Regulation, or Program	Description
Federal	
Protection of Historic Properties (36 CFR Part 800)	Contains the regulations for Section 106 of the NHPA. Outlines procedures for NHPA consultation related to historic properties.
Antiquities Act of 1906	Establishes protection over any "historic ruin or monument, or any object of antiquity situated on government lands…" required permits for their removal. The Secretary of the Interior was charged with this responsibility.
Archaeological Resource Protection Act of 1979	Establishes the permit process on public and Native American lands; provided criminal and civil penalties for looting or damaging sites that are 100 years or older on public and tribal lands.
Archeological and Historical Preservation Act of 1974	Amends the Reservoir Salvage Act of 1960, which provided for the recovery and preservation of historical and archeological data (including relics and specimens) that might be lost or destroyed in the construction of dams and reservoirs. The act gave the Secretary of the Interior the responsibility for coordinating and administering a nationwide program for recovery, protection, and preservation of scientific, prehistoric, and historic data.
Indian Sacred Sites (Executive Order 13007)	Enacted in 1996, protects and preserves Indian religious practices, orders agencies managing federal lands to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, the agency is to maintain the confidentiality of sacred sites.
National Historic Preservation Act of 1966	As amended through 2000, authorizes the Secretary of the Interior to expand and maintain a National Register of Historic Places, establishes and defines the responsibilities of the State and Tribal Historic Preservation Officers and the Advisory Council of Historic Preservation, and pledges federal assistance to preservation efforts of state and local groups. Serves as the primary mandate governing projects under federal jurisdiction that might affect cultural resources. Section 106 of the NHPA, codified in 36 CFR Part 800, requires federal agencies to consider the effects of federally funded or approved undertakings having the potential to affect any district, site, building, structure, or object that is listed in, or eligible for listing in, the NRHP. Under Section 106, the lead federal agency must provide an opportunity for the State Historic Preservation Officer, affected tribes, and other stakeholders to comment.

Law, Regulation, or Program	Description
Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.; 43 CFR Part 10)	Provides for the repatriation and disposition of certain Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony.
State	
Conservation Easement (ORS 271.715–271.795)	Outlines the State of Oregon's process for designating conservation easements and scenic preservation easements.
Indian Graves and Protected Objects (ORS 97.740–97.760)	Describes prohibited and permitted actions related to actions with the potential to encounter native Indian burial sites.
Administrative Rules for Archaeological Permits for Public and Private Lands (OAR 736-051-0000 through 0090)	Describes the requirements related to archaeological permits on public and private lands.
Archaeological Objects and Sites (ORS 358.905–358.961)	Outlines requirements related to the discovery of archaeological objects and sites located on public lands.

CFR = Code of Federal Regulations; NHPA = National Historic Preservation Act; OAR = Oregon Administrative Rules; ORS = Oregon Revised Statute; USC = United States Code

Tribal Resources

Law, Regulation, or Program	Description
Federal	
United States Constitution, Article II and Article VI (1787)	Authorizes the federal government to make treaties and regulate commerce with Indian tribes.
Treaty with the Yakama (1855)	Sets aside reservation land and reserve fishing, gathering, and hunting rights for the Confederated Tribes and Bands of the Yakama Nation.
Treaty with the Walla Walla, Cayuse, and Umatilla (1855)	Sets aside reservation land and reserve fishing, gathering, hunting, and pasturing rights for the Confederated Tribes of the Umatilla Indian Reservation.
Treaty with the Nez Perce (1855)	Sets aside reservation land and reserve fishing, gathering, and hunting rights for the Nez Perce Tribe.
Treaty with the Tribes of Middle Oregon (1855)	Sets aside reservation land and reserve fishing, gathering, and hunting for the Confederated Tribes of Warm Springs Reservation.
Treaty with the Kalapuya, etc. (1855), as restored by the Grande Ronde Restoration Act of 1983 (Public Law 98-165) and the Grande Ronde Reservation Act of 1988 (Public Law 100-425) (as amended)	The Treaty with the Kalapuya, etc., also known as the Kalapuya Treaty or the Treaty of Dayton, established federal recognition for bands of the Kalapuya tribe, the Molala tribe, the Clackamas, and several others in the Oregon Territory via treaty with the United States in 1855. Federal recognition was lost in 1954. The Grand Ronde Restoration Act of 1983 restored federal recognition but not reserved treaty rights of the Confederated Tribes of Grand Ronde.
United States v. Winans, 198 U.S. 371 (1905)	Held that the Treaty with the Yakama of 1855 and similar treaties protect tribal access rights to fishing, hunting, and other privileges on off-reservation lands.
Western Oregon Termination Act (Public Law 588, August 13, 1954)	Terminated federal supervision over the trust and restricted property of Indian bands and tribes located west of the Cascade Mountains in Oregon.

Law, Regulation, or Program	Description
Klamath Termination Act (Public Law 83-587, August 1954)	Terminated federal supervision over the trust and restricted property of Klamath lands, as well as federal aid provided to the Klamath because of their special status as Indians.
United States v. Oregon, 302 F. Supp. 899 (D. Or. 1969) "Sohappy v. Smith"	Protects and implements the reserved fishing rights of Columbia River treaty tribes. The federal court continues to oversee the management of the Columbia River through the United States v. Oregon proceedings. Fisheries in the Columbia River and its tributaries are co-managed by the States of Washington, Oregon, and Idaho as well as four treaty tribes—Warm Springs, Yakama, Umatilla, and Nez Perce Tribes.
Siletz Indian Tribe Restoration Act (Public Law 95-195, November 1977)	Restores federal recognition of the Confederated Tribes of Siletz Indians of Oregon.
Cow Creek Band of Umpqua Tribe of Indians Recognition Act (Public Law 97–391, December 1982)	Restores federal recognition of the Cow Creek Band of Umpqua Tribe of Indians.
Grand Ronde Restoration Act (Public Law 98-165, November 1983)	Restores federal recognition of the Confederated Tribes of the Grand Ronde Community of Oregon.
Coos, Lower Umpqua, and Siuslaw Restoration Act (Public Law 98-481, October 1984)	Restores federal recognition of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians.
Klamath Restoration Act (Public Law 99-398, August 1986)	Restores federal recognition of the Klamath Tribes.
Coquille Restoration Act (Public Law 101-42, June 1989)	Restores federal recognition of the Coquille Indian Tribe.
Executive Order 12875, Enhancing the Intergovernmental Partnership (1993)	Establishes regular and meaningful consultation and collaboration with state, local, and tribal governments.
Secretarial Order 3206 (1997)	Clarifies the responsibilities of the Department of the Interior and Department of Commerce to ensure that Indian tribes do not bear a disproportionate burden for the conservation of listed species.
Executive Order 13175, Consultation and Coordination with Indian Tribal Governments (65 FR 67249) (2000)	Charges federal departments and agencies with establishing regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, strengthening government-to-government relationships with Indian tribes, and reducing the imposition of unfunded mandates upon Indian tribes.
Presidential Memorandum, Tribal Consultation (2009)	Reaffirms EO 13175, Consultation and Coordination with Indian Tribal Governments (65 FR 67249) and charges executive departments and agencies with engaging in consultation and collaboration with tribal officials in the development of federal policies that have tribal implications.
Secretarial Order 3317 (2011)	Updates, expands, and clarifies Department of Interior policies on consultation with tribes and provisions for conducting consultation in compliance with EO 13175.

Law, Regulation, or Program	Description
Commerce Department Administrative Order (DAO 218-8) (2012)	Implements EO 13175, Consultation and Coordination with Indian Tribal Governments, and describes the actions to be followed by the Department of Commerce concerning tribal self-government, trust resources, treaty, and other rights.
NOAA Procedures for Government-to-Government Consultation with Federally Recognized Tribal Governments (2021)	Provides guidance on obtaining meaningful and timely input from tribes into the NOAA decision-making process on policies that have tribal implications.
NOAA Fisheries and National Ocean Service Guidance and Best Practices for Engaging and Incorporating Traditional Ecological Knowledge in Decision-Making (2019)	Provides guidance on the inclusion of traditional ecological knowledge in the line offices' environmental science, policy and decision making process, to facilitate consultations as required by EO 13175, understand environmental justice concerns as directed by EO 12898, inform agency decision making, and build partnerships with indigenous people.
Secretarial Order 3335 (2014)	Reaffirms of the Federal Trust Responsibility to Federally Recognized Indian Tribes and Individual Indian Beneficiaries.
U.S. Fish and Wildlife Service Native American Policy (January 20, 2016)	Updates Native American policy providing a framework for government-to-government relationships, addressing the United States' and the Department of the Interior's trust responsibility to federally recognized tribes to protect, conserve, and use tribal reserved, treaty guaranteed, or statutorily identified resources.
Western Oregon Tribal Fairness Act (Public Law 115-103, January 2018)	Transferred federal land to the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians and Cow Creek Band of Umpqua Tribe of Indians. Amended the Coquille Restoration Act to remove the requirement that Department of Interior manage the land transferred to the Tribe.
State	
Confederated Tribes of Siletz Indians v. State of Oregon, Civil No. 80-433, 1980.	Defines tribal hunting, fishing, trapping, and animal gathering rights of the Confederated Tribes of Siletz Indians via agreement among the State of Oregon, the United States of America and the Confederated Tribes of Siletz Indians.
Confederated Tribes of Grand Ronde Community of Oregon v. State of Oregon, Civil No. 86-1620, 1986.	Defines tribal hunting, fishing, trapping, and animal gathering rights of the Confederated Tribes of Grand Ronde via agreement among the State of Oregon, the United States of America and the Confederated Tribes of the Grand Ronde Community of Oregon.
Executive Order EO-96-30; State/Tribal Government to Government relations, May 22, 1996	Establishes formal government-to-government relationships between Oregon's Indian tribes and the State of Oregon to establish a process that can assist in resolving potential conflicts, maximize key intergovernmental relations, and enhance an exchange of ideas and resources.
Relationship of State Agencies with Indian Tribes (ORS 182.162–182.168), 2019 Edition	Directs Oregon state agencies to develop and implement agency policies on relationship and cooperation with.
Tribal/Local	
The Confederated Tribes of the Grand Ronde Community of	Regulates hunting, fishing, and gathering rights of the Confederated Tribes of the Grand Ronde Community of Oregon, including hunting and fishing defined in the 1986 Consent Decree with the State of Oregon.

Law, Regulation, or Program	Description
Oregon Fish and Wildlife Ordinance (2015)	
Cow Creek Band of Umpqua Tribe of Indians hunting rules and regulations (2019)	Regulates hunting, fishing, and gathering rights under the authority of the Cow Creek Band of Umpqua Tribe of Indians Tribal Board.
Confederated Tribes of Siletz Indians of Oregon Hunting, Fishing, and Gathering Ordinance (Siletz Tribal Code Section 7.001)	Regulates hunting, fishing, and gathering rights of Confederated Tribes of Siletz Indians of Oregon, including hunting and fishing defined in the 1980 Consent Decree with the State of Oregon.

DAO = Department Administrative Order; EO = Executive Order; FR = *Federal Register*; NMFS = National Marine Fisheries Service; ORS = Oregon Revised Statute; USC = United States Code

Socioeconomics

Law, Regulation, or Program	Description
State	
ORS 321.015	Describes the levy of Forest Product Harvest Taxes on timber harvest and the distribution of the tax revenue to the relevant agencies. The statute also specifies that the first 25,000 board feet of timber harvested annually by taxpayers shall be exempt from taxation.
ORS 530.115	Outlines how revenues from State Forest lands may be distributed. It specifies that distribution to the county general fund should be "no less than 10 percent of the total", 25% of the remainder would be credited to the county school fund, and the remainder would be prorated and apportioned to the taxing districts. It also specifies the mechanism of apportionment.
ORS 327.405	Describes Common School Fund revenue sources and the allowable uses of Common School Fund revenue.
ORS 327.410	Describes how Common School Fund revenues are distributed among counties and school districts.
ORS 327.008	Describes the structure of the State School Fund and the allowable uses of revenue in the State School Fund.
ORS 327.011	Describes Local Revenues for the purpose of State School Fund distributions.

ORS = Oregon Revised Statute

Environmental Justice

Law, Regulation, or Program	Description
Federal	
Executive Order 14008, Tackling the Climate Crisis at Home and Abroad (January 27, 2021)	Emphasizes the need to prioritize environmental justice in agency missions and address disproportionately high and adverse human health, environmental, climate-related and cumulative impacts on disadvantaged communities.

Law, Regulation, or Program	Description
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (February 16, 1994)	Requires agencies to identify and address disproportionate human health and environmental impacts on low-income and minority populations.
Environmental Justice Guidance Under the National Environmental Policy Act (CEQ 1997)	Provides guidance to address environmental justice concerns in compliance with EO 12898 and NEPA.
Memorandum of Understanding on Environmental Justice and Executive Order 12898 (2011)	Reaffirms the importance of EO 12898 and creates interagency processes to provide research and guidance on best practices for implementing environmental justice policies.
Promising Practices for Environmental Justice Methodologies in NEPA Reviews (Federal Interagency Working Group on Environmental Justice 2016)	Describes procedures and recommends specific methodologies to identify environmental justice populations based on racial/ethnic background and income levels.
Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (U.S. Environmental Protection Agency 2016)	Recommends revised methods, best practices, and analytic principles to identify and assess threats to environmental justice populations. This guidance was prepared by EPA with input from the EPA Science Advisory Board and the public.

CEQ = Council on Environmental Quality; EO = Executive Order; EPA = U.S. Environmental Protection Agency; NEPA = National Environmental Policy Act

Greenhouse Gas Emissions and Carbon Storage

Law, Regulation, or Program	Description
Federal	
Final Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews (Council on Environmental Quality 2016)	Recommends that agencies address climate change by considering (1) the effects of climate change on a proposed action and its environmental impacts, and (2) the potential effects of a proposed action on climate change as indicated by assessing greenhouse gas emissions.
Executive Order 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (February 19, 2021)	Calls on the CEQ to rescind its 2019 draft guidance entitled, “Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions” and review, revise, and update its 2016 final guidance (86 FR 7037). CEQ officially rescinded the 2019 draft guidance and reinstated the 2016 final guidance on February 19, 2021 (86 FR 10252).

CEQ = Council on Environmental Quality; EO = Executive Order; FR = *Federal Register*

References Cited

Fish and Wildlife

Oregon Watershed Enhancement Board. 2021. *2019-2021 Biennial Report: The Oregon Plan for Salmon and Watersheds*.

Aesthetics and Visual Resources

Oregon Tourism Commission and Oregon Department of Transportation. 2018. *Oregon Scenic Byways, The Official Scenic Byways & Tour Routes Driving Guide*. Oregon Tourism Commission and Oregon Department of Transportation. Portland, OR.

State of Oregon. 2021a. *Oregon Parks & Recreation Department: List of Scenic Waterways*. Available: https://www.oregon.gov/oprd/BWT/Pages/SSW-list.aspx. Accessed: September 7, 2021.

State of Oregon. 2021b. *Oregon Parks & Recreation Department: Scenic Waterway Activities Notification.* Available: https://www.oregon.gov/oprd/PRP/Pages/SSW-notification.aspx. Accessed: September 7, 2021.

Recreation

Oregon Parks and Recreation Department. 2016. 2016–2025 Oregon Statewide Recreation Trails Plan. Salem, OR.

Oregon Tourism Commission and Oregon Department of Transportation. 2018. *Oregon Scenic Byways, The Official Scenic Byways & Tour Routes Driving Guide*. Oregon Tourism Commission and Oregon Department of Transportation. Portland, OR.

Environmental Justice

Council on Environmental Quality. 1997. Environmental Justice Guidance Under the National Environmental Policy Act. Available: https://ceq.doe.gov/docs/ceq-regulations-and-guidance/regs/ej/justice.pdf.

Federal Interagency Working Group on Environmental Justice. 2016. *Promising Practices for Environmental Justice Methodologies in NEPA Reviews.* March 2016. Available: https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf.

U.S. Environmental Protection Agency. 2016. Technical Guidance for Assessing Environmental Justice in Regulatory Analysis. Available: https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf.

Greenhouse Gas Emissions and Carbon Storage

Council on Environmental Quality. 2016. Final Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews.

Appendix 3.1-B
Forest Management Modeling

This appendix describes the forest management model (forest model) used to evaluate effects of the Western Oregon State Forests Habitat Conservation Plan (HCP) and Environmental Impact Statement (EIS) alternatives. The forest model employs resource and management data in a linear programming method[1] to project future timber harvest activity, forest habitat, and revenue considerations under the different management scenarios. While the model results provide sufficient detail for comparing future strategies and tradeoffs between economic, conservation, and social values, they should not be interpreted as specific harvest plans.

The primary model scenarios are the 2010 Northwest and Southwest Oregon Forest Management Plan (FMP) scenario, which is the no action alternative in the EIS, and the HCP scenario, which is the proposed action in the EIS. Model scenarios for EIS Alternatives 3 through 5 are modifications of the HCP scenario.

Model Data

This section describes the basic data used in the model to inform the land base, management options, growth and yield, and financial considerations.

Land Base

The model is applied to the permit area minus the road right-of-way area (622,985 acres). The model used a geographic information system (GIS) to break the land base into polygons, each of which contain unique stand, geographic, administrative, operational, or ecological conditions. The land base is characterized using ODF's Stand Level Inventory (SLI), which applies data from surveyed areas to the broader land base. The model uses 2018 SLI data, so reflects the effects of past disturbance events. Effects of disturbance events since 2018 (e.g., the 2020 Beachie Fire, which burned 142,970 acres of the plan area) are not reflected in the model. Contiguous polygons with the same harvesting characteristics were then grouped, with groups ranging in size from 1.2 acres to 741 acres to group. After eliminating overlapping conditions that preclude forest management activity, the operable land base for the model is 497,005 acres with a total inoperable[2] area of 125,980 acres. Additionally, there are a total of 34,384 acres where thinning of the existing forest is not considered. Considerations regarding riparian areas or steep slopes are mapped to polygons and handled through constraints in the model. For the purpose of analysis, the model results are post-processed to remove harvest units of less than 10 acres in size, due to operational constraints on harvesting small areas.

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[1] Linear programming in forestry has been a fundamental component of the planning process since the 1960s (Curtis 1962).

[2] Inoperable areas are ground that ODF has designated as not accessible or feasible with current logging technology.

Management Options

Management options were developed for both existing forest acreage prior to a clearcut and for the subsequent reforested acres. The model simulated as many as 31 management regimes for each acre. A management regime included variations on the number of thinning entries, volume removed, and size- or species-based preferences. The primary driver for assigning reforested stand management options was site productivity.

Growth and Yield

The U.S. Forest Service's Forest Vegetation Simulator (FVS) (Dixon 2002), a distance-independent individual-tree growth model was used to project the stands with available SLI data forward in time for 100 years in 5-year periods.

Post-harvest forest conditions were also projected using FVS, assuming reforestation with a site-appropriate species mix. These stand projections were completed using the range of site conditions present across the permit area. The model assigned yields to harvest units using site-specific and geographic rules.

Financial Considerations

For reforested stands, ODF management costs were specified for each of the eight districts ranging from $472/acre to $804/acre and assessed at stand age zero. Pre-commercial thinning costs also varied by district ranging from $91/acre to $166/acre and were assessed in the year in which the thinning occurred. Road maintenance, spur construction, logging, and hauling costs were assumed in the model to occur at time of harvest. Road maintenance and spur road construction are per-acre costs specified for each harvest unit based on the harvest unit's modeled timber volume. Spur road costs have an additional 20 percent added to the per-acre cost on the first entry in the 100-year modeling time horizon. Logging costs are on a per-thousand board feet basis and vary depending on whether it is a thinning or clearcut entry, average diameter, volume removed, slope, yarding distance, and logging system employed (ground-based, cable, or helicopter). Hauling costs were specific to the harvest unit and the log species and grade. Log prices varied depending on the district, tree species, and grade sold with up to five grades specified for each of the 11 tree species tracked.

Model Function and Scenario Constraints

Objective Function

The most common objective function structure employed in forest linear programming analyses is net present value, otherwise known as discounted cash flow (Belavenutti et al. 2018). The discount rate employed in all versions of the forest model is 3 percent. In the absence of constraints, this solution would be consistent with a Faustmann (1849) approach for even-aged stands. For the habitat considerations, the model approach is more like what is described in Montgomery et al. (2006). The model was solved to maximize net present value for 100 years encompassing 20, 5-year time periods.

2010 FMP Scenario and HCP Scenario Constraints

This section describes each type of constraint imposed in the 2010FMP scenario (the no action alternative in the EIS) and HCP (the proposed action in the EIS) scenario.

Land Allocation

The primary variables to be determined in a forest planning model are the land allocation variables. These variables include the stand (or polygon) designations, as well as the management regime and harvest timings, which are determined by the model. The treatment of land allocation has been broadly grouped into two classes, Model I and Model II, since the pioneering work of Johnson and Scheurman (1977). Martin et al. (2017) provides a more modern synthesis of the approaches by identifying Model I as being stand-based, allowing better spatial representation, and Model II as being strata-based,[3] allowing more silvicultural prescriptions to be explored. Mathematically, there is flexibility in structuring the variables and constraints, and the forest model takes advantage of this by taking a hybrid Model I and II approach for the even-aged stands to allow better spatial and silvicultural representation. All polygons must be assigned a management and harvest timing that include a grow-only option with "never" as a harvest timing. This regime was assigned to 125,980 acres identified as inoperable.

Adjacency Size Limitation

The Oregon Forest Practices Act (Oregon Revised Statute 527.740) limits harvesting practices that require reforestation, such as clearcutting, to a maximum of 120 acres in size on a single ownership. Clearcutting of adjacent areas is restricted until the reforested stand is 4 years old or 4 feet tall. To account for this legal requirement, the model limited clearcutting of contiguous polygons to 120 acres within a single 5-year model period.

Harvest Accounting

The model differentiated the harvest volume calculation by harvest type (clearcut or thinning), district, and in the HCP scenario, whether it was a result of a forest health and rehabilitation program applied over the first 30 years of the model run.

The model specified constraints controlling harvest levels, regional distribution, and period-to-period fluctuations differently in the 2010 FMP scenario and HCP scenario. The 2010 FMP scenario was designed to represent the current implementation plans, which establish annual harvest objectives at the district level. The rule was to achieve the current allowable harvest level before adjusting to a new non-declining even flow harvest level. This rule is applied to ensure that near-term harvest decisions do not come at the expense of long-term sustainability of harvest.

The HCP scenario assumed that harvest levels would be established based on geographic regions instead of district level goals. By expanding the geographic scale of the harvest targets the HCP scenario was intended to free up more of the landscape to meet other objectives. The districts were grouped into three geographic regions: the North Coast (Astoria, Forest Grove, and Tillamook Districts), Valley (North Cascade and Western Oregon Districts), and South (West Lane, Coos Bay, and Southwest Districts). In the HCP scenario, the first condition specified that the total harvest in

[3] Based on similar characteristics (e.g., stand conditions, constraints, site class).

any given period must be less than 10 percent above or below the average periodic harvest over the 100-year modeling time horizon. In each period, 75 to 80 percent of the total harvest had to be in the North Coast region, 12 to 15 percent of the harvest in the Valley region, and 7 to 13 percent in the South region. In addition, no regional harvest level—not counting harvest levels associated with forest health and rehabilitation treatments—could vary up or down by more than 5 percent from the prior period.

Net Revenue

Net revenue for both the 2010 FMP scenario and HCP scenario included log prices specific to each region. The model tabulated log species and grade in each period. Costs were broken down into free-to-grow regrowth, pre-commercial thinning, road maintenance, spur roads, harvest cost, and hauling costs. The scenarios did not consider any other ODF costs, including the costs of road construction and repair.

Ecological

Riparian Buffers

Both scenarios assigned no-harvest management prescriptions to riparian buffers. In the FMP scenario, these buffers comprised 72,810 acres defined as riparian management areas. In the HCP scenario, they comprised 76,166 acres defined as riparian conservation areas (RCAs).

Landslide Initiation Sites

Both scenarios assigned no-harvest management prescriptions to areas identified as high landslide hazard locations[4] near human use (e.g., roads, buildings). These areas comprised approximately 11,700 acres.

Desired Future Conditions

The 2010 FMP scenario applied a desired future conditions constraint, which set proportions of total acreage in each district that must remain in complex structural stages for a specified number of years. The proportion of complex structure must be maintained in all periods following release. The structural percentage of acres goals are Astoria 30 percent, Forest Grove 30 percent, Tillamook 35 percent, North Cascade 35 percent, Western Oregon 31 percent, West Lane 37 percent, Coos Bay 0 percent, and Southwest 45 percent. The years prior to release are Astoria 70, Forest Grove 70, Tillamook 70, North Cascade 35, Western Oregon 70, West Lane 35, Coos Bay 0, and Southwest 20. In all cases, once a stand achieves complex structure, it cannot be harvested for at least 20 years.

Terrestrial Anchors

The 2010 FMP scenario applied a terrestrial anchors constraint to 44,859 acres, excluding clearcut harvesting and any thinning that would result in a residual stand with less than 80 square feet of basal area, or 35 percent relative density.

[4] High landslide hazard locations are identified based on slope and landform information. In general, areas with 70 percent or greater slope are considered high landslide hazard locations.

Northern Spotted Owl

The 2010 FMP scenario applied harvest constraints for northern spotted owl based on two concentric management circles around existing occupied nest sites. There are 26,903 acres designated in the inner management circle and 95,255 acres designated in the outer circle. The constraint requires that at least 60 percent of the inner circle and 40 percent of the inner and outer circle combined be suitable[5] habitat. Once those inner and outer circle targets are met they must be maintained.

The 2010 FMP scenario applied harvest constraints on an additional 123,061 acres of potentially suitable northern spotted owl habitat to estimate the effect of future take avoidance measures on harvest. The additional sites were identified using the based on stand projections with a habitat suitability index of 0.6 or greater at year 40. No-harvest management prescriptions were applied to these sites in the model after year 10.

The HCP scenario applied non-declining habitat suitability constraints to ensure northern spotted owl suitable habitat increases in habitat conservation areas (HCAs) over time.

Marbled Murrelet

Both scenarios assigned no-harvest management prescriptions to marbled murrelet avoidance areas. The 2010 FMP scenario applied harvest constraints on an additional 76,432 acres of potentially suitable marbled murrelet habitat to estimate the effect of future take avoidance measures on harvest. The additional sites were identified based on stand projections with a habitat suitability index of 0.6 or greater at year 40. No-harvest management prescriptions were applied to these sites in the model after year 10.

Red Tree Vole

The 2010 FMP scenario identified 115,408 acres of potentially suitable red tree vole habitat to estimate the effect of a potential listing and associated take avoidance measures on harvest. The sites were identified based on stand projections with a habitat suitability index of 0.6 or greater at year 40. Candidate sites were assumed to exist only north of the Siuslaw River and west of the Willamette River. No-harvest management prescriptions were applied to these sites in the model after year 10.

Habitat Conservation Areas

The HCP scenario constrained management within HCAs (274,633 acres). Thinnings (up to two) were limited to the first 30 years of the permit term. Additional thinning constraints were applied with respect to tree age and canopy cover. Harvest was limited to Swiss needle cast and hardwood-dominant stands in the HCAs to contribute to achieving species habitat goals (forest health and rehabilitation treatments). During each of the first six 5-year periods (i.e., 30 years), the HCP scenario harvests 2,500 acres of Swiss needle cast stands and 1,000 acres of hardwood-dominant stands. As these stands are primarily in the North Coast region and their harvest occurs within the first 30 years, they do not count toward the 5 percent regional harvest fluctuation constraint or the northern spotted owl habitat in HCAs constraint.

[5] Suitable habitat for northern spotted owl is defined as acres with a habitat suitability index greater than 0.6.

Non-Habitat Conservation Area Age Class Structure

The HCP scenario applies a constraint to target the following age class distributions to operable areas outside of HCAs by year 70: 30 percent age 0 to 30 years, 30 percent age 30 to 60 years, and the remaining 40 percent greater than 60 years. To allow flexibility in model solution, these target percentages are allowed to vary +/- 2 percent.

Terminal Conditions

To avoid issues related to aberrant behavior in the time periods toward the end of a model run (i.e., the model overestimating feasible harvest in the later time periods), the model applied a terminal condition requiring at least an average of 20 thousand board feet per acre standing inventory across all operable acres.

Other EIS Alternative Constraints

Model scenarios for EIS Alternatives 3, 4, and 5 were the same for the HCP scenario except as described below.

Alternative 3: Increased Conservation

The HCP scenario was modified to reflect expanded RCAs. This modification increased no-harvest management prescriptions by 9,481 acres.

Alternative 4: Reduced Permit Term

The HCP scenario outputs for years 1 through 50 apply to this alternative.

Alternative 5: Increased Timber Harvest

The HCP scenario was modified to reflect a different delineation of HCAs, resulting in approximately 17,000 fewer acres designated as HCAs, and increased harvest of Swiss needle cast stands from 15,000 to 21,000 acres.

References

Belavenutti, P., C. Romero, and L. Diaz-Balteiro. 2018. A critical survey of optimization methods in industrial forest plantations management. *Scientia Agricola* 75(3):239–245.

Curtis, F.H. 1962. Linear programming the management of a forest property. *Journal of Forestry* 60(9):611–616.

Dixon, G.E. 2002. Essential FVS: A User's Guide to the Forest Vegetation Simulator. Internal Rep. U.S. Department of Agriculture, Forest Service, Forest Management Service Center. Fort Collins, CO. Revised January 2020. p. 240.

Faustmann, M. 1849. Calculation of the value which forest land and immature stands possess for forestry. In Martin Faustmann and the evolution of discounted cash flow. Inst. Pap. No. 42, Commonwealth Forestry Institute, Oxford, U.K. (1968). *Translated by* W. Linnard. pp. 27–55.

Johnson, K.N., and H.L. Scheurman. 1977. Techniques for prescribing optimal timber harvest and investment under different objectives–discussion and synthesis. *Forest Science* 23(1):a0001–z0001.

Martin, A.B., E. Richards, and E. Gunn. 2017. Comparing the efficacy of linear programming models I and II for spatial strategic forest management. *Canadian Journal of Forest Management* 47(3):16–27.

Montgomery, C.A., G.S. Latta, and D.M. Adams. 2006. The cost of achieving old-growth forest structure. *Land Economics* 82(2):240–256.

Appendix 3.2
Disturbance and Climate Change

This document describes historical ecological disturbances and projected climate change and disturbances that affect environment conditions in western Oregon, including the Cascades, Coast Range, Klamath Mountains, and Willamette Valley ecoregions (Figure 1) (Thorson et al. 2003).

Ecological disturbances have occurred throughout the plan area. The best-known example is the great fires that swept Tillamook County and its neighboring counties in 1933–1945, which have today regenerated to vast acreages of mature timber. Most recently, a high wind-driven fire event in September 2020 swept through parts of the plan area. Other disturbances such as floods, landslides, and invasive pests have influenced the landscape, and such events will continue to occur. The plan area also shows evidence of the effects of anthropogenic climate change, and these changes are forecast to become more extreme.

The disturbance history of the plan area has altered the landscape as well as the approach to forest management on the landscape. Responses to severe disturbances triggered extensive road construction programs (1933–1965) in an effort to salvage burned or blown-down forests. Forest regulations and management have changed over time to address effects of forestry management in western Oregon, including the effects of roads and logging on landslide frequency. Changes in regulation and forest management will likely continue in the future; however, the nature and extent of these changes are unknown at this time. Therefore, the current regulations are assumed for the duration of the analysis period.

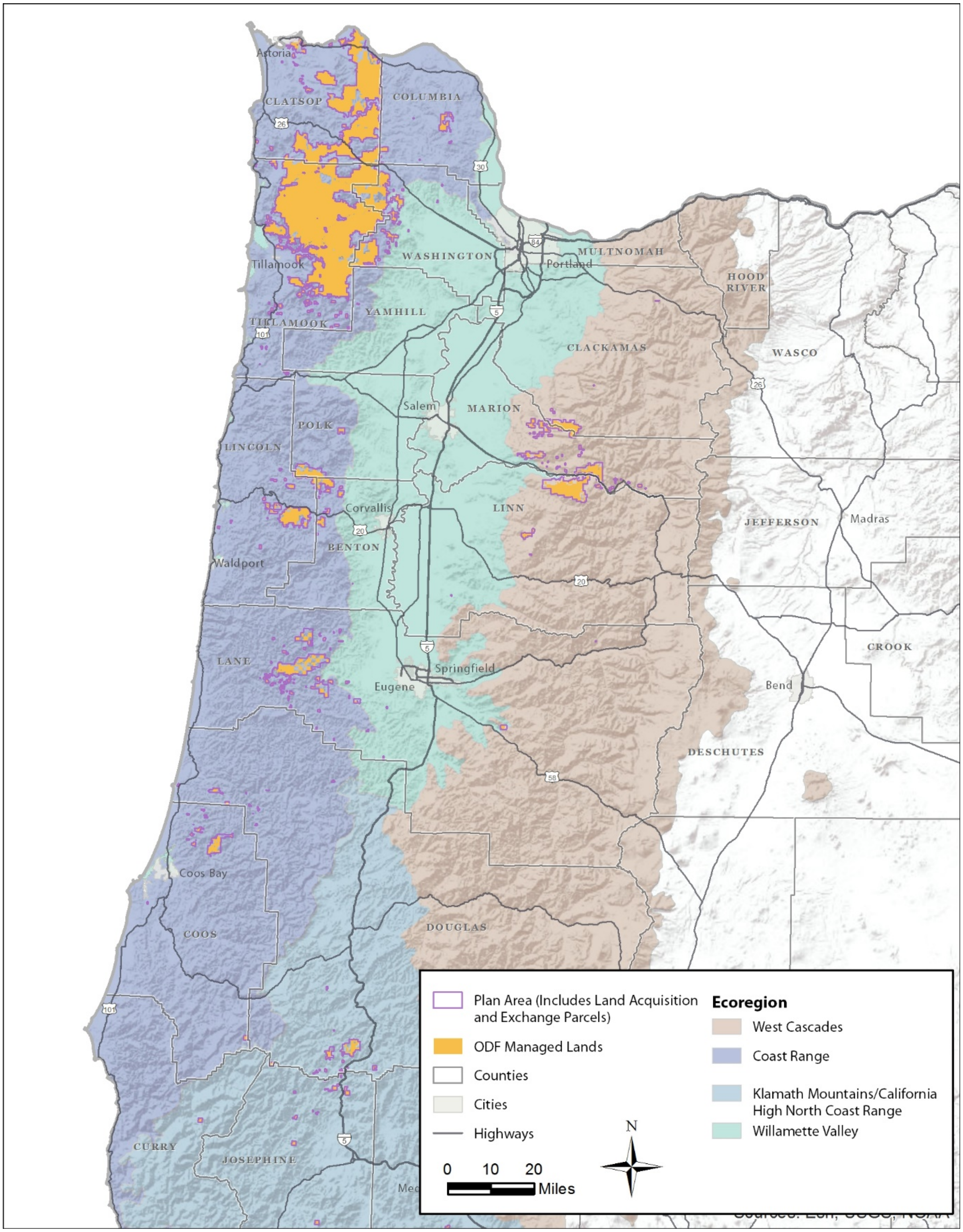
Disturbance History and Effects

This section describes past wildfires, storms, and invasive species that have affected western Oregon timberland.

Wildfire

Wildfires have the potential to substantially alter forest management activities, affecting many harvest units and conservation areas, and thus materially alter impacts on resources. The record of wildfire in western Oregon extends from the precontact era to the present (Zybach 2003). In the Coast Range, nearly all events were started by humans, with fires prior to about 1840 chiefly due to indigenous burning and since that time chiefly due to Euro-American burning, usually in conjunction with land clearing or logging activities (Zybach 2003:191). In the Cascades, Klamath Mountains, and Willamette Valley ecoregions, some fires have been caused by lightning, though the majority were human ignitions. Fires tended to occur in years of exceptionally dry summers, often with no rainfall recorded from May or June, with ignitions typically occurring from mid-August through mid-September. The majority of impacts would sometimes occur in just one or two days, although most large fires took months to run their course.

Figure 1. Ecoregions of Western Oregon



Wildfires in western Oregon are typically followed by important secondary effects. Often, some green forest survives within the burn area and provides a seed source for forest regeneration. Regeneration is usually dominated by Douglas-fir and red alder, species that regenerate best on mineral soils (in contrast to regeneration after storms, discussed in *Storms*). Changes in soil chemistry and nutrient status occur, including sudden increases in mineral availability and rapid loss of soluble minerals in subsequent winter rains; fires may also produce hydrophobic soils, which do not wet readily and result in increased rates of runoff. Pest outbreaks may occur due to the sudden abundance of dead and dying trees as a food source for insects such as the Douglas-fir beetle. Post-fire emergency tree removal and salvage logging can influence how the affected area responds after a fire. In areas where the burned logs are not removed, legacy structures such as snags and downed wood provide habitat for a wide range of wildlife and invertebrates, provide a refuge for soil microbiota, and, through slow decay, gradually release nutrients that contribute to regeneration of the forest. To the extent that timber is removed during salvage or for safety reasons, these ecological functions are impaired. Fires may be followed by increased surface erosion and shallow-rapid landslides and substantial changes in the form and function of affected stream channels. Surface erosion and shallow-rapid landslides occur because of the loss of healthy tree and shrub vegetation and associated loss of the fine and coarse root structure that binds the soil and gives it structural strength when saturated by winter rains. The eroded soil and landslide debris typically accumulate in headwater stream channels and the sudden buildup of fine sediment may take years or decades to move downstream. Invasive plant species often colonize burned areas.

Reburns, which may occur soon or up to several decades after the initial fire, commonly affect one-third to two-thirds of the initially burned areas and result in further losses of green vegetation, soil nutrients, dead and downed wood, and organisms reliant upon these resources. For example, the Mt. Hebo area in the Coast Range has some areas that have not yet reforested due to multiple reburns following the 1850 Yaquina fire (Zybach 2003), and much of the area burned in the 1933 Tillamook fire was reburned in the 1939 fires (ODF 2010). Also, reburns may kill seedlings and saplings that regenerated soon after the original fire. Reburns can delay forest recovery for decades (Coppoletta et al. 2016).

Table 1 summarizes fires known to have occurred in western Oregon from the beginning of the historical record through 2020. For the period before the 1933 Tillamook burn, the table is based on after-the-fact historical research and likely records only the largest fires. For the 1933–1992 period, the table is based mainly on records maintained by the Oregon Department of Forestry (ODF), based largely on after-the-fact research performed in ODF's unpublished records. This is the best available data for this period but likely shows bias towards fires on state, county, local, and private lands, because these are the lands where ODF most often takes a primary role in fire suppression efforts and these lands have the most complete records. For the 1992-2020 period, the record includes digital records collected and periodically updated by ODF, the U.S. Forest Service (USFS), and the National Interagency Fire Center (NIFC). NIFC, which receives data from virtually all government agencies involved in fire suppression, provides the most complete data on relatively large fires, but omits a fraction of the small fires, especially those smaller than 1 acre. The NIFC data also have the shortest period of record. Comparison of ODF, USFS, and NIFC data suggests that for the 1992–2020 period, ODF underestimates the total acreage burned in western Oregon by about 19.5 percent, mainly due to fires that occurred on federal lands where ODF did not take an active role in fire suppression. It is therefore reasonable to expect that a similar underestimation affects the 1933–1992 fire record. Overall, the data in Table 1 likely underestimate the extent of wildfire by approximately 20 percent for the period since 1933, with greater underestimation for fires before 1933.

The record of historical fire is most complete in the Coast Range, where the earliest recorded major fire occurred in approximately 1765. There are about 4.8 million acres of timberlands in the Coast Range (Campbell et al. 2004) and about 1.6 million acres burned in 1850–1949, or about 0.34 percent of the area per year. The 1850–1949 period is significant because the data on large fires are reasonably complete since about 1850, while 1949 marked the end of reburns in the Tillamook Burn area and initiation of fire exclusion policies that were largely effective until the early 21st century. As shown in Table 1, substantial burn acreages were recorded in 20 years from 1850 to 1949 (i.e., in 20 percent of the years during that timeframe) and the average area burned during each of those years was 232,125 acres. Over the total time span, an annual average of 46,425 acres burned. When adding the effects of smaller fires, it appears that across the historical record, the likelihood of wildfire on any given parcel of land is about 0.4 to 0.5 percent per year in the Coast Range. A comparison of the 1992–2020 fire record (Oregon Department of Forestry 2021; National Interagency Fire Center 2021) across the four ecoregions indicates that about 14 percent of the entire area burned during that time period, with about 32 percent of the Klamath ecoregion burned, 23 percent of the Cascades ecoregion, and less than 1 percent of the Coast Range and Willamette Valley ecoregions.

Table 2 focuses on data on all fires for the 1967–2020 period, drawn from the ODF database discussed above (ODF 2021). The vast majority of fires (34,792 out of 40,929 fires recorded) are smaller than 1 acre. However, all of these fires together have accounted for only 0.2 percent of total burned acres. Although there have only been seven fires recorded that exceeded 100,000 acres, these fires alone have accounted for 58 percent of the total burned acreage, with another 28 percent of burned acreage accounted for by 28 fires of 10,000 to 100,000 acres in size.

Table 1. Historic Fires in Western Oregon

Date	Extent (acres)	Description	Sources
1765 ca.	200,000	Coast Range: Millicoma fire.	Zybach 2003:201
1850 ca.	450,000	Coast Range: Yaquina fire.	Zybach 2003:205
1853 ca.	300,000–375,000	Coast Range: Nestucca fire.	Zybach 2003:211
1868	300,000	Coast Range: (Second) Yaquina fire. A significant fraction was reburn of areas affected in the 1849 Yaquina and 1853 Nestucca fires. The reburn area regenerated slowly, remaining open into the 1880s and in places much longer; Munger (1944) describes the Mt. Hebo area as still barren due to multiple reburns.	Zybach 2003:205
1868	300,000	Coast Range: Coos fire. Extent limited on north by Yaquina fire, on south by Millicoma fire, and on west by coastal fog belt. 1868 had severe drought, with strong east winds through much of September, and also had innumerable smaller fires from southwest Oregon up into Washington.	Zybach 2003:216
1902	170,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02

Date	Extent (acres)	Description	Sources
1914	146,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1915	109,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1917	258,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1918	184,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1919	143,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1922	179,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1924	252,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1926	208,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1928	104,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1929	298,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1931	188,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1932	333,000	Western Oregon: Various smaller burns.	Zybach 2003:Table 4.02
1933	311,000–350,000	Coast Range: Tillamook Burn. First well-documented fire in region. Ignition source: logging in the Coast Range. No rain since June 9; a strong east wind caused a firestorm that burned 200,000 acres in one day (August 24). 12 to 13 billion board feet of timber killed in this burn; a little more than half was salvaged. Followed by severe Douglas-fir beetle infestation, mostly not salvaged (not clear from sources if this mortality is included in the board feet killed). Salvage operations let to construction of hundreds of miles of roads and railroads, with associated erosion and landsliding.	Hoadley 2001; Larson 1977:18; National Weather Service 2000; Zybach 2003:221
1939	190,000–225,000	Coast Range: Reburn mostly within the Tillamook Burn perimeter; about 28,000 acres was previously green timber. Follow-on work was not clearly documented, presumably included ongoing salvage.	Hoadley 2001; Larson 1977:18; National Weather Service 2000; Zybach 2003
1945	110,000–180,000	Coast Range: Partially reburn within the Tillamook Burn perimeter, partially burn of adjacent green stands. Killed most of the seedlings replanted after the 1933 and 1939 burns; affected area had to be replanted again.	Hoadley 2001; Larson 1977:18; National Weather Service 2000; Zybach 2003
2002	499,945	Klamath: Biscuit Fire, destroyed 3.6 billion board feet of timber.	ODF 2021; USFS 2021; Zybach 2003
2017	190,858	Klamath: Chetco Bar fire.	ODF 2021; National Interagency Fire Center 2021
2018	175,258	Klamath: Klondike fire	ODF 2021; National Interagency Fire Center 2021
2020	193,570	Cascades: Beachie Creek fire. Most of the area affected (142,970 acres) was in the plan area.	ODF 2021; National Interagency Fire Center 2021
2020	173,899	Cascades: Holiday Farm fire.	ODF 2021; National Interagency Fire Center 2021

Date	Extent (acres)	Description	Sources
2020	152,270	Klamath: Illinois Valley Support fire; about 2/3 of acreage burned was in California.	ODF 2021
2020	131,542	Cascades: Archie Creek fire.	BLM 2021; National Interagency Fire Center 2021
2020	138,104	Cascades: Riverside fire. 55,000 acres was in the plan area.	ODF 2021; National Interagency Fire Center 2021

Table 2. Size Distribution of Fires in Western Oregon, 1967–2020

Acres per fire	Number of fires	Total acres burned	Percent of total burned
up to 0.1	26,368	1,293	0.049%
0.1 to 1	7,448	4,150	0.16%
1 to 10	4,364	16,005	0.61%
11 to 100	1,252	40,741	1.5%
101 to 1,000	293	81,939	3.1%
1,001 to 10,000	70	227,148	8.6%
10,001 to 100,000	28	735,374	28%
100,001 to 500,000	7	1,523,076	58%
Total	**39,811**	**2,629,725**	**100%**

Source: ODF 2021, limited to data on fires located west of longitude 121.7 degrees, which is the approximate location of the Cascade crest.

Storms

Most major storm events in western Oregon have been extratropical cyclones, derived either from extratropical storms formed over the Pacific Ocean or from tropical cyclones (typhoons) formed in the tropical Pacific and moving northward from the eastern Pacific Ocean (Mass and Dotson 2010:2499). These storms focus most of their energy in an upper tropospheric jet in a band tens of miles wide, mostly in the form of water vapor, in volumes similar to the Earth's largest rivers; these storms are often called *atmospheric rivers* (Dalton et al. 2017:22). They may release large amounts of rainfall accompanied by strong winds. If that rainfall occurs over an area with appreciable snow deposits, it is called a *rain-on-snow* storm and the affected snowpack is typically melted. The storm of December 2007, which melted a Coast Range snowpack equivalent to 9 inches of water in less than 24 hours, is an example (Dalton et al. 2017:22; National Weather Service 2008:10). Such storms are responsible for most of the floods of record in the region.

Storms primarily occur from November through February, less commonly in October or March, and rarely in other months. The damage caused by these storms is primarily related to high winds and flooding, with secondary effects that include blowdown,[1] insect infestations, shallow-rapid landsliding, changes to stream channels, and property damage to facilities such as road networks

[1] *Blowdown* is loss of timber when trees are either blown down or broken off. It is usually measured in units of board feet because nearly all inventories of this damage are performed in connection with timber management activities.

and power lines. Strong winds, predominantly during major cyclones, account for 80 percent of regional tree mortality (Kirk and Franklin 1992). Blowdown occurs because extended high rainfall and snowmelt can saturate soils to the surface, reducing their cohesive strength and thus reducing the capacity of roots to resist the force of wind (Stathers et al. 1994). In the Coast Range blowdown occurrence is much more pronounced in managed forests than in naturally late-successional forests (Schmidt et al. 2001). Blowdown also occurs when winds cause the crown to break off. Large windthrow events may level vast tracts of timberland, with some storms leveling billions of board feet of timber.

Storms vary in their potential to cause timber blowdown. Though wind velocity is a major factor in blowdown, other considerations such as wind direction, storm duration, antecedent precipitation, and terrain also affect blowdown severity (Stathers et al. 1994). Terrain effects are most pronounced in the form of accelerated winds on lee sides of mountainous areas. Stathers et al. (1994:14) record that "Few trees are strong enough to withstand mean wind speeds in excess of 30 m/s [meters per second] (67 mph [miles per hour]) for more than about 10 minutes, yet considerable windthrow can occur in some stands at wind speeds of only about 15–17 m/s [33–38 mph]." Read (2003a) provides 60-mph winds as an approximate threshold for widespread blowdown.

Pest insect outbreaks may also occur in response to the large food supply during a windthrow event; Wickman (1965) describes the insect response to the Columbus Day storm in northern California, when insects attacked living trees and degraded the wood of recently killed trees. Storms also affect the occurrence of shallow-rapid landslides, mainly by reducing soil cohesive strength, as well as hydrostatic pressure in shallow rock strata. Increased weight of the wet soils causes slope failure; slope failure can also result from bank undercutting by swollen streams. These inputs of flood water and sediment can force rivers from their channels, causing rapid bank-cutting or complete avulsion to form a new channel elsewhere on the floodplain, particularly if inputs of large downed wood or landslides dam the stream (Coho and Burges 1994).

The record of extratropical cyclones in western Oregon extends back for centuries, using tree-ring evidence (Knapp and Hadley 2012) and early historical records (Knapp and Hadley 2011), but documentation and understanding of these storms has increased greatly since about 1950 in response to improved meteorological data gathering and modeling.

The record of extratropical cyclones in the Pacific Northwest shows that nearly all storms have been important in the Coast Range, but most have had a much larger footprint, causing widespread damage approximately from northwest California to southwest British Columbia. Since 1880, 36 such storms are known or suspected to have produced sustained wind speeds in excess of 67 mph in some portion of the plan area, with winds in excess of 60 mph across a substantial portion of the plan area. Of these storms, 31 occurred from November to March, though there have also been two storms in April, one in August, and two in October. Due to their high wind velocities, these storms can be expected to have generated substantial blowdown, although in most cases there have been no inventories of blowdown losses in response to individual storms. Inventories are available, however, for the 1880 storm (Read 2004a; Mass and Dotson 2010), the 1921 storm (Mass and Dotson 2010), the 1951 storm (Read 2004b, 2005), the 1953 storm (Read 2004a, 2005), the 1962 storm (Read 2015a), and the 2006 storm (Mass and Dotson 2010; Read 2015b), each of which caused blowdown losses in excess of 1 billion board feet, with greatest recorded damage (14 billion board feet) from the 1962 storm. Other effects of these storms included widespread flooding, shallow-rapid landsliding, and property damage, especially to roads (National Weather Service 2000, 2008;

Northwest River Forecast Center no date.; Read 2003b, 2003c, 2004c, 2007, 2008, 2015a; Robison et al. 1999; Mass and Dotson 2010). In the 2007 storm, Lincoln, Tillamook, Clatsop, Columbia and Yamhill Counties were declared federal disaster areas, and storm damages exceeded $1 billion (Mass and Dotson 2010; National Weather Service 2008; Northwest River Forecast Center no date.; Read 2008).

Robison et al. (1999) describe landsliding on timberlands affected by the February 1996 storm, as well as a less-severe November 1996 storm that also produced large numbers of landslides, debris torrents, and altered stream channels. Within an array of eight study areas, Robison et al. (1999) detected more than 500 landslides, conducted a comprehensive inventory of landslide-related damages, and considered the possible contributing effects of various forest practices. Findings from this work included the following.

- 72 percent of all landslides inventoried on the ground were not previously detected in aerial photographs; the undetected landslides accounted for approximately half of the total sediment delivered to stream channels by landslides. About half of all landslides occurred in areas harvested in the prior decade, but significant numbers of landslides occurred in areas with dense forest cover, though landslides were rare in stands more than 100 years old.
- Digital elevation models were generally a poor predictor of landslide locations, although this may partly be due to the low spatial resolution (30 meters or 98.4 feet) of most such data available at the time of the study.
- The two storms caused 506 landslides in a 46-square-mile study area—an average of more than 10 landslides per square mile, with a maximum of 24 per square mile. For landslides unrelated to roads, initial failure zones averaged 0.02 acre and landslides with associated debris flows mobilized an average of 6,290 cubic yards of sediment per square mile. A minority of landslides were associated with roads.
- Landslides typically started on very steep slopes, commonly over 70 percent, which is near the angle of repose.
- Landslide probability was greatest in the first 10 years after a timber harvest. In general, both landslide density and amount of sediment mobilized was greatest in these clearcut stands.
- Forest practices at the time of the storms prohibited high-risk activities such as construction of skid trails in high-landslide-risk areas. The elevated landslide risk in recent clearcuts appears to have been simply related to vegetation removal, without contributing effects from other forest practices.
- Although earlier studies found most landslides on timberlands are related to roads, numerous measures to minimize that risk had been adopted by the time of the 1996 storms. Road-related landslides still occurred but were less common and less destructive than described in earlier studies. However, the average road-related landslide was still several times larger and more destructive than the average landslide not related to a road. Primary causes of road-related landslides included roads built on fill placed on steep slopes, and poor drainage such as due to an obstructed culvert. Similar causes were found in earlier studies.
- About one-third of all affected stream channels had severe damage associated with debris flows or debris torrents; typically, the channel was extensively scoured, and much riparian vegetation was lost or damaged. Road-associated landslides were disproportionately likely to be associated with channel damage.

These findings are typical of those reported for other timberland regions of the Pacific Northwest, such as western Washington and Alaska (Amaranthus et al. 1985; Ralph et al. 1994; Benda et al. 1998; Johnson et al. 2000; Jones et al. 2000). It is thus likely that many other storms had comparable, but less well-documented effects. For example, the December 2007 storm, which was a very severe storm in the plan area, had its most severe effects in the Willapa Hills area of southwest Washington. Landslides caused on timberlands in Washington by the 2007 storm were documented extensively (Sarikhan et al. 2008; Stewart et al. 2013; Murphy et al. 2013); the Washington State Department of Natural Resources inventoried 1,147 landslides caused by this storm alone (Stewart et al. 2013). In the final analysis, 22 of 99 landslides reviewed in detail occurred despite limitation of harvest at those sites to avoid landsliding, and over 30 percent of landslides originated on terrain not identified as at risk; thus, approximately half of all landslides studied occurred despite implementation of forest practice rules intended to avoid such events (Murphy et al. 2013). However, there are no data to assess how many landslides might have occurred in the absence of forest practices in the area. Such a large storm would cause some level of landsliding even in unmanaged, late-successional forests. No such forests were included in the inventory; however, other studies have examined landsliding as a function of forest successional state. Studies in both the Oregon Coast Range and southeast Alaska have found that landslides are somewhat more common in young forests than in mature and old-growth forests, and that the volumes of sediment moved and the run-out length of the landslides is much greater in young forests than in older forests (Johnson et al. 2000; May 2002).

In a long-term experiment at the Cascade Head Experimental Forest in the Coast Range west of Salem, Harmon and Pabst (2019) studied 1-acre plots established in 1935 and remeasured every 5–13 years. Since 1935 there had been 10 storms in the area with peak wind gusts of at least 90 mph. During the earlier storms the trees were relatively small and were unaffected, but from the Columbus Day storm (1962) onwards, most storms influenced at least one plot, although no individual storm clearly influenced all plots. Depending on the plot, wind caused 16–59 percent of the total mortality over time. The authors concluded that the largest impacts are cumulative from exposure to multiple storms, thus, both the severity and frequency of winter storms contribute to long-term effects.

A relatively detailed and complete record of storms with high potential to cause blowdown and related damage to timberlands extends from 1950 to 2020 and includes 34 storms, an average of one event every 2 years. Those storms have potential to cause blowdown in a substantial fraction of one or more ecoregions, with effects most frequently recorded in the Coast Range. The same 70-year record includes 5 storms (one event every 14 years) that resulted in documented blowdown affecting 1 to 14 billion board feet of timber, in addition to widespread severe damage from shallow-rapid landsliding, flooding, and property damage.

Invasive Species

Invasive species may affect humans, other organisms, or ecosystem functions; a given invasive species may belong to more than one of these groups. Invasive species can represent any taxonomic group (e.g., microorganisms, fungi, plants, animals) and may be aquatic or terrestrial. Most invasive species are nonnative species that have been introduced by humans, but they are sometimes native species whose ecological roles have been substantially altered through human activity; this phenomenon is projected to become more common with climate change (*Ecological Effects of Climate Change*).

Invasive species that affect humans include diseases introduced by Euro-Americans, which reduced the population of native people in the plan area by more than 90 percent during the 1830s. One ecological consequence of this event was the virtual cessation of millennia-old traditions of anthropogenic burning in the Willamette Valley and the Coast Range, which resulted in dramatic changes in forest cover across these areas (Boyd 1999; Zybach 2003).

Invasive species that affect an organism are most noticeable when the organism is a species of special concern. An example is the barred owl (*Strix varia*), a species of eastern North America that was introduced to the West when settlement of the Great Plains produced patches of cottonwood forest habitat that allowed the owl to migrate to western forests. Since then it has been spreading south through Pacific Coast forests, where it competes with and hybridizes with the northern spotted owl (*Strix occidentalis caurina*), with such severe consequences that extinction of the northern spotted owl is one potential outcome (Gutiérrez et al. 2007).

Invasive species that alter ecosystem functions come in several types, depending upon whether the species is native or nonnative. The American crow (*Corvus brachyrhynchos*) is a native invasive species. Crows have always been common in the plan area, but the proliferation of agriculture and urbanization on the landscape have greatly favored the crow over most other species of wildlife, allowing crow populations to grow enormously relative to historical norms (Marzluff et al. 2001). As a result, crows are invasive in neighboring native ecosystems where they prey upon the nests of native birds, including the marbled murrelet (*Brachyramphus marmoratus*), further degrading the status of this protected species (Raphael et al. 2002; Malt and Lank 2009). Thus, biological diversity and other values in the affected native ecosystems are altered by large increases in crow populations.

In the plan area, the greatest concerns involve invasive species that alter ecosystem functions, and in some cases invasive species that directly affect species of concern. The primary concern for forested ecosystems is the potential for introduction of new pests and pathogens, or the spread of existing pests and pathogens, particularly if there is risk that climate change could contribute to these effects. These pests and pathogens have the potential to affect ecosystem structure primarily by causing tree death, usually affecting a single tree species, over a large area. Historical examples include the introduction of the fungal disease white pine blister rust, an Asian disease introduced to North America in 1910 that subsequently killed a large portion of all white pines on the Pacific Coast, including the entire plan area (Scharpf 1993). Currently, the sudden oak death pathogen is spreading through western Oregon, including the plan area, affecting oaks and some conifers; concerted efforts by ODF and others have slowed the spread of this pathogen, but it has continued to infect forests in Oregon since it was first detected in 2001 (USFS and ODF 2020). Four newly invasive species of wood-boring beetles were discovered recently in western Oregon, though none have yet become widespread (USFS and ODF 2020).

Seybold et al. (2021:352–377) provide a comprehensive summary of invasive species threats to forest lands of the Pacific Northwest, including the plan area. They note that nearly 190 species and species groups have been identified as regional invasive or nuisance species of key concern. Plants of concern include the aquatic species flowering rush (*Butomus umbellatus*), waterthyme (*Hydrilla verticillata*), water primrose (*Ludwigia grandiflora*), yellow floating heart (*Nymphoides peltata*), reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), giant salvinia (*Salvinia molesta*), and water chestnut (*Trapa natans*), as well as various toxic algae. There are also numerous upland plants of concern, of which the most common and widespread are Japanese knotweed (*Fallopia japonica*), giant hogweed (*Heracleum mantegazzianum*), and Himalayan blackberry (*Rubus armeniacus*). Other upland species pose specific hazards due to their toxicity to ungulates (e.g., knapweeds [*Centaurea* spp.]) or their capacity to invade and outcompete native forest understory herbs and shrubs (e.g., yellow archangel [*Lamium galeobdolon*] or English ivy).

Invasive pathogens of concern include sudden oak death disease (*Phytophthora ramorum*), Port Orford cedar root disease (*Phytophthora lateralis*), and white pine blister rust (*Cronartium ribicola*). European and Asian gypsy moths (*Lymantria dispar* subsp. *dispar* and *asiatica*) are constant threats, continually detected in the region. Established invasive insects of concern include balsam woolly adelgid (*Adelges piceae*), hemlock woolly adelgid (*Adelges tsugae*), larch casebearer (*Coleophora laricella*), spotted wing drosophila (*Drosophila suzukii*), and brown marmorated stink bug (*Halyomorpha halys*). The most significant invasive aquatic and terrestrial animals include Asian clams (*Corbicula fluminea*), New Zealand mud snails (*Potamopyrgus antipodarum*), zebra mussels and quagga mussels (*Dreissena polymorpha* and *D. bugensis*), American bullfrogs (*Lithobates catesbeianus*), Atlantic salmon (*Salmo salar*), Amur goby (*Rhinogobius brunneus*), golden shiners (*Notemigonus crysoleucas*), feral swine (*Sus scrofa*), and nutria (*Myocastor coypus*).

Forecasted Climate Change and Ecological Effects

Anthropogenic climate change affected the plan area during the 20th century (Abatzoglou et al. 2014) and those changes have persisted and intensified into the 21st century. A variety of general circulation models have been developed to forecast possible future changes through the end of the 21st century. These models, generally speaking, provide projections based on observable climate changes to date. They are not predictions, and studies of past climate variability have shown that climate variability is frequently not a linear process; there is considerable uncertainty inherent in using model projections to discuss possible future conditions. Additional uncertainty comes from model input parameters; for instance, it is unknown how successful ongoing and hypothetical future programs to limit carbon emissions will be. Nonetheless, the climate models cited in this section constitute the best available science on this topic.

This section presents the results of existing climate change forecasts applicable to the plan area (*Climate Change Forecasts for the Plan Area*), discusses the ecological implications of those forecasts (*Ecological Effects of Climate Change*), and describes the future disturbance scenario associated with climate change effects (*Future Disturbance Scenario*).

Climate Change Forecasts for the Plan Area

A wide variety of studies have been used to develop climate change forecasts for areas including the plan area. The two most comprehensive such studies are the following.

- The Third Oregon Climate Assessment Report (Dalton et al. 2017).
- Climate, Disturbance, and Vulnerability to Vegetation Change in the Northwest Forest Plan Area (Reilly et al. 2018).

The wide variety of changes shown in these studies are described below. Despite model uncertainty, by about mid-century, these changes are expected to exceed the range of variation seen during the 20th century (Dalton et al. 2017; Reilly et al. 2018).

- Sea-surface temperatures may become elevated off the Oregon coast for a significant fraction of some winters, with complex consequences that include elevated winter temperatures, reduced winter precipitation, reduced fog drip, and greatly reduced snowfall (Dalton et al. 2017:13; Johnstone and Dawson 2010). These effects would be most pronounced in the Klamath Mountains and Coast Range but would affect the whole plan area.

- Significant warming will occur throughout the year, with greatest warming in summer months (Reilly et al. 2018).
- Net precipitation will slightly decrease, but summers will be much drier and winters somewhat wetter (Reilly et al. 2018), with average summer rainfall diminishing by 25–28 percent by mid-century, and 25–33 percent by the end of the analysis period, depending upon the model scenario used (Sheehan et al. 2015:Table 4). Year-to-year rainfall variability will increase in all seasons (Reilly et al. 2018). Summer drought intensifies through increased temperature and reduced rainfall (Reilly et al. 2018). Summer drought effects will be greatest in the southern plan area, becoming progressively less intense farther north (Reilly et al. 2018).
- Winter warming will increase flooding effects through greater rainfall and reduced snowpack, producing more variable flow. Previously snow-dominated regions are likely to see an increase in winter flooding from rapid rain runoff and will also experience reductions in summer flows by up to 50 percent due to the reduction in spring snowmelt (Mote et al. 2018).
- Increased winter season precipitation will increase incidence and severity of flooding (Reilly et al. 2018). Nearly all major storms affecting the plan area are extratropical cyclones associated with atmospheric rivers. Atmospheric river events are likely to increase in frequency and intensity over the Pacific Northwest under future climate change, largely due to the warmer atmosphere that can accommodate more moisture (Hagos et al. 2016; Warner et al. 2015). Conversely, due to reductions in snowpack, a smaller fraction of winter storms will be associated with rain-on-snow events. Since most major storm events in western Oregon are extratropical cyclones and only a few are rain-on-snow events, it is expected that climate change will increase the frequency and severity of major storm events.
- Climatic warming is already changing streamflow in Oregon. Summer low flows have decreased and streamflow timing has shifted earlier at many sites. Driven by loss of snowpack and drier summers, these trends are expected to continue, particularly for historically snow-dominated basins in parts of the Western Cascades (Dalton et al. 2017:18–19).
- Impacts of the 2015 drought in Oregon are likely a sample of the types of drought-related changes that would become commonplace by the mid-21st century. These impacts include very low snowpack, low streamflows, and elevated stream water temperatures (Dalton et al. 2017:13).

Ecological Effects of Climate Change

The ecological effects of regional climate change in the plan area are summarized below based primarily on Dalton et al. (2017) and Reilly et al. (2018).

- Climate change increases the frequency, severity, and extent of disturbances, particularly drought, fire, and invasive species (particularly insects and pathogens). These disturbances have the potential to cause rapid ecological change at landscape scales, such as a transformation from one forest type to another (Dale et al. 2001; Littell et al. 2010; Crausbay et al. 2017). Interactions among climate change, forests, and disturbance regimes may cause disturbance effects outside the natural range of variation (Dale et al. 2000). These can include multiple, successive, or compound disturbances that constitute *stress complexes* (McKenzie et al. 2008) that may amplify disturbance severity, cause changes between ecological states (e.g., forest to nonforest transitions), and decrease forest resilience to other or continuing disturbances (Buma 2015).

- The greatest drivers of tree mortality in the plan area have been abiotic: drought, fire, storms, and associated events such as floods and landslides. Tree growth (and thus forest productivity and potential harvest) are likely to decrease; in particular, Douglas-fir growth is predicted to decrease in areas where it currently is water limited, which includes most of the plan area (Restaino et al. 2016).
- Acute drought and prolonged heat waves are likely to trigger rapid ecological changes in affected areas, such as, widespread tree mortality (Allen et al. 2010, 2015) or disturbance by insects or pathogens (Reilly et al. 2018:48) as forests suffer impaired ability to resist infestations. These effects are already apparent; mortality rates in old-growth forests throughout the western United States have increased above most published rates since the mid-1970s (van Mantgem et al. 2009).
- Increased invasive species effects, particularly in the form of insect and pathogen outbreaks, are likely due to a variety of climate change effects; for instance, the current rapid spread of green spruce aphid in Coast Range forests is thought to be due to a recent series of winters with mild temperatures (ODF 2017), as is the recent rapid spread of Swiss needle cast in Coast Range Douglas-fir forests (Stone et al. 2008). In the Klamath Mountains ecoregion, sudden oak death is also projected to increase substantially from warmer and wetter winters (Meentemeyer et al. 2011) and from increased fire severity (Metz et al. 2011). Accordingly, the frequency and severity of insect and pathogen outbreaks is expected to increase in response to climate change.
- Increased frequency and area affected by wildfires in the western United States since the mid-1980s have been attributed to longer fire seasons associated with earlier snowmelt and warmer spring and summer temperatures (Jolly et al. 2015; Westerling et al. 2006) as well as drought (Gedalof et al. 2005; Littell et al. 2009). In the Pacific Northwest, the fire season length increased from 23 days in the 1970s, to 43 days in the 1980s, 84 days in the 1990s, and 116 days in the 2000s (Westerling 2016); this trend is likely to continue. Nearly all studies in the region have forecast climate change to cause increases in area burned (Reilly et al. 2018:52). Consequently, climate change will foreseeably increase the acres affected annually by wildfire, although it is not apparent that burn severity or sizes of individual fires would change.
- Since a substantially different forest type (i.e., a forest dominated by a different mix of species, or having a different structure) may be better adapted to the mid- and late-21st century climate (Crausbay et al. 2017), it is likely that adapting to the changed climate will be one of the principal challenges faced by forest managers in the plan area. Recent studies detailing this concept include work by Halofsky et al. (2019) in south-central Oregon, who found that "Higher air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree and shrub species, with drought-tolerant species being more competitive. Ecological disturbance, including wildfire and insect outbreaks, will be the primary facilitator of vegetation change, and future forest landscapes may be dominated by younger age classes and smaller trees." In view of these prospects, climate change effects may lead forest managers to revise tree species and silvicultural methods used in the plan area.
- Reduced streamflows and increased stream temperatures will reduce habitat quality for stream-dependent species (especially at lower elevations) and sometimes exceed stream temperature lethal limits for salmon and other fish (Dalton et al. 2017; Halofsky et al. 2019). Harmful algal

blooms will become more widespread, severe, and frequent. Crowding and warm temperatures are also conducive to the rapid spread of infectious disease among migrating salmon. Greater prevalence of warm water fish species will increase competition and predation for native fish species. These flow and temperature changes will also occur at somewhat different times of the year, with maximum flows occurring earlier and elevated summer stream temperatures lasting longer; these changes could shift preferred habitats, alter the timing of life history stages, and exacerbate current stressors. Peak flows will also increase, increasing risks of redd scour and habitat degradation (Dalton et al. 2017). Climate change will also adversely affect oceanic conditions for salmonids and their habitat. Although recent forecasts do not predict substantial changes in cyclic oceanic factors important to salmonids, such as the El Nino-Southern Oscillation or the Pacific Decadal Oscillation, forecast changes include increased stratification and acidification of the water column, and changes in coastal upwelling. Such changes can affect the ocean food web, altering the behavior and migration patterns of oceanic salmonid life stages, potentially reducing growth and populations (Halofsky et al. 2019).

- There are numerous adaptation options for responding to climate change, which could minimize adverse effects. Resilience to drought, fire, insects, and pathogens can be increased by thinning, use of prescribed fire, and planting drought-resistant ecotypes. Invasive species can be addressed with increased control efforts (Halofsky et al. 2011, 2019; Reilly et al. 2018:60). Establishment of climate change refugia can also be effective. Because site microclimate varies over short distances in steep, mountainous terrain, such areas are relatively buffered against climate change effects and may become important biological refugia. Adaptation options similar to those currently proposed for implementation on national forests in Washington and Oregon (described by Halofsky et al. 2011, 2019) may be implemented by forest managers in the plan area during the permit term, although plans for such management have not yet been adopted. HCP Chapter 6, *Monitoring and Adaptive Management,* describes how ODF will use adaptive management to respond to monitoring results and new information. HCP Chapter 7, *Assurances,* defines specific changed and unforeseen circumstances (including temporary changes in species habitat quality from disturbance events, aquatic invasive plants, nonnative fish and disease/parasites, and stream temperature changes) and describes ODF's planned responses to these circumstances.

In summary, climate change is forecast to reduce the resilience of forests to all forms of stress, particularly those associated with heat and drought, leading to reduced growth and increased vulnerability to stress-related disturbances such as pathogens and insect attack. Drought stress also increases vulnerability to severe fire because temperature, humidity, and fuel moisture loadings under drought conditions are conducive to ignition and rapid spread of fire. Climate change forecasts also predict more frequent occurrences of extratropical cyclones and thus increased risks of blowdown, flooding, and associated disturbances such as shallow-rapid landsliding and modification of stream channels. Accordingly, all disturbances discussed in *Disturbance History and Effects* are projected to become more severe during the analysis period, exceeding 20th century norms by mid-century and becoming even more severe by the late 21st century. A measurable increase, including disturbances of all kinds that meet or exceed previous conditions, can be expected by halfway through the analysis period. Substantial further increases in both disturbance frequency and severity can be expected by the end of the analysis period.

Future Disturbance Scenario

Wildfire

Major fires have burned a long-term average of about 0.5 percent of western Oregon per year since records have been kept. The actual burned acreage varies greatly from year to year, with severe fires occurring on average less than once per decade. In 2020, 198,000 acres burned in the plan area, and 2021 fires caused further losses that have not yet been fully inventoried. Due to climate change, severe fires are already more frequent in the plan area than during the 20th century.

By the end of the analysis period, climate change projections indicate summers will be much hotter and drier than currently, with extremely dry conditions persisting through a substantially longer part of the growing season and affecting larger areas of the forest. Fires are expected to be more frequent, more intense, and larger. Some areas are likely to burn repeatedly. Continuation of current conditions (0.5 percent burn probability per acre per year) would suggest 35 percent of the plan area is likely to burn over the analysis period; given the added severity and extent of fires predicted with climate change, the actual extent of likely burning is significantly larger. However, none of the sources available provide a quantitative estimate of the increase. Although many authorities have recognized a substantial increase in the frequency and severity of fires since the beginning of the 21st century, a variety of causes have been invoked to explain this increase, including curtailment of indigenous burning practices, livestock grazing, and modern fire suppression, as well as climate change; moreover, future fire regimes will depend heavily on which adaptation options are exercised by land management agencies (Prichard et al. 2021).

Fires can alter distribution of habitat for all species. Some species will move from areas of degraded habitat to surviving areas of intact habitat; others will simply decline in degraded areas. Burned areas may include green trees and large numbers of snags, and so retain appreciable habitat value for some terrestrial species; due to these legacies, regeneration of forests in burned areas usually produces high-value habitat substantially more quickly compared to regeneration in clearcut logged areas (Lindenmayer et al. 2004; Leverkus et al. 2020).

Storms

Under current conditions, storms affecting a large fraction of the plan area and causing extensive destruction in the form of blowdown, landslides, and flooding occur approximately once per decade. Storms having such effects within small portions of the plan area occur approximately once every 2 years. Similar storms are expected to continue to occur during the analysis period and to cause blowdown and flooding in the plan area.

By the end of the analysis period, due to forecasted increases in storm severity associated with climate change, the record will likely contain the most severe storms ever recorded in the plan area. Once-per-decade and once-every-2-years storms will be substantially more severe and frequent, and will affect similarly extensive or perhaps larger areas. Large storms can alter distribution of suitable habitat for all species. Some species will move from areas of degraded habitat to surviving areas of intact habitat; other species that have limited ability to move (such as plants, fish or amphibians) will decline in degraded areas.

Invasive Species

Under current conditions, many invasive species have been introduced to the plan area, with severe adverse biological consequences such as introduction of aquatic invasive species that degrade salmonid habitat, and northern spotted owl declines due to barred owl range expansions.

Although regulations and programs exist to discourage invasive species introductions, such introductions continue to occur, with many of the existing invasive species having been introduced recently enough that they are continuing to actively spread; for instance, as recently as March 2021, pet stores in Oregon were found to be selling aquarium plants infested with zebra mussels (Boatner and Dennehy 2021). Accordingly, it is expected that many existing invasive species will continue to spread, and an appreciable number of new invasive species will be introduced, during the analysis period. Many of these species are likely to be pests and pathogens, which are especially difficult to restrict. Additionally, climate change effects will allow existing pests and pathogens to spread and access hosts that have previously been protected due to existing climate conditions.

References

Abatzoglou, J.T., Rupp, D.E., and Mote, P.W. 2014. Questionable evidence of natural warming of the northwestern United States. *Proc Natl Acad Sci USA* 111(52): E5605–E5606.

Allen, C.D., A.K. Macalady, H. Chenchouni, D. Bachelet, N. McDowell, M. Vennetier, T. Kitzberger, A. Rigling, D.D. Breshears, E.H. (Ted) Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J.-H. Lim, G. Allard, S.W. Running, A. Semerci, and N. Cobb. 2010. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. *Forest Ecology and Management* 259(4):660–684.

Allen, C.D., D.D. Breshears, and N.G. McDowell. 2015. On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene. *Ecosphere* 6(8): art129. doi:10.1890/ES15-00203.1.

Amaranthus, M. P., R. M. Rice, N. R. Barr, and R. R. Ziemer. 1985. Logging and forest roads related to increased debris slides in southwestern Oregon. *Journal of Forestry* 83:229–233.

Benda, L.E., D.J. Miller, T. Dunne, G.H. Reeves, and J.K. Agee. 1998. Dynamic Landscape Systems. Pages 261–288 in R. J. Naiman, R. E. Bilby, and S. Kantor, editors. *River Ecology and Management*. Springer New York:New York, NY.

Boatner, R.J., and M.N. Dennehy. 2021. Invasive zebra mussels found in aquarium product sold at aquarium and pet supply stores. March 9. https://www.dfw.state.or.us/news/2021/03_Mar/030321.asp. Accessed April 29, 2021.

Boyd, Robert (ed.). 1999. *Indians, Fire, and the Land in the Pacific Northwest*. OSU Press, Corvallis, OR.

Buma, B. 2015. Disturbance interactions: characterization, prediction, and the potential for cascading effects. *Ecosphere* 6(4):1–15.

Bureau of Land Management. 2021. Archie Creek Fire. Roseburg District. https://inciweb.nwcg.gov/incident/7176/. Accessed: July 23, 2021.

Campbell, S., D. Azuma, and Dale Weyermann. 2004. Forests of western Oregon: an overview. PNW-GTR-525. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Coho, C.S., and Burges, S.J. 1994. Dam-break floods in low order mountain channels of the Pacific Northwest. University of Washington Department of Civil Engineering, Water Resources Series Technical Report No. 138.

Coppoletta, M., K.E. Merriam, and B.M. Collins. 2016. Post-fire vegetation and fuel development influences fire severity patterns in reburns. *Ecological Applications* 26(3):686–699.

Crausbay, S.D., P.E. Higuera, D.G. Sprugel, and L.B. Brubaker. 2017. Fire catalyzed rapid ecological change in lowland coniferous forests of the Pacific Northwest over the past 14,000 years. *Ecology* 98(9):2356–2369.

Dale, V.H., L.A. Joyce, S. McNulty, and R.P. Neilson. 2000. The interplay between climate change, forests, and disturbances. *The Science of the Total Environment* 262:201–204.

Dale, V.H., L.A. Joyce, S. Mcnulty, R.P. Neilson, M.P. Ayres, M.D. Flannigan, P.J. Hanson, L.C. Irland, A.E. Lugo, C.J. Peterson, D. Simberloff, F.J. Swanson, B.J. Stocks, and B. Michael Wotton. 2001. Climate Change and Forest Disturbances. *BioScience* 51(9): 723. doi:10.1641/0006-3568(2001)051[0723:CCAFD]2.0.CO;2.

Dalton, M. M., K. D. Dello, L. Hawkins, P. W. Mote, and D. E. Rupp. 2017. The Third Oregon Climate Assessment Report. Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR.

Gedalof, Z., D.L. Peterson, and N.J. Mantua. 2005. Atmospheric, climatic, and ecological controls on extreme wildfire years in the northwestern United States. *Ecological Applications* 15(1):154–174. doi:10.1890/03-5116.

Gutiérrez, R.J., Cody, M., Courtney, S., and A.B. Franklin. 2007. The invasion of barred owls and its potential effect on the spotted owl: a conservation conundrum. *Biological Invasions* 9(2): 181–196.

Hagos, S.M., L.R. Leung, J. Yoon, J. Lu, and Y. Gao. 2016. A projection of changes in landfalling atmospheric river frequency and extreme precipitation over western North America from the Large Ensemble CESM simulations. *Geophys. Res. Lett.* 43(3):1357–1363.

Halofsky, J. E., Peterson, D. L., O'Halloran, K. A., and Hawkins Hoffman, C. 2011. Adapting to climate change at Olympic National Forest and Olympic National Park. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. doi:10.2737/PNW-GTR-844.

Halofsky, J. E., Peterson, D. L., and Ho, J. J. 2019. Climate change vulnerability and adaptation in south-central Oregon. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. doi:10.2737/PNW-GTR-974.

Harmon, M., and R. Pabst. 2019. The long-term effects of wind disturbance on a Sitka spruce-western hemlock forest. *Forests* 10:119.

Hoadley, J. 2001. The Tillamook burn, separating fact from legend. Available: http://oregonstate.edu/instruct/geo422/522-Paper%20hoadley.pdf. Accessed: April 19, 2021.

Johnson, A.C., D.N. Swanston, and K.E. McGee. 2000. Landslide initiation, runout, and deposition within clearcuts and old-growth forests of Alaska. *Journal of the American Water Resources Association* 36:17–30.

Johnstone, J.A., and T.E. Dawson. 2010. Climatic context and ecological implications of summer fog decline in the coast redwood region. *Proceedings of the National Academy of Sciences* 107(10): 4533–4538.

Jolly, W.M., M.A. Cochrane, P.H. Freeborn, Z.A. Holden, T.J. Brown, G.J. Williamson, and D.M.J.S. Bowman. 2015. Climate-induced variations in global wildfire danger from 1979 to 2013. *Nature Communications* 6(1):7537.

Jones, J.A., F.J. Swanson, B.C. Wemple, and K.U. Snyder. 2000. Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks. *Conservation Biology* 14:76–85.

Kirk, R., and Franklin, J.F. 1992. *The Olympic Rain Forest*. University of Washington Press, Seattle, WA.

Knapp, P.A., and K.S. Hadley. 2011. Lewis and Clarks' Tempest: The 'perfect storm' of November 1805, Oregon, USA. *The Holocene* 21:693–697.

Knapp, P.A., and K.S. Hadley. 2012. A 300-year history of Pacific Northwest windstorms inferred from tree rings. *Global and Planetary Change* 92–93:257–266.

Larson, R.C. 1977. An Interview with Robert L. Furniss. 22 p.

Leverkus, A.B., Gustafsson, L., Lindenmayer, D.B., Castro, J., Rey Benayas, J.M., Ranius, T., and Thorn, S. 2020. Salvage logging effects on regulating ecosystem services and fuel loads. *Frontiers in Ecology and the Environment* 18(7):391–400.

Lindenmayer, D.B., Foster, D.R., Franklin, J.F., Hunter, M.L., Noss, R.F., Schmiegelow, F.A., and Perry, D. 2004. Salvage Harvesting Policies After Natural Disturbance. *Science* 303(5662):1303–1303.

Littell, J.S., D. McKenzie, D.L. Peterson, and A.L. Westerling. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916–2003. *Ecological Applications* 19(4):1003–1021.

Littell, J.S., E.E. Oneil, D. McKenzie, J.A. Hicke, J.A. Lutz, R.A. Norheim, and M.M. Elsner. 2010. Forest ecosystems, disturbance, and climatic change in Washington State, USA. *Climatic Change* 102(1–2):129–158.

Malt, J.M., and D.B. Lank. 2009. Marbled Murrelet nest predation risk in managed forest landscapes: dynamic fragmentation effects at multiple scales. *Ecological Applications* 19(5):1274–1287.

Marzluff, J.M., K.J. McGowan, R. Donnelly, and R.L. Knight. 2001. Causes and consequences of expanding American Crow populations. In *Avian Ecology and Conservation in an Urbanizing World*. Edited by J.M. Marzluff, R. Bowman, and R. Donnelly. Springer US, Boston, MA:331–363.

Mass, C., and B. Dotson. 2010. Major Extratropical Cyclones of the Northwest United States: Historical Review, Climatology, and Synoptic Environment. *Monthly Weather Review* 138:2499–2527.

May, C.L. 2002. Debris flows through different forest age classes in the central Oregon Coast Range. *Journal of the American Water Resources Association* 38(4):1097–1113.

McKenzie, D., D.L. Peterson, and J.J. Littell. 2008. Global Warming and Stress Complexes in Forests of Western North America. In Developments in Environmental Science. Elsevier. 319–337.

Meentemeyer, R.K., N.J. Cunniffe, A.R. Cook, J.A.N. Filipe, R.D. Hunter, D.M. Rizzo, and C.A. Gilligan. 2011. Epidemiological modeling of invasion in heterogeneous landscapes: spread of sudden oak death in California (1990–2030). *Ecosphere* 2(2): art17. doi:10.1890/ES10-00192.1.

Metz, M.R., K.M. Frangioso, R.K. Meentemeyer, and D.M. Rizzo. 2011. Interacting disturbances: wildfire severity affected by stage of forest disease invasion. *Ecological Applications* 21(2):313–320.

Mote, P.W., S. Li, D.P. Lettenmaier, M. Xiao, and R. Engel. 2018. Dramatic declines in snowpack in the western US. *Climate and Atmospheric Science* 1(1):2. doi:10.1038/s41612-018-0012-1.

Munger, T.T. 1944. Out of the ashes of Nestucca. *American Forests* 50(7):342–345, 366.

Murphy, B.O., I.Y. Sarikhan, and S.L. Slaughter. 2013. *Southern Willapa Hills Retrospective Study*. Washington Department of Natural Resources, Olympia, WA.

National Interagency Fire Center. 2021. WFIGS - Wildland Fire Locations Full History GIS dataset. Available: https://data-nifc.opendata.arcgis.com/datasets/wfigs-wildland-fire-locations-full-history/explore?location=44.008172%2C-120.820325%2C8.51. Accessed: September 30, 2021.

National Weather Service. 2000. Oregon's top 10 weather events of 1900s. Available: https://www.wrh.noaa.gov/pqr/paststorms/index.php#top5. Accessed: March 19, 2021.

National Weather Service. 2008. Service Assessment Pacific Northwest Storms of December 1–3, 2007. National Weather Service, Silver Spring, MD.

Northwest River Forecast Center. No date. DECEMBER 2007 FLOOD EVENT. Available: https://www.nwrfc.noaa.gov/floods/dec_2007/dec2007flood_part1.htm. Accessed: March 19, 2021.

ODF (Oregon Department of Forestry). 2010. *Northwest Oregon State Forests Management Plan*. Oregon Department of Forestry, Salem, OR.

ODF (Oregon Department of Forestry). 2017. *Spruce Aphid Forest Health Fact Sheet*. Oregon Department of Forestry, Salem, OR.

ODF (Oregon Department of Forestry). 2021. GIS database containing point data and associated information for fires recorded in Oregon, received August 9, 2021 from ODF.

Prichard, S.J., P.F. Hessburg, R.K. Hagmann, N.A. Povak, S.Z. Dobrowski, M.D. Hurteau, V.R. Kane, R.E. Keane, L.N. Kobziar, C.A. Kolden, M. North, S.A. Parks, H.D. Safford, J.T. Stevens, L.L. Yocom, D.J. Churchill, R.W. Gray, D.W. Huffman, F.K. Lake, and P. Khatri-Chhetri. 2021. Adapting western North American forests to climate change and wildfires: ten common questions. *Ecological Applications* doi:10.1002/eap.2433.

Ralph, S.C., G.C. Poole, L.L. Conquest, and R.J. Naiman. 1994. Stream channel morphology and woody debris in logged and unlogged basins of western Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 51:37–51.

Raphael, M.G., D.E. Mack, J.M. Marzluff, and J.M. Luginbuhl. 2002. Effects of forest fragmentation on populations of the marbled murrelet. *Studies in Avian Biology* 25:221–235.

Read, W. 2003a. The Major West Coast Windstorm of December 12, 1995. Available: https://climate.washington.edu/stormking/December1995.html. Accessed: April 6, 2021.

Read, W. 2003b. The Unusual Mid-Spring Windstorm of April 27, 1962. Available: https://climate.washington.edu/stormking/April1962.html. Accessed: April 6, 2021.

Read, W. 2003c. The Strong Windstorm of January 16-17, 1986. Available: https://climate.washington.edu/stormking/January161986.html. Accessed: April 6, 2021.

Read, W. 2004a. The January 9, 1880 "Storm King". Available: https://climate.washington.edu/stormking/January1880.html. Accessed: March 19, 2021.

Read, W. 2004b. The Major Windstorm of December 4, 1951. Available: https://climate.washington.edu/stormking/December1951.html. Accessed: March 19, 2021.

Read, W. 2004c. December 27, 2002 Minor Windstorm. Available: https://climate.washington.edu/stormking/December272002.html. Accessed: April 6, 2021.

Read, W. 2005. Oregon Windstorms and Trees.

Read, W. 2007. The Strongest Windstorms in the Western Pacific Northwest 1950–2004. Available: https://climate.washington.edu/stormking/PNWStormRanks.html. Accessed: April 5, 2021.

Read, W. 2008. The Great Coastal Gale of December 1–3, 2007.

Read, W. 2015a. The 1962 Columbus Day Storm. Available: https://climate.washington.edu/stormking/October1962.html. Accessed: March 18, 2021.

Read, W. 2015b. The December 14-15, 2006 "Hanukkah Eve" Windstorm. Available: https://climate.washington.edu/stormking/December2006.html. Accessed: April 6, 2021.

Reilly, M.J., T.A. Spies, J. Littell, R. Butz, and J.B. Kim. 2018. Chapter 2: Climate, Disturbance, and Vulnerability to Vegetation Change in the Northwest Forest Plan Area. U.S. Department of Agriculture, Forest Service.

Restaino, C.M., D.L. Peterson, D.L., and J. Littell. 2016. Increased water deficit decreases Douglas fir growth throughout western US forests. *Proceedings of the National Academy of Sciences* 113(34):9557–9562.

Robison, D. E. G., K. A. Mills, J. Paul, and L. Dent. 1999. *Storm Impacts and Landslides of 1996*. Oregon Department of Forestry. 157 pp.

Sarikhan, I.Y., Stanton, K.D., Contreras, T.A., Polenz, M., Powell, J., Walsh, T.J., and R.L. Logan. 2008. *Landslide Reconnaissance Following the Storm Event of December 1–3, 2007, in Western Washington*. Washington Division of Geology and Earth Resources, Olympia, WA.

Scharpf, Robert F. (tech. coord.) 1993. Diseases of Pacific Coast Conifers. U.S. Department of Agriculture Handbook 521 (p. 85).

Schmidt, K.M., J.J. Roering, J.D. Stock, W.E. Dietrich, D.R. Montgomery, and T. Schaub. 2001. The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range. *Canadian Geotechnical Journal* 38(5):995–1024.

Seybold, S.J., S.J. Frankel, D.H. Olson, R. Flitcroft, B.K. Kerns, J.C. Lee, K.L. Ripley, and A.S. Munson. 2021. Northwest Region. Pages 352–377 in Poland, T.M., T. Patel-Weynand, D.M. Finch, C.F. Miniat, D.C. Hayes, and V.M. Lopez. (Editors). *Invasive Species in Forests and Rangelands of the United States: A Comprehensive Science Synthesis for the United States Forest Sector*. Springer International Publishing, Cham. Doi:10.1007/978-3-030-45367-1.

Sheehan, T., D. Bachelet, and K. Ferschweiler. 2015. Projected major fire and vegetation changes in the Pacific Northwest of the conterminous United States under selected CMIP5 climate futures. *Ecological Modelling* 317:16–29.

Stathers, R.J., Rollerson, T.P., and Mitchell, S.J. 1994. Windthrow Handbook for British Columbia Forests. Research Program Working Paper 9401, Ministry of Forests Research Program, Victoria, BC.

Stewart, G., J. Dieu, J. Phillips, M. O'Connor, and C. Veldhuisen. 2013. *The Mass Wasting Effectiveness Monitoring Project: An examination of the landslide response to the December 2007 storm in Southwestern Washington*; Cooperative Monitoring, Evaluation and Research Report CMER 08-802; Washington Department of Natural Resources, Olympia, WA.

Stone, J.K., L.B. Coop, and D.K. Manter. 2008. Predicting effects of climate change on Swiss needle cast disease severity in Pacific Northwest forests. *Canadian Journal of Plant Pathology* 30(2):169–176.

Thorson, T.D., Bryce, S.A., Lammers, D.A., Woods, A.J., Omernik, J.M., Kagan, J., Pater, D.E., and Comstock, J.A. 2003. Ecoregions of Oregon (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

U.S. Forest Service. 2021. National USFS Fire Occurrence Point GIS dataset. Available: https://data-usfs.hub.arcgis.com/datasets/national-usfs-fire-occurrence-point-feature-layer/explore?location=43.943983%2C-120.526588%2C7.63. Accessed: September 28, 2021.

U.S. Forest Service and Oregon Department of Forestry (USFS and ODF). 2020. Forest Health Highlights in Oregon – 2019. Available: https://www.oregon.gov/odf/Documents/ForestBenefits/Forest-health-highlights-report-2019.PDF. Accessed: July 20, 2021.

van Mantgem, P.J., N.L. Stephenson, J.C. Byrne, L.D. Daniels, J.F. Franklin, P.Z. Fule, M.E. Harmon, A.J. Larson, J.M. Smith, A.H. Taylor, and T.T. Veblen. 2009. Widespread increase of tree mortality rates in the western United States. *Science* 323(5913):521–524.

Warner, M.D., C.F. Mass, and E.P. Salathé. 2015. Changes in Winter Atmospheric Rivers along the North American West Coast in CMIP5 Climate Models. *Journal of Hydrometeorology* 16(1):118–128.

Westerling, A.L. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. *Science* 313(5789):940–943.

Westerling, A.L. 2016. Increasing western US forest wildfire activity: sensitivity to changes in the timing of spring. *Phil. Trans. R. Soc. B* 371(1696): 20150178. doi:10.1098/rstb.2015.0178.

Wickman, B.E. 1965. Insect-caused Deterioration of Windthrown Timber in Northern California, 1963-1964. Research Paper, USFS Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

Zybach, B. 2003. The great fires: Indian burning and catastrophic forest fire patterns of the Oregon Coast Range, 1491–1951. Dissertation, Oregon State University, Corvallis, OR.

Appendix 3.3
Geology and Soils Technical Supplement

This appendix describes existing conditions for geology and soils in the plan area and, where appropriate, permit area. Conditions in the plan are described within each ecoregion level (EPA 2013).

Regional Geology and Soils

Regional differences between the four ecoregions in the plan area affect not only forest productivity, but also stream geomorphology and geologic processes. The tables in this appendix summarize characteristics of the study area that affect likelihood of shallow-rapid landslide, aquatic effects related to debris flow/debris torrent, and risk of erosion in the plan area, all of which can affect human safety, habitat, and forest productivity. Tables in this appendix include study area characteristics by ecoregion (Table 1), landslide density (Table 2), and soil hazards (Tables 3 through 7).

Shallow-Rapid Landslide[1] and Debris Torrent

Shallow-Rapid Landslide

Table 1 summarizes the geologic origin, topography, soils, and climate of the four ecoregions in the study area, which indicate that conditions in the study area are favorable to initiation of shallow-rapid landslide, namely steep slopes and high precipitation rates.

Table 1. Characteristics of the Study Area by Ecoregion

Ecoregion	Geologic Origin	Topography	Soils	Climate
Coast Range	Tectonic and volcanic activity when a volcanic island chain collided with the North American plate about 50 million years ago.	Ranges from steep to relatively flat, with some areas with slopes greater than 60%. Slopes are deeply dissected.	Formed from sandstone, siltstone, weathered basalts and breccias and generally have potential to be highly productive.	Rain-dominated, with 50–200 inches of annual precipitation.
West Cascades	Volcanic activity approximately 35 million years ago.	Generally steep; slopes are deeply dissected.	Formed from weathered andesite and other igneous rock.	Snow-dominated, with 80–300 inches of annual precipitation.

[1] This analysis does not consider deep-seated landslide. Within the plan area, most deep-seated landslides are ancient, naturally caused, and not currently moving (ODF 2020:71). Some forest management activities can affect deep-seated landslide, in particular those that make large-scale modifications to topography, including quarrying, aggregate stockpiling, placement of large fill, and construction of large road cuts, especially at the base along the toe of the landslide. However, shallow-rapid landslide and associated debris torrent are the predominant ground failure characteristics that shape the landscape.

Ecoregion	Geologic Origin	Topography	Soils	Climate
Klamath Mountains	Metamorphic and igneous rocks of oceanic origin that collided with the North American plate about 150 million years ago.	Widely variable, including both steep mountains and flat valley bottoms, with elevations ranging from 600 to 7,400 feet.	Formed from weathered metamorphic rock, interspersed with peridotite or serpentine and therefore are relatively unproductive for tree growth.	Mediterranean, with hot, dry summers and moderate winter rainfall, approximately 25–120 inches of annual precipitation.
Willamette Valley	A watershed between the Coast Range and the West Cascades. Some sediments in this basin originated from multiple Ice Age floods.	Flat valley bottoms.	Formed from relatively deep alluvium, colluvium, and glaciolacustrine deposits over basalt and sandstone; and therefore are productive.	Mediterranean, with hot, dry summers and moderate winter rainfall, approximately 35–65 inches of annual precipitation

Source: Department of Oregon Geology and Mineral Industries no date(a); ODF 2010a, 2010b, 2020; NRCS 2021

Most steep-sloped drainage areas, including those in the plan area, experience mass wasting as the predominant erosional process (Rice 1977:1; Cover et al. 2010:1596–1597; ODF 2010a:2-46, 2010b:2-24).

The permit area has been mapped using light detection and ranging (LiDAR) for multiple characteristics, including slope steepness and landform (TerrainWorks 2014a). Based on these characteristics, TerrainWorks used the LiDAR mapping data to model landslide density. TerrainWorks developed an evaluation index unit with values from 0 to 13.25. An index of 2 indicates a landslide density within the evaluation unit twice that of an evaluation unit with an index of 1. Table 2 shows the landslide density in each ecoregion (EPA 2013). The minimum value indicates the lowest landslide density for an evaluation unit within the ecoregion. The maximum value indicates the highest landslide density for an evaluation unit, and the mean value is an average value based on integrating all evaluation units within the ecoregion. Standard deviation indicates the extent to which evaluation units vary from the mean.

Table 2. Landslide Density within the Plan Area by Ecoregion

Ecoregion	Mean	Standard Deviation	Minimum	Maximum
Coast Range	0.81	1.61	0	13.25
West Cascades	0.57	1.54	0	13.25
Klamath Mountains	0.94	1.50	0	13.25
Willamette Valley	0.52	1.55	0	13.25

Source: TerrainWorks 2014a

The landslide modeling results indicate that the Coast Range and Klamath Mountains have similar landslide densities, and tend to be slightly higher than the landslide densities of the West Cascades and Willamette Valley.

Projected Harvest Acreage

Likelihood of shallow-rapid landslide increases with increased disturbance of forest floors, including harvest (Benda in prep.:5; Cover et al. 2010:1596). Clearcut harvest has a greater likelihood of triggering landslide than thinning harvest, but because both involve destabilizing events, and both have potential to trigger landslide (Burton et al. 2016:247). Tables 3.1-2 and 3.1-3 in Section 3.1, *Introduction*, show the modeled clearcut and thinning harvest acreages by alternative.

Roads

ODF (2021a, 2021b, 2021c, 2021d, 2021e) tracks road information, including projected construction of new roads in road miles and information about road slope. Roads with slopes equal to or greater than 50 percent have a greater likelihood of initiating shallow-rapid landslide (ODF 2000a:4). However, none of the alternatives involve the planned construction of more than 1 mile of new road with a slope 50 percent or greater (ODF 2021a, 2021b, 2021c, 2021d, 2021e). Planned new road routes are preliminary, and actual routes would be determined at the time that harvest is planned to minimize or avoid building across steep slopes, stream channels, and other sensitive areas. ODF has adopted guidelines to constrain road construction on steep slopes (ODF 2000b:4-1 to 4-11). For example, ridge-top roads are preferred over mid-slope roads (Guiding Principle 2) and high-risk sites are avoided for road construction whenever possible through the use of alternative routes or different logging systems. In addition, ODF follows different engineering procedures depending on road slope. Base level engineering procedures are followed where gentle side slopes are less than 35 percent or for ridge-top roads without high landslide hazard locations or other natural resource concerns. Mid-level engineering procedures are followed on slopes greater than 35 percent but less than 60 percent and without high landslide hazard locations or deep seated landslides. Upper level engineering procedures are followed where portions of the road are located on slopes greater than 60 percent, cross high landslide hazard locations, or meet a variety of other criteria indicating potential for slope failure or erosion or debris torrent that could enter fish-bearing streams.

Soils

Soils in the plan area vary considerably with respect to parent material and productivity, depending on alternative and ecoregion. This also implies variability with respect to soil hazards.

While Tables 3 through 7 show high hazards, forestry activities follow established best management practices with respect to soil management to minimize effects related to soil hazards. These best management practices include conducting a detailed soil inventory, following harvesting strategies to meet soil disturbance standards based on local soil susceptibility to disturbance, considerations of climate constraints, monitoring the resulting soil disturbance, and restoring soils that are over prescribed disturbance limits (Curran et al. 2005:8).

Overview of Soil Hazards

Soils vary in terms of their susceptibility to erosion, suitability for log landings and roads, and depth to a restrictive layer. While all ecoregions contain soils with hazards from slight to severe, Table 3 summarizes the predominant ratings for these soil hazards in the plan area by ecoregion. Tables 4 to 7 provide detailed information about soil characteristics summarized in Table 3. While Table 3 shows high hazards, forestry activities follow established best management practices with respect to soil management in order to minimize effects related to soil hazards.

Table 3. Predominant Soil Hazard Ratings in the Plan Area by Ecoregion

	Water Erosion Hazard (Off-Road, Off-Trail)	Water Erosion Hazard (Road, Trail)	Soil Suitability for Log Landings	Soil Suitability for Roads
Coast Range	Severe to very severe	Severe	Poorly suited	Poorly to moderately suited
West Cascades	Moderate to severe	Severe	Poorly to moderately suited	Poorly to moderately suited
Klamath Mountains	Severe	Severe	Poorly suited	Poorly suited
Willamette Valley	Severe	Severe	Poorly to moderately suited	Poorly to moderately suited

Source: Natural Resources Conservation Service 2021

Water Erosion Hazard for Soils in the Plan Area

Soils in the plan area range from having slight to very severe water erosion hazard (NRCS 2021). The Natural Resources Conservation Service has evaluated soils for their soil erosion hazard, providing analysis for off-road, off-trail areas and for road and trail areas. The analysis for off-road, off-trail is based on slope and soil erosion factor K (an index that quantifies the relative susceptibility of the soil to sheet and rill erosion). The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. The analysis for road and trail is based on soil erosion factor K, slope, and content of rock fragments. Tables 4 and 5 show water erosion hazard in acres and percentage of area with each rating for off-road, off-trail areas and for road and trail areas, respectively, in the plan area by ecoregion.

Approximately 40 percent of the plan area is rated as very severe water erosion hazard off-road and off-trail, and approximately 92 percent as very severe water erosion hazard on road and trail (NRCS 2021). However, adherence to best management practices for forestry activities, including harvest and road construction, such as are discussed above under *Roads*, would reduce the likelihood of triggering shallow-rapid landslide related to soil hazards.

Table 4. Water Erosion Hazard, Off-Road and Off-Trail, within the Plan Area by Ecoregion

	Coast Range		Cascades		Klamath Mountains		Willamette Valley			
Erosion Hazard Rating	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Total Ac**	**Total %**
Very Severe	231,405	42.8%	4	0.0%	401	2.3%	479	8.0%	232,289	37.6%
Severe	249,428	46.2%	19,783	36.7%	13,310	76.5%	4,787	79.6%	287,308	46.5%
Moderate	33,780	6.3%	20,713	38.5%	2,580	14.8%	610	10.1%	57,683	9.3%
Slight	8,804	1.6%	6,209	11.5%	450	2.6%	119	2.0%	15,582	2.5%
Not rated	16,894	3.1%	7,121	13.2%	661	3.8%	18	0.3%	24,694	4.0%
Grand Total	**540,310**	**100.0%**	**53,830**	**100.0%**	**17,403**	**100.0%**	**6,014**	**100.0%**	**617,556**	**100.0%**

Source: Natural Resources Conservation Service 2021

Table 5. Water Erosion Hazard, Road and Trail, within the Plan Area by Ecoregion

	Coast Range		Cascades		Klamath Mountains		Willamette Valley			
Erosion Hazard Rating	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Total Ac**	**Total %**
Severe	507,039	93.8%	40,456	75.2%	16,384	94.1%	5,759	95.8%	569,637	92.2%
Moderate	10,095	1.9%	6,050	11.2%	123	0.7%	130	2.2%	16,397	2.7%
Slight	6,288	1.2%	203	0.4%	235	1.4%	107	1.8%	6,833	1.1%
Not rated	16,888	3.1%	7,121	13.2%	661	3.8%	18	0.3%	24,689	4.0%
Grand Total	**540,310**	**100.0%**	**53,830**	**100.0%**	**17,403**	**100.0%**	**6,014**	**100.0%**	**617,556**	**100.0%**

Source: Natural Resources Conservation Service 2021

Modeled Generic Erosion Potential for Soils in the Plan Area

TerrainWorks has developed a geographic-based tool, at the scale of individual channel segments, to assess risk of surface erosion and shallow-rapid landslide in a portion of the permit area in the Coast Range and Willamette Valley ecoregions (TerrainWorks 2014b). The values of the generic erosion potential (GEP) index indicate the susceptibility of hillslopes to shallow-rapid landslide and gullying based on an index that combines slope steepness with slope convergence. The values for GEP range from 0 to 1. The low end of the range indicates a lower risk of erosion, and the high end of the range indicates a higher risk. Table 6 includes an assessment of mapped slopes in the permit area by ecoregion, showing likelihood of shallow-rapid landslide and surface erosion according to the GEP index. This analysis shows that the frequency of shallow-rapid landslide occurrence in the Coast Range is greater than in Willamette Valley.

Table 6. Generic Erosion Potential Index within the Permit Area by Ecoregion

Ecoregion	Average Generic Erosion Potential Index in Watershed
Coast Range	0.41
Willamette Valley	0.20

Source: TerrainWorks 2014b

Suitability for Log Landings and Roads for Soils in the Plan Area

Soils in the plan area range from being poorly suited to well suited for log landings and roads (NRCS 2021). Approximately 80 percent of the plan area is poorly suited for log landings, and approximately 80 percent is poorly suited for roads. However, best management practices for forestry activities that could affect soil would reduce risks to soil.

Table 7 shows soil suitability for log landings and roads in the plan area by ecoregion.

Table 7. Soil Suitability for Log Landings and Roads within the Plan Area by Ecoregion

	Cascades		Coast Range		Klamath Mountains		Willamette Valley			
Soil Suitability Rating	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Ac**	**%**	**Total Ac**	**Total %**
Well suited	146	0.3%	15	0.0%	115	0.7%	0	0.0%	276	0.0%
Moderately suited	14,288	26.5%	88,210	16.3%	1,592	9.2%	2,596	43.2%	106,686	17.3%
Poorly suited	32,275	60.0%	435,198	80.5%	14,937	85.8%	3,399	56.5%	485,809	78.7%
Not Rated	7,121	13.2%	16,888	3.1%	650	3.7%	18	0.3%	24,678	4.0%
No Data	0	0.0%	0	0.0%	108	0.6%	0	0.0%	108	0.0%
Grand Total	**53,830**	**100.0%**	**540,310**	**100.0%**	**17,403**	**100.0%**	**6,014**	**100.0%**	**617,556**	**100.0%**

Source: NRCS 2021

References

Benda, L. in prep. Rates of Shallow Landslides, Effects of Forest Management and Implications for the Supply of Sediment and Wood to Fish Streams. Draft, Version 2.0. August 18.

Burton, J.I., D.H. Olson, and K.J. Puettmann. 2016. Effects of riparian buffer width on wood loading in headwater streams after repeated forest thinning. *Forest Ecology and Management* 372(2016):247-257.

Cover, M.R., J.A. de la Fuente, V.H. Resh. 2010. Catastrophic disturbances in headwater streams: the long-term ecological effects of debris flows and debris floods in the Klamath Mountains, northern California. *Canadian Journal of Fisheries and Aquatic Sciences* 67(10):1596–1610.

Curran, M.P., R.L. Heninger, D.G. Maynard, and R.F. Powers. 2005. Harveseting effects on soils, tree growth, and long-term productivity. In C.A. Harrington and S.H. Schoenholtz, eds. Productivity of Western forests: A forest products focus. (Gen. Tech. Rep. PNW-GTR-642.) Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 176 p. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr642.pdf. Accessed: August 27, 2021.

Oregon Department of Geology and Mineral Industries. n.d. Geologic Provinces. Available: https://www.oregongeology.org/learnmore/GeologicSightseeing.HTM. Accessed: February 17, 2022.

EPA (U.S. Environmental Protection Agency). 2013. Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States. Available: https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states. Accessed: July 30, 2021.

NRCS (Natural Resources Conservation Service). 2021. Gridded Soil Survey Geographic Database. Released July 2020. Available: https://datagateway.nrcs.usda.gov/GDGHome.aspx. Accessed: July 12, 2021.

ODF (Oregon Department of Forestry). 2000a. *Forest Road Management Guidebook*. Available: https://www.oregon.gov/odf/Documents/workingforests/forest-road-management-guidebook.pdf. Accessed: August 25, 2021.

ODF (Oregon Department of Forestry). 2000b. Forest Roads Manual. July.

ODF (Oregon Department of Forestry). 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

ODF (Oregon Department of Forestry). 2010b. *Southwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/Documents/AboutODF/2010FMPSouthwestOregon.pdf.

ODF (Oregon Department of Forestry). 2020. Western Oregon State Forest Management Plan. Available: https://www.oregon.gov/odf/board/Documents/fmp-hcp/Western-Oregon-State-Forest-Management-Plan-Final-Draft.pdf. Accessed: August 3, 2021.

ODF (Oregon Department of Forestry). 2021a. Route Haul Data—Alternative 1 (No Action Alternative). Salem, OR.

ODF (Oregon Department of Forestry). 2021b. Route Haul Data—Alternative 2 (Habitat Conservation Plan). Salem, OR.

ODF (Oregon Department of Forestry). 2021c. Route Haul Data—Alternative 3 (Increased Conservation). Salem, OR.

ODF (Oregon Department of Forestry). 2021d Route Haul Data—Alternative 4 (Reduced Permit Term). Salem, OR.

ODF (Oregon Department of Forestry). 2021e. Route Haul Data—Alternative 5 (Increased Timber Harvest). Salem, OR.

Rice, R.M. 1977. Forest management to minimize landslide risk. In: Guidelines for Watershed Management, FAO Conservation Guide. Rome, Italy. Pp. 271-287. Available: http://www.fao.org/3/AD071E/AD071E00.htm. March 5, 2021.

TerrainWorks. 2014a. Shallow Landslide Density—Hillside. Available: http://www.netmaptools.org/Pages/NetMapHelp/hillside_2.htm?mw=MjQw&q=bHMtZGVu&st=Mw==&sct=MA==&ms=AAAAAAA=. Accessed: August 13, 2021.

TerrainWorks. 2014b. NetMap Tools: Generic Erosion Potential (GEP) – Channel. Available: http://www.netmaptools.org/Pages/NetMapHelp/channel_1.htm?mw=MzQ2&q=ZXJvc2lvbiBwb3RlbnRpYWw=&st=Mw==&sct=MA==&ms=AAAAAAA=. Accessed: August 10, 2021.

Appendix 3.4
Water Resources Technical Supplement

Affected Environment

Surface Water

Table 1 summarizes the average stream and road density of the study area. A map of the study area is presented in Section 3.4, *Water Resources*, Figure 3.4-2. Table 2 summarizes the elevation, slope, aspect, depth to bedrock, and subwatershed area in the study area. Higher stream and road density, along with shallower depth to bedrock and steeper slopes, and lower permeability bedrock, indicate increasing drainage efficiency. The more efficiently a watershed drains, the faster streamflow reaches peak flow and the larger those peak flows are.

Table 1. Average Stream Density and Road Density of Study Area by Basin

Basin	Average Stream Density (miles per square miles)	Average Road Density (miles per square miles)
Lower Columbia	6.0	4.7
Northern Oregon Coastal	6.1	5.3
Southern Oregon Coastal	5.8	4.3
Willamette	5.6	5.4
Klamath	7.2	1.7[a]
Northern California Coastal	7.1	0.2[a]

Source: USGS 2020; ODF 2021

[a] Road data do not cover a significant portion of subwatershed located in California.

Table 2. Physiographic Characteristics of Subwatersheds in the Study Area

Basin	Mean Elev. (feet)	Max Elev. (feet)	Mean Slope (%)	Mean South Aspect (%)	Area Weighted Mean Depth to Bedrock (in)	Mean Subwater-shed Area (sq km)
Lower Columbia	759	4,483	18	7	24	95
Northern Oregon Coastal	1,058	3,691	36	13	28	68
Southern Oregon Coastal	1,871	7,417	40	12	24	78
Willamette	1,648	5,922	27	14	32	83
Klamath	4,260	7,417	37	17	29	48
Northern California Coastal	1,995	3,411	41	3	28	144

Source: USGS 2020

In the study area, most snowfall occurs in high elevation portions of the Cascades and Klamath Mountains, with some snowfall occurring in the north end of the Northern Oregon Coastal basin, where elevations are highest. Rain-dominated areas experience rapid increase in streamflow and sustained maximum flows for a period of a few hours. Snow-dominated areas experience a gradual increase in streamflow over several weeks or months, with maximum flows sustained for a week or more, and a gradual decline to base flow levels. Areas that are in the transition zone, between rain- and snow-dominated zones, experience rain-on-snow events, which tend to produce a more rapid rise in peak flow and rapid return to baseflow than snow dominated zones. Rain-on-snow events are expected to increase under climate change.

Peak Flows

Based on a statistical analysis of 15 watershed characteristics and 376 stream gages in western Oregon, the U.S. Geological Survey (USGS) found that peak flow behavior differs significantly in western Oregon according to three hydrologic zones. These zones are demarcated by precipitation and runoff characteristics, which are controlled by major divides and elevation. North of the Klamath Mountains, the study area is divided from north to south by the Coast Mountains, the Willamette Valley, and the Cascade Mountains. Above 3,000 feet the climate transitions from rain-dominated to snow-dominated zone (Cooper 2005:8). Figure 1 shows the three hydrologic flood zones by color coding the gaging stations as zone 1, 2A, and 2B. Zone 1 is the Coastal Range. Zone 2A stations are above 3,000 feet elevation. Zone 2B are the Willamette Valley, Klamath, and Cascades Range stations located below 3,000 feet elevation.

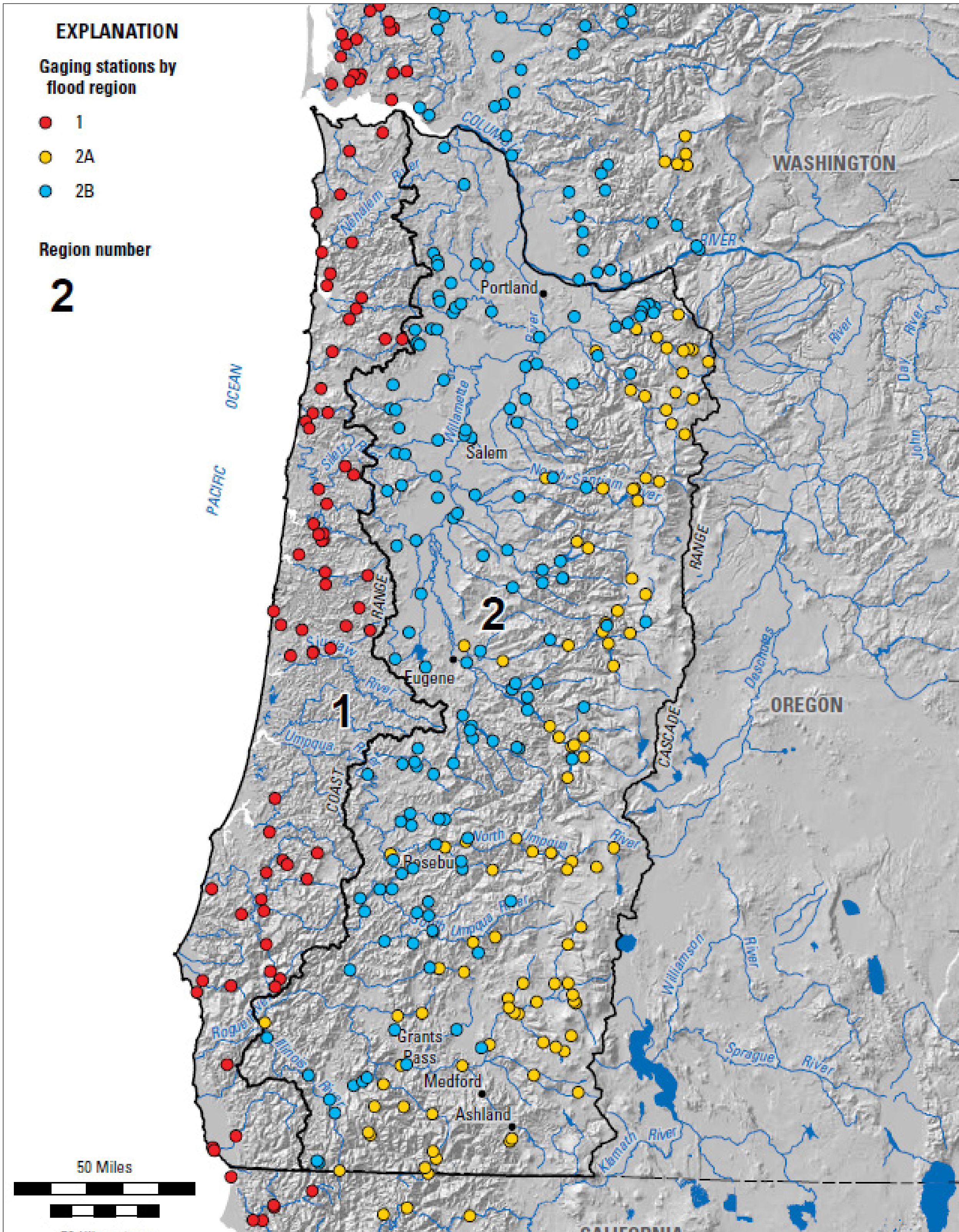
The main drivers of peak flow rates in western Oregon are summarized in Table 3 (Cooper 2005:43–45). Soil permeability and soil capacity play a significant role in governing peak flows in the Coastal Range but not in the Willamette, Cascades or Klamath ranges. Soil capacity is the maximum volume of water a soil can hold. It is the product of its porosity and its depth. Soil permeability is the rate at which water can infiltrate the soil.

Table 3. Peak Flow Drivers by Hydrologic Zone

Hydrologic Zone	Factors Driving Peak Flows	Factors Sensitive to Climate Change
Zone 1: Coastal Range watersheds	Drainage area 24-hour, 2-year precipitation intensity Soil permeability Soil storage capacity	24-hr, 2-year precipitation intensity
Zone 2A: Cascades and Klamath Range watersheds above 3,000 feet	Drainage area Slope 24-hr, 2-year precipitation intensity Mean minimum January temperature Mean maximum January temperature	24-hour, 2-year precipitation intensity Mean minimum January temperature Mean maximum January temperature
Zone 2B: Willamette, Cascades, and Klamath Range watersheds below 3,000 feet	Drainage area Slope 24-hour, 2-year precipitation intensity	24-hour, 2-year precipitation intensity

Source: Cooper 2005:35–37

Figure 1. Flood Regions of Western Oregon (Regions 2A and 2B are divided by elevation)



Based on Cooper's results, annual peak flows may increase in the study area under climate change as 24-hour, 2-year precipitation intensity increases and as January temperatures increase. Under climate change, precipitation intensity is expected to increase in western Oregon and extreme precipitation intensity events are expected to increase in frequency. By 2070, precipitation events that had a 20 percent annual exceedance probability up to 2011, may shift to the 50 percent return interval (Easterling et al. 2017:219). In other words, the 5-year event may become the 2-year event. The change in number of days below freezing is projected to decrease in all three zones by 2050. Higher elevations are projected to lose 50 to 70 days of freezing temperatures (Vose et al. 2017:199).

Drainage density, depth to bedrock, vegetation, soil characteristics, and aspect were not considered in Cooper's analysis. The Natural Resources Conservation Service (NRCS) Curve Number method for estimating peak flow for smaller drainages depends on the amount of precipitation, degree of vegetative cover, and the soil infiltration rate (NRCS 1986). Higher vegetative cover is always inversely related to runoff according to this method. NRCS categorizes soil infiltration into hydrologic groups from high infiltration (A) to low infiltration (D). Acres and percentages of the study area by hydrologic soil group and basin are summarized in Tables 4 and 5. Rainfall intensity, runoff from snowmelt, or rain on frozen ground are not estimated using the NRCS Curve Number method.

Table 4. Acres of Study Area by Hydrologic Soil Group and Basin

Basin	A	A/D	B	B/D	C	C/D	D
Lower Columbia	20,536	513	109,988	1,274	47,947	16,064	5,159
Northern Oregon Coastal	9,364	1,177	944,033	5,819	281,574	17,353	13,049
Southern Oregon Coastal	36,543	3,705	232,202	1,336	382,044	9,048	165,295
Willamette	74,262	635	336,931	3,035	401,677	19,758	82,529
Klamath	3,146		1,452		1,285	26	2,552
Northern California Coastal	--	100	1,291	--	2,536	--	1,673

Source: NRCS 2019

Table 5. Percent of Study Area by Hydrologic Soil Group and Basin

Basin	A	A/D	B	B/D	C	C/D	D	No Data
Lower Columbia	7	0	36	0	16	5	2	34
Northern Oregon Coastal	1	0	71	0	21	1	1	4
Southern Oregon Coastal	4	0	26	0	42	1	18	9
Willamette	7	0	33	0	39	2	8	10
Klamath	34	0	16	0	14	0	27	9
Northern California Coastal	0	1	19	0	38	0	25	17
Grand Total	4	0	45	0	31	2	8	10

Source: NRCS 2019

Surface Water Quality

Table 6 summarizes the extent of the impaired waters in the study area by basin.

Table 6. Miles of Impaired Rivers/Streams and Acres of Impaired Waterbodies in the Study Area

Basin	Rivers and Streams (miles)	Waterbodies (acres)
Lower Columbia	68	119,157
Northern Oregon Coastal	1,036	19,503
Southern Oregon Coastal	646	15,597
Willamette	487	17,912
Klamath	0	0
Northern California Coastal	0	0

Source: ODEQ 2020

Tables 7 and 8 summarize the most extensive impairment causes and impaired uses in the study area by basin.

Table 7. Top Three Most Extensive Impairment Causes for Waterbodies, Streams, and Rivers[a] in the Study Area by Basin

Ranking	Lower Columbia	Extent	Northern Oregon Coastal	Extent	Southern Oregon Coastal	Extent	Willamette	Extent
Waterbody-1	Fecal coliform, E. coli, enterococci	134,382 acres	Temperature	18,409 acres	Temperature	10,761 acres	Harmful algal blooms	9,009 acres
Waterbody-2	Temperature	115,865 acres	Fecal coliform, E. coli, enterococci	15,713 acres	Fecal coliform, E. coli, enterococci	8,397 acres	Turbidity[b]	6,876 acres
Waterbody-3	DDE 4,4'	115,831 acres	Arsenic	13,352 acres	Dissolved oxygen	5,201 acres	Temperature	2,081 acres
Streams-1	Temperature	35 miles	Temperature	163 miles	Temperature	120 miles	Temperature	50 miles
Streams-2	Fecal coliform, E. coli, enterococci	13 miles	BioCriteria	163 miles	BioCriteria	61 miles	Dissolved oxygen	39 miles
Streams-3	Dissolved oxygen	13 miles	Fecal coliform, E. coli, enterococci	74 miles	Dissolved oxygen	48 miles	Fecal coliform, E. coli, enterococci	16 miles
Rivers-1	Temperature	29 miles	Temperature	577 miles	Temperature	390 miles	Temperature	321 miles
Rivers-2	BioCriteria	16 miles	Fecal coliform, E. coli, enterococci	379 miles	Fecal coliform, E. coli, enterococci	87 miles	Dissolved oxygen	192 miles
Rivers-3	Fecal coliform, E. coli, enterococci	14 miles	Dissolved oxygen	212 miles	Dissolved oxygen	57 miles	Fecal coliform, E. coli, enterococci	73 miles

[a] The Oregon Department of Environmental Quality defines “streams” as fourth-order streams or lower and “rivers” as fifth-order streams and higher. The uppermost channel in a drainage network, with no upstream tributaries, is a first-order stream. Second-order streams are formed below the confluence of two first-order streams, and so on. A second-order stream conjoining a first-order stream is still a second-order stream, and so on.

[b] Acres of waterbodies affected by turbidity are Fern Ridge Lake and Foster Lake. Fern Ridge and Foster Lakes are in subwatersheds that have less than 3 percent and less than 0.1 percent coverage by study area, respectively. Removing these waterbodies from the totals would make fecal bacteria indicators the third-most extensive and temperature would be the second-most.

DDE 4.4’ = Dichlorodiphenyldichloroethylene. The commonly known pesticide DDT degrades over time to form DDE.

Table 8. Top Three Most Extensive Impaired Uses for Waterbodies, Streams, and Rivers in the Study Area by Basin

Ranking	Lower Columbia	Extent	Northern Oregon Coastal	Extent	Southern Oregon Coastal	Extent	Willamette	Extent
Waterbody-1	Fish and aquatic life	117,244 acres	Fishing	18,991 acres	Fishing	15,561 acres	Fish and aquatic life	8,902 acres
Waterbody-2	Fishing	115,831 acres	Fish and aquatic life	18,460 acres	Fish and aquatic life	12,766 acres	Private domestic water supply	6,876 acres
Waterbody-3	Private domestic water supply	115,831 acres	Water contact recreation	12,778 acres	Water contact recreation	4,840 acres	Public domestic water supply	6,876 acres
Streams-1	Fish and aquatic life	35 miles	Fish and aquatic life	293 miles	Fish and aquatic life	197 miles	Fish and aquatic life	103 miles
Streams-2	N/A	0 miles	Water contact recreation	22 miles	Water contact recreation	13 miles	Water contact recreation	6 miles
Streams-3	N/A	0 miles	Private domestic water supply	4 miles	Private domestic water supply	3 miles	N/A	0 miles
Rivers-1	Fish and aquatic life	33 miles	Fish and aquatic life	648 miles	Fish and aquatic life	423 miles	Fish and aquatic life	376 miles
Rivers-2	Water contact recreation	14 miles	Water contact recreation	295 miles	Water contact recreation	64 miles	Water contact recreation	73 miles
Rivers-3	N/A	0 miles	Fishing	63 miles	Fishing	53 miles	Aesthetic quality	2 miles

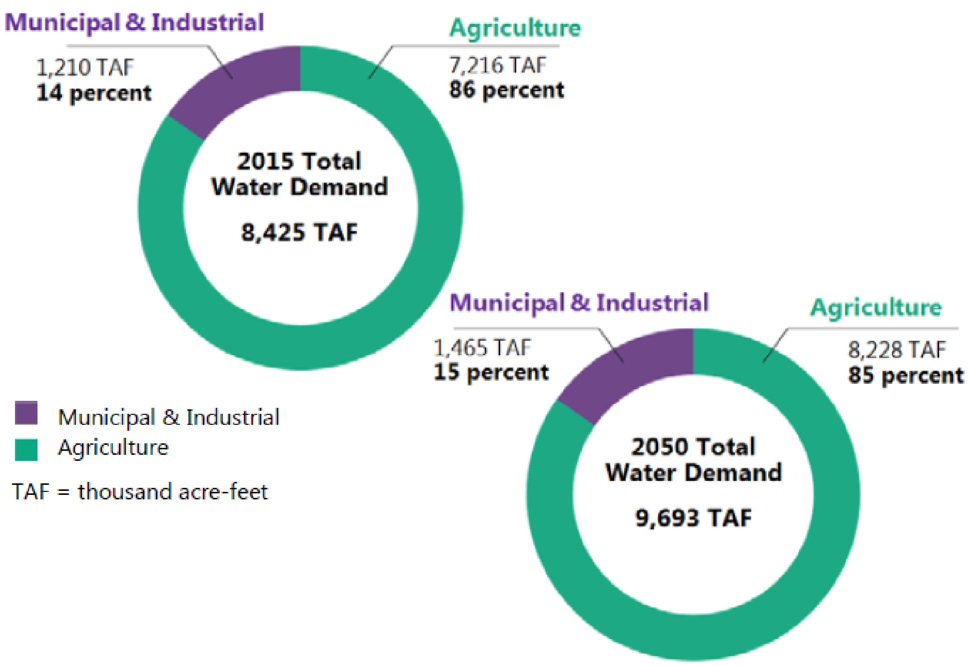
N/A = not applicable

Surface Water Supply

The study area overlaps with surface water drinking water source areas (ODEQ 2019). Because most precipitation falls in the winter months, which are outside of the growing season, surface water rights are fully allocated in late summer in almost all study area watersheds, whereas very small areas have fully allocated water rights during winter months (OWRD 2017).

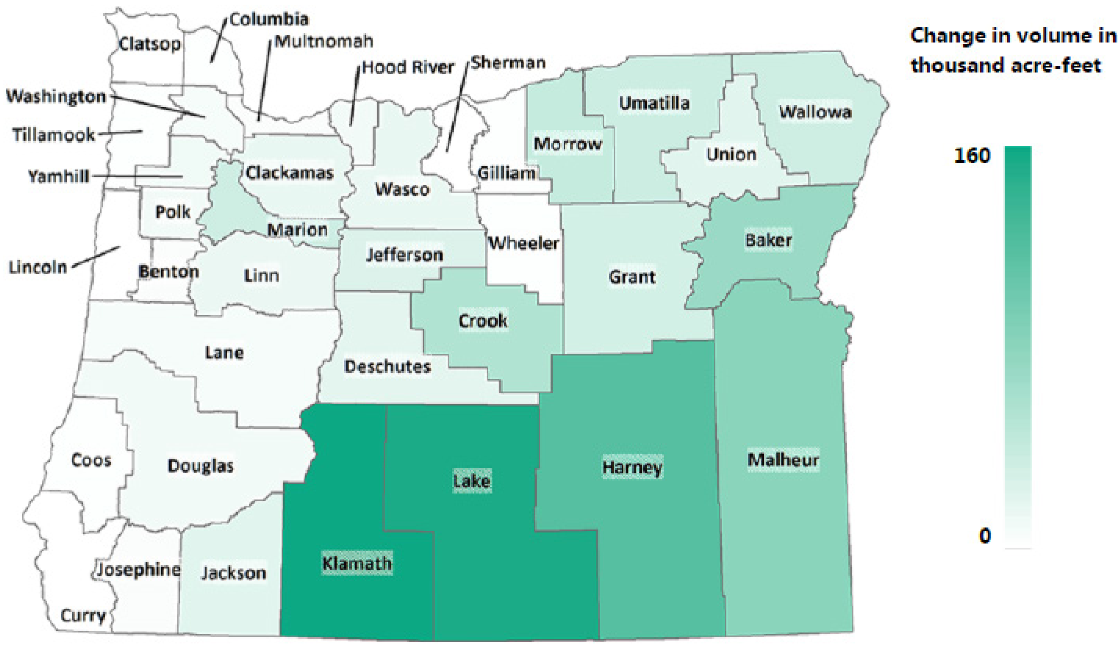
Figures 2 through 4 depict recent and projected change in water demand by use type.

Figure 2. Statewide Forecasted Change in Consumptive Water Demand by 2050



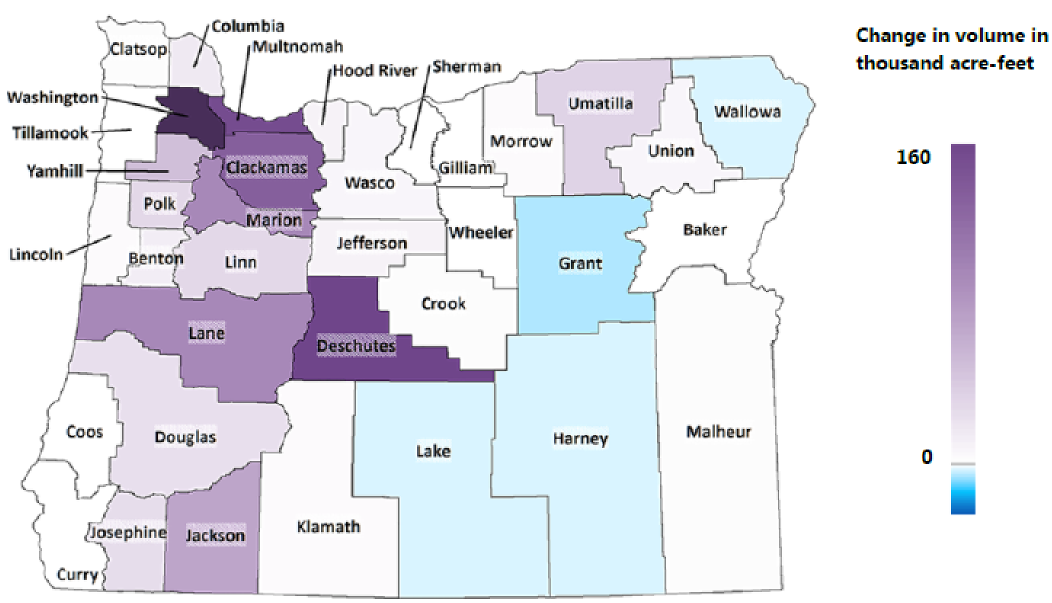
Source: OWRD 2017

Figure 3. Forecasted Change in 2050 Agricultural Water Demand Volume by County



Source: OWRD 2017

Figure 4. Forecasted Change in 2050 Municipal and Industrial Water Demand Volume by County



Source: OWRD 2017

Groundwater

Aquifers and Recharge Areas

Table 9 quantifies the acres of plan area in each rock type and aquifer. Table 10 describes the typical depth to water, well yield, and principal water use of principal aquifers by county.

Table 9. Aquifer Names and Rock Types in the Study Area

Aquifer Name (USGS 2000)	Rock Types (USGS 1994)	Plan Area (acres)	Percentage of Plan Area	Recharge Potential
Other rocks	Pre-Miocene rocks	608,454	84%	Low
Pacific Northwest basaltic-rock	Miocene basaltic or volcanic and sedimentary rocks	84,294	12%	Variable
Pacific Northwest basin-fill	Unconsolidated deposits	25,019	3%	High
Willamette Lowland basin-fill	Willamette Trough regional aquifer system (unconsolidated deposits)	4,540	1%	High

Source: USGS 1994, 2000

Table 10. Types of Aquifers Used for Water Supply Outside the Major Puget-Willamette Trough Regional Aquifer System and Types of Human Water Uses

Plan Area Counties	Principal aquifer*	Typical well depth (feet below land surface)	Depth to water (feet below land surface)	Range of well yields (gallons per minute)	Principal water use**
Benton	Ud	60–150	10–35	<500–1,000	PS, DC, A, I
Clackamas	Ud, Obr	No data	No data	1–20	DC, A
Clatsop	Ud	10–100	<10–50	300–2,000	DC, A
Columbia	Ud, Obr	No data	No data	1–500	PS, DC, A
Coos	Ud	20–150	10–110	50–250	DC, A
Curry	Ud	20–150	10–110	50–250	DC, A
Douglas	Ud, pM	80–120	<10–25	50–250	PS, DC, A, I
Jackson	Ud, pM	40–145	<10–15	No data	DC, A
Josephine	Ud, pM	60–125	<10–15	No data	DC, A
Lane	Ud, Vsr, Obr	<150	<5–25	50–700	DC, A
Lincoln	Ud	<150	<5–25	50–700	DC, A
Marion (Willamette Trough)	Ud, Vsr, Obr	25–270	10–55	<300–<2,000	PS, DC, A, I
Marion (other)	Ud, Vsr, Obr	No data	No data	1–20	DC, A
Multnomah	Ud, Vsr, Obr	No data	No data	10–10,000	PS, DC, A, I
Polk	Ud	60–150	10–315	<500–1,000	PS, DC, A, I
Tillamook	Ud	10–100	<10–50	300–2,000	PS, DC, A

Plan Area Counties	Principal aquifer*	Typical well depth (feet below land surface)	Depth to water (feet below land surface)	Range of well yields (gallons per minute)	Principal water use**
Washington	Ud, Obr	25–700	10–190	No data	PS, DC, A, I
Yamhill	Ud, Obr	65–220	No data	500–800	PS, DC, A, I

Source: USGS 1994

*Aquifer: Ud, unconsolidated deposits
Obr, Miocene basaltic rocks
Vsr, volcanic and sedimentary rocks
pM, pre-Miocene rocks

**Water use: A, agricultural
I, industrial
DC, domestic and commercial
PS, public supply

In lower elevations of the Cascades, where the volcanic parent material tends to be relatively impermeable, groundwater recharge is low, and stream networks are well developed and have a high density (Moore and Wondzell 2005:764). At higher elevations in the Cascades, where the volcanic material is newer, permeability is high. This leads to lower drainage densities, less developed stream networks, and more groundwater interaction. High groundwater interaction can mitigate the effects of precipitation events and seasonal change. Depending on location, a stream can lose peak flow to groundwater, or the groundwater can support higher baseflows in the dry summer months (Moore and Wondzell 2005).

Groundwater Quality and Special Management Areas

Oregon has declared three groundwater management areas due to elevated nitrogen concentrations, which require state agencies to focus efforts on action plan development and groundwater quality restoration. The study area does not overlap with any of these management areas (ODEQ 2004:7). The most recent Statewide Groundwater Monitoring Program Report for the North Coast Basin (ODEQ 2018) found contamination from nitrate in the Northern Oregon Coastal Basin, near Gearhart, with elevated measurements also found near Tillamook and Manzanita. Arsenic contamination was found in Clatsop Plains. Bacterial and pesticide contamination was found at multiple locations throughout the Northern Oregon Coastal Basin, with more pesticide detection clustered in Clatsop Plains. According to the study, the detected pesticides were well below any level known to cause a human health risk, and the Clatsop Plains are primarily recharged by precipitation and only minorly from the Coast Range foothills runoff, which would be influenced by the study area (ODEQ 2018:3).

The study area overlaps with areas identified as potential groundwater quality concern in the Northern and Southern Oregon Coastal basins (ODEQ and Oregon Health Authority 2017). Most of the contaminated wells identified in the Statewide Groundwater Monitoring Program (ODEQ 2013, 2016, 2018) were located outside of the study area.

Approximately two wells with elevated contaminants (nitrate, fecal bacteria, arsenic) are in the study area—the Nehalem subbasin in the Northern Oregon Coastal basin and Upper Rogue subbasin in the Southern Oregon Coastal basin (ODEQ 2013, 2016, 2018). The Oregon Department of Environmental Quality cites irrigated agriculture as the main source of nitrates in the Rogue Basin.

Wells near Cave Junction with historically high nitrate levels, which lie within the study area, were not enhanced in 2011. Pesticides were detected near Shady Cove, inside the study area, but they were well below any human health screening standard.

Analysis Methods

The following information supports the water resource effects analysis in the environmental impact statement (EIS).

Model Results

The following tables present forest model results of subwatershed basal area change over time, which are used to analyze the effects of timber harvest, reforestation, and young stand management on water yield and peak flows in the EIS. Table 11 presents the average subwatershed percent changes in basal area during three intervals of the analysis period under each alternative. Table 12 shows the maximum decrease in basal area in any one subwatershed in each basin due to harvest and reforestation activities, during three intervals of the permit term. Table 13 shows the difference between modelled basal area under the no action alternative versus the proposed action in the same subwatershed. This indicates how alternatives would change the location of effects on water resources.

Table 11. Modeled Average Percent Change[a] in Subwatershed Basal Area by Basin and Alternative over the Analysis Period

Basin	2048–2023	2073–2048	2093–2073
Lower Columbia			
No action alternative	0.47%	1.22%	-0.04%
Proposed action	0.20%	-1.27%	3.13%
Alternative 3	-0.17%	-1.37%	2.98%
Alternative 4	0.20%	-1.27%	Unknown
Alternative 5	-0.42%	-1.52%	3.24%
Northern Oregon Coastal			
No action alternative	2.36%	1.68%	0.69%
Proposed action	0.15%	2.08%	-0.22%
Alternative 3	0.23%	3.06%	-0.22%
Alternative 4	0.15%	2.08%	Unknown
Alternative 5	-0.17%	2.30%	-0.33%
Southern Oregon Coastal			
No action alternative	0.26%	0.23%	0.11%
Proposed action	0.55%	0.04%	-0.03%
Alternative 3	0.55%	0.03%	-0.3%
Alternative 4	0.55%	0.04%	Unknown
Alternative 5	0.51%	-0.06%	0.08%
Willamette			
No action alternative	1.36%	1.14%	1.05%
Proposed action	0.40%	1.83%	1.00%
Alternative 3	0.44%	1.84%	0.99%
Alternative 4	0.40%	1.83%	Unknown
Alternative 5	0.36%	1.83%	0.96%

Basin	2048–2023	2073–2048	2093–2073
Klamath			
No action alternative	0.19%	0.09%	0.02%
Proposed action	0.19%	0.09%	0.02%
Alternative 3	0.19%	0.09%	0.02%
Alternative 4	0.19%	0.09%	Unknown
Alternative 5	0.19%	0.09%	0.02%
Northern California Coastal			
No action alternative	0.52%	-0.63%	1.08%
Proposed action	0.69%	0.27%	0.14%
Alternative 3	0.69%	0.27%	0.14%
Alternative 4	0.69%	0.27%	Unknown
Alternative 5	0.69%	0.27%	0.14%

Source: Forest model

[a] Average percent change calculated by subtracting area weighted average basal area in the first year from the last year in the period and dividing the difference by the first year in the period.

Table 12. Maximum Modeled Decrease in Percentage Basal Area in a Subwatershed by Basin and Alternative over the Analysis Period[a]

Basin	2048–2023	2073–2048	2093–2073
Lower Columbia			
No action alternative	-5%	-5%	-5%
Proposed action	-10%	-8%	-2%
Alternative 3	-9%	-7%	-3%
Alternative 4	-10%	-8%	Unknown
Alternative 5	-13%	-8%	-2%
Northern Oregon Coastal			
No action alternative	-23%	-8%	-17%
Proposed action	-18%	-9%	-18%
Alternative 3	-17%	-8%	-17%
Alternative 4	-18%	-9%	Unknown
Alternative 5	-18%	-8%	-21%
Southern Oregon Coastal			
No action alternative	-1%	-3%	-2%
Proposed action	0%	-1%	-2%
Alternative 3	0%	-1%	-2%
Alternative 4	0%	-1%	Unknown
Alternative 5	0%	-2%	-1%
Willamette			
No action alternative	-5%	-7%	-1%
Proposed action	-6%	-1%	-1%
Alternative 3	-6%	-1%	-1%
Alternative 4	-6%	-1%	Unknown
Alternative 5	-5%	-1%	-3%

Basin	2048–2023	2073–2048	2093–2073
Klamath			
No action alternative	0%	0%	0%
Proposed action	0%	0%	0%
Alternative 3	0%	0%	0%
Alternative 4	0%	0%	Unknown
Alternative 5	0%	0%	0%
Northern California Coastal			
No action alternative	1%	-1%	1%
Proposed action	1%	0%	0%
Alternative 3	1%	0%	0%
Alternative 4	1%	0%	Unknown
Alternative 5	1%	0%	0%

Source: Forest model

[a] Negative numbers indicate a decrease in basal area. Positive numbers indicate that the subwatershed with the lowest change in the basin still experienced an increase in basal area between the timesteps.

Table 13. Differences[a] in Modeled Percent Change of Basal Area between the Proposed Action and No Action Alternative within the Same Subwatershed

	Klamath	Lower Columbia	Northern California Coastal	Northern Oregon Coastal	Southern Oregon Coastal	Willamette
Average Difference						
2023 and 2048	0%	0%	0%	-2%	0%	-1%
2048 and 2073	0%	-2%	1%	0%	0%	1%
2073 and 2093	0%	3%	-1%	-1%	0%	0%
Maximum Difference No Action Alternative decreases more than Proposed Action						
2023 and 2048	0%	6%	0%	14%	2%	4%
2048 and 2073	0%	4%	1%	16%	4%	21%
2073 and 2093	0%	14%	-1%	12%	2%	11%
Minimum Difference No Action Alternative increases more than Proposed Action						
2023 and 2048	0%	-7%	0%	-26%	0%	-15%
2048 and 2073	0%	-15%	1%	-24%	-2%	-4%
2073 and 2093	0%	-2%	-1%	-13%	-2%	-4%

Source: Forest model

[a] Differences between the no action alternative and Alternative 4 would be the same as those presented in the table for the first two time periods.

Surface Water

The following sections provide details of effect mechanisms and the magnitude and duration estimates.

Water Supply

This section provides additional details on estimates made in the EIS section. In rain-dominated drainages, increases in water yield have ranged from 2 to 6 millimeters per percentage of basin harvested (Moore and Wondzell 2005; Brown et al. 2005). In snow-dominated drainages, increases in water yield have been measured at 0.25 to 3 millimeters per percentage of basin harvested (Moore and Wondzell 2005). Increases in annual water yield can diminish rapidly in the first 3 to 10 years after forest cover regrows (Moore and Wondzell 2005), but smaller effects can persist from 10 to 30 years in rain-dominated drainages and potentially up to 80 years in snow-dominated areas (Moore and Wondzell 2005). Estimates made in the EIS were made based on a 6-millimeter increase per percentage change in basal area.

The magnitude of change in water yield and the duration of the change depends on the aspect of the catchment (Brown et al. 2005; Goeking and Tarboton 2020), degree of soil compaction (Brown et al. 2005), characteristics of post-disturbance vegetation regrowth (Brown et al. 2005; Goeking and Tarboton 2020), and amount of water coming from fog drip (Moore and Wondzell 2005). Catchments with northern aspects had nearly three times the water yield increase as those with southern aspects (Brown et al. 2005). As the stand regenerates, transpiration may exceed preharvest levels for a period, thereby causing a decrease in water yield relative to the preharvest condition, especially if the recovering vegetation has high leaf area and high transpiration rates (Brown et al. 2005; Goeking and Tarboton 2020). Where fog drip is a significant water input, water yield can actually decrease in the first years after timber harvest, until the canopy regenerates (Moore and Wondzell 2005). As long as the stand does not undergo a permanent change in vegetation community or significant soil compaction, water yield is expected to return to its pre-harvest condition over time (Brown et al. 2005).

Soil Moisture

Historically in the United States, increasing water yield has been an objective of forest management. In the face of climate change, many forest managers are attempting to manage forests to increase recovery and resilience to disturbances such as drought, wildfire, and insect- and disease-related die-off. To achieve resilience goals, the objective is to improve soil moisture during the growing season by maximizing snow retention (Goeking and Tarboton 2020). Wet areas, such as western Oregon, typically see increases in soil moisture in years following harvest (Goeking and Tarboton 2020). In areas where average winter temperatures are greater than freezing (Coast Range and lower elevation sites), moderate thinning may optimize snow retention by providing solar shading while also minimizing longwave radiation (Goeking and Tarboton 2020). Areas where average winter temperatures are less than freezing, especially on south-facing slopes, where radiation is higher, are more susceptible to decreases in snow-pack and retention, and therefore decreases in soil moisture, as a result of forest density reduction.

Peak Flows

This section provides additional detail on the thresholds for timber harvest effects on peak flows. Peak flows typically increase as a result of timber harvest and tend to occur earlier in disturbed areas than in nondisturbed areas, although there is some variability in peak flow response depending on severity and extent of disturbance, solar radiation, and post-disturbance vegetation recovery, which control snow accumulation and retention (Goeking and Tarboton 2020). In a set of coastal watersheds in the Pacific Northwest, peak flows increased by 13 to 40 percent following timber harvest. In snow-dominated basins, peak flows increased, but the response was more variable, ranging from 20 to 90 percent for catchments that were 20 to 40 percent harvested. Results of the snow-dominated watershed studies did not show as clear a relationship between change in basal area or percentage of basin cut and peak flows as rain-dominated watersheds (Moore and Wondzell 2005). Effects on peak flows in the Cascades have been shown to persist for at least 10 years and in some cases over 30 years (Moore and Wondzell 2005). In most studies of coastal watersheds, the magnitude of changes to peak flow decreases with event magnitude (Moore and Wondzell 2005). This means that the larger the peak flow, the smaller the effect in coastal watersheds. In rain-dominated and transition regions, these effects are only detectable up to the 6-year storm (Grant et al. 2008) and are therefore not a concern for flood flows (Grant 2008 et al.; Moore and Wondzell 2005). At higher elevation, snow-dominated watersheds, these effects have been more variable; in some cases, increasing with event magnitude and basin size[1] (Moore and Wondzell 2005; Goeking and Tarboton 2020; Jones and Perkins 2010). As snow-dominated and transition areas shift to rain dominated systems, under climate change, the magnitude of peak flow increases will be reduced (Goeking and Tarboton 2020).

Figures 5 through 7 depict the relationship between watershed conditions, management considerations, and percentage area harvested on peak flow. Figure 5 depicts the relationship between factors other than forest cover removal and peak flows. Based on these relationships, the Southern Oregon Coastal basin may be more susceptible to increases in peak flows due to steep slopes and shallow depth to bedrock and in the Klamath basin due to road and stream density and steep slopes (Grant et al. 2008). The Northern Coastal basin would also be more susceptible to increases in peak flow due to shallower depth to bedrock and a higher-density road and stream network (Grant et al. 2008). The study area, in the coastal basins, would also be more susceptible to the effects of road system management on peak flows due to peak flow sensitivity to soil compaction in that region (Cooper 2005).

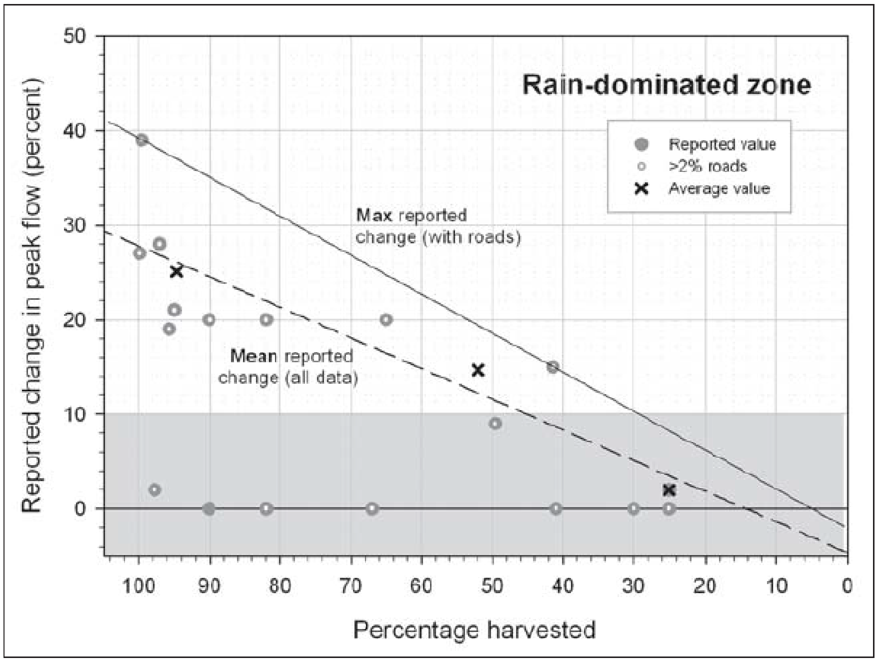
Figure 5. Conditions Effecting Peak Flow Increase

Likelihood of peak flow increase: High ←		→ Low	Potential considerations (High ↕ Low)
High	Moderate	Low	**Road density**
All or most	Some	Few or none	**Road connectivity**
Fast	Moderate	Slow	**Drainage efficiency**
Large	Small	Thinned	**Patch size**
Absent	Narrow	Wide	**Riparian buffers**

Source: Grant et al. 2008
Note: Considerations are listed from high to low likelihood of effect.

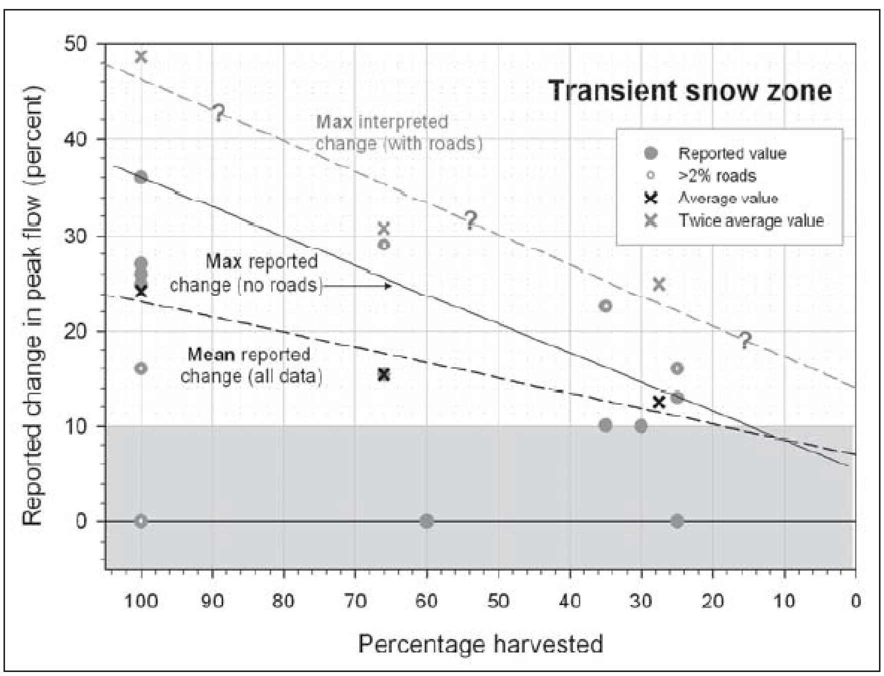
[1] Likely due to synchronization of snowmelt by elevation.

Figure 6. Peak Flow Response to Harvest in Rain-Dominated Areas



Source: Grant et al. 2008
Note: Gray shading indicates limit of detection.

Figure 7. Peak Flow Response to Harvest in Transient Snow Dominated Areas



Source: Grant et al. 2008
Note: Gray shaded area indicates limit of detection.

Low Flows

Dry season low flows typically increase as a result of harvest (Goeking and Tarboton 2020; Moore and Wondzell 2005). Perry and Jones (2017) found that summer flows in basins with Douglas fir ages 25 to 45 years were 50 percent lower than basins of 150- to 500-year-old mixed conifer forests. Summer baseflows are more sensitive to increasing transpiration than winter flows in western Oregon because evapotranspiration is highest in summer, and precipitation is at its lowest (Brown et al. 2005). Because almost all precipitation occurs during the winter, decreases in summer low flows may be a concern for fish habitat, stream temperature, and surface water users who do not have sufficient capacity to store winter flows (Perry and Jones 2017).

Water Quality

The riparian buffer width needed to maintain shading takes place within about 150 to 200 feet for old-growth conifers in the Pacific Northwest (Moore et al. 2005). Groom et al. (2011a) reported that 68 to 75 percent of post-harvest shade in western Oregon streams were accounted for by increased basal area, tree height, and downed large wood within 100 feet of the stream (Groom et al. 2011b). Yonce et al. (2021) found that effects on stream shade approached zero after 177 feet. Although riparian buffers protect water temperature warming from timber harvest, they are unlikely to fully compensate for the additional effects of climate change on water temperature (Yonce et al. 2021).

Further protecting and restoring diverse tree age class, large wood recruitment, stream enhancement, and restricting soil disturbance in aquatic and riparian areas may mitigate the effects of climate change on surface water temperature (Yonce et al. 2021; Groom et al. 2011b). Large wood mitigates the effect of timber harvest on water temperature by increasing shade and improving hyporheic exchange with groundwater. Large wood also creates pools which tend to stay cooler, provides additional shading to streams, and aids conifer establishment in the riparian area (Naiman et al. 2002).

Environmental Consequences

The following sections provide additional information on effects on water resources.

Surface Water

Water Supply

Differences in average and maximum change in basal area over time, averaged across all the study area subwatersheds in the basin, do not reflect the difference in the location of harvest between subwatersheds across basins. Potential differences in effects on water yield in each subwatershed were evaluated based on the difference in basal area percent change across subwatersheds. Table 13 summarizes the average, maximum, and minimum differences in percent change in basal area between the no action alternative and proposed action by subwatershed.

The average differences in percent change between alternatives at the subwatershed scale are small over time—less than 5 percent in all cases and 0 percent in 10 cases. The minimums and maximums demonstrate the degree of the greatest differences between alternatives at the individual subwatershed level. If there are water supply sources in these subwatersheds, they may experience greater periodic gains or losses depending on which alternative is selected. Based on the literature discussed above, a 1 percent difference in basal area is roughly equivalent to a 0.25- to 6-millimeter change in water yield per year, depending on whether the loss in cover is due to thinning or clearcut harvest and whether the subwatershed is rain or snow dominated. This equates to roughly 0.001 to 0.02 acre-feet per acre of contributing effected catchment per year, which changes over time as vegetation reestablishes or harvest activities continue. In the rain-dominated Northern Coastal basin, after the first 25 years, for example, the subwatershed experiencing the greatest decrease in basal area under the proposed action relative to the no action alternative would show a greater water yield by roughly 170,000 gallons per acre or 200 acre-feet, given the entire subwatershed area. To put this difference in perspective, an average household may use between 0.5 and 1 acre-foot of water per year (Water Education Foundation 2021). The significance of this effect depends on the water supply capacity in the region.

Minor Forest Product Harvest

Minor forest product harvest tends to increase after fire and timber harvest (Pilz et al. 2007). Heavy harvest years can cause concerns, especially over local channel condition and water quality. A system of permitting, camping policies, and outreach efforts have been successful at addressing environmental impact concerns on National Forests (Pilz et al. 2007:82). Permitting informs land managers of potential environmental impacts from high harvest activity.

Fire Management

Controlled burning increases stream flows by reducing understory vegetation and slash material. The duration of the effect depends on the age of the vegetation burned. Typically, prescribed fire is used for younger understory plants, because burning medium-sized trees poses the risk of starting a crown fire, which is difficult to control (Allen et al. 2019). Therefore the effect may last on the order of 10 years. More importantly, controlled burns reduce the likelihood of severe fire, which can replace decades old stands and cause soil to repel water. This can significantly increase peak flows and sediment delivery to streams and consequently cause changes to channel structure, which can negatively affect habitat, water quality, groundwater recharge, and water supply systems. Controlled burns also reduce the need to use equipment, which avoids soil compaction and mitigates the effect of runoff. Prescribed burns in riparian areas can temporarily increase stream temperature and nutrient concentrations, elevating biological oxygen demand and reducing dissolved oxygen (Ice et al. 2004). Streams already impaired by temperature and dissolved oxygen would be most vulnerable to this effect. The majority of impaired streams in western Oregon are impaired by temperature or dissolved oxygen, and they are widespread. Insofar as prescribed burn can mitigate the potential for severe wildfire, there could be a long-term benefit to prescribed burn in the riparian area.

Groundwater

Fire Management

Prescribed fire can temporarily increase shallow water tables by removing vegetation and thereby decrease transpiration while maintaining surface roughness and infiltration rates. In its ability to mitigate reasonably foreseeable catastrophic fire (Fernandes 2015), prescribed fire can prevent decreases in soil storage capacity caused by severely burned soils, which repel water (Seibert et al. 2010).

References

Allen, I., S. Chhin, and J. Zhang. 2019. Fire and forest management in montane forests of the Northwestern States and California, USA. *Fire* 2(17).

Brown, A., L. Zhang, T. McMahon, A. Western, and R. Vertessy. 2005. A review of paired catchment studies for determining changes in water yield resulting from alternations in vegetation. *Journal of Hydrology* 310:28–61.

Cooper, R.M. 2005. Estimation of peak discharges for rural, unregulated streams in Western Oregon: U.S. Geological Survey Scientific Investigations Report 20025-5116, 134 p. Available: https://pubs.usgs.gov/sir/2005/5116/pdf/sir2005-5116.pdf. Accessed: July 2021.

Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner. 2017. Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

Fernandes, Paolo M. 2015. Empirical support for the use of prescribed burning as a fuel treatment. Fire Science and Management Topical Collection. Current Forestry Reports 1:118-127. Available: https://link.springer.com/content/pdf/10.1007/s40725-015-0010-z.pdf Accessed: November 2021.

Goeking, S., and D. Tarboton. 2020. Forests and water yield: A synthesis of disturbance effects on streamflow and snowpack in Western coniferous forests. *Journal of Forestry* 118(2):172–192.

Grant, G.E., S. Lewis, F. Swanson, J. Cissel, and J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: A state-of-science report for Western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Available: https://www.fs.fed.us/pnw/pubs/pnw_gtr760.pdf. Accessed: August 2021.

Groom, J., L. Dent, and L. Madsen. 2011a. Stream temperature change detection for state and private forests in the Oregon Coast Range. *Water Resources Research*. Vol 47. Available: http://sites.science.oregonstate.edu/~madsenl/files/GroomDentMadsen2011.pdf. Accessed: August 2021.

Groom, J., L. Dent, L. Madsen, and J. Fleuret. 2011b. Response of western Oregon (USA) stream temperatures to contemporary forest management. *Forest Ecology and Management* 262:1618–1629.

Ice, G.G., D.G. Neary, and P.W. Adams. 2004. Effects of wildfire on soils and watershed processes. *Journal of Forestry* 102(6):16–20.

Jones, J.A., and R.M. Perkins. 2010. Extreme flood sensitivity to snow and forest harvest, western Cascades, Oregon, United States. Water Resources Research. Vol 46, W12512. Available: https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub3089.pdf. Accessed: September 2021.

Moore, D.R., and S.M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: a review. *Journal of the American Water Resources Association* 41(4):763–784.

Moore, R.D., D.L Spittlehouse, A. Story. 2005. Riparian microclimate and stream temperature response to forest harvesting: A review. *Journal of the American Water Resources Association* 41(4):813–834.

Naiman, R.J., E.V. Balian, K.K. Bartz, R.E. Bilby, and J.J. Latterell. 2002. Dead Wood Dynamics in Stream Ecosystems. USDA Forest Service General Technical Report PSW-GTR-181.

NRCS (Natural Resources Conservation Service). 1986. Urban Hydrology for Small Watersheds. 210-VI-Technical Release-55, Second Ed.

NRCS (Natural Resources Conservation Service). 2019. Gridded Soil Survey Geographic by State. Available: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628. Accessed: July 15, 2021.

ODEQ (Oregon Department of Environmental Quality). 2004. Southern Willamette Valley Groundwater Summary Report. Available: https://www.oregon.gov/deq/FilterDocs/gw-swvgwma-summaryrpt.pdf. Accessed: August 2021.

ODEQ (Oregon Department of Environmental Quality). 2013. Statewide Groundwater Quality Monitoring Program; 2011 Rogue Basin Groundwater Investigation. Available: https://www.oregon.gov/deq/FilterDocs/gw-2013RogueReport.pdf. Accessed: August 2021.

ODEQ (Oregon Department of Environmental Quality). 2016. Statewide Groundwater Monitoring Program: Mid-Rogue Basin 2015. Available: https://www.oregon.gov/deq/FilterDocs/gw-DEQ16-LAB-0042-TR.pdf. Accessed: August 2021.

ODEQ (Oregon Department of Environmental Quality). 2018. Statewide Groundwater Monitoring Program: North Coast 2015-2016 Report. Available: https://www.oregon.gov/deq/FilterDocs/grw-northcoast2015-16.pdf Accessed: September 2021.

ODEQ (Oregon Department of Environmental Quality). 2019. Surface water drinking water source areas in Oregon. Available: https://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx.

ODEQ (Oregon Department of Environmental Quality) and Oregon Health Authority. 2017. Oregon Public Water Systems Groundwater Resource Guide for Drinking Water Source Protection. Version 1.0. Available: https://www.oregon.gov/deq/FilterDocs/gwresguide.pdf. Accessed: August 2021.

ODF (Oregon Department of Forestry). 2021. Operational road network data. Salem, OR.

OWRD (Oregon Water Resources Department). 2017. Oregon's 2017 Integrated Water Resources Strategy. Available: https://www.oregon.gov/owrd/programs/Planning/IWRS/Pages/Project-Documents.aspx. Accessed: September 2021.

Perry, T.D. and J.A. Jones. 2017. Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology. 10(2):1-13. Available: https://onlinelibrary.wiley.com/doi/10.1002/eco.1790 Accessed: October 2021.

Pilz, D., R. McLain, S. Alexander, L. Villarreal-Ruiz, S. Berch, T.L. Wurtz, C.G. Parks, E. McFarlane, B. Baker, R. Molina, and J.E. Smith. 2007. *Ecology and Management of Morels Harvested from the*

Forests of Western North America. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. General Technical Report PNW-GTR-710.

Seibert, J., Je McDonnel, and R. Woodsmith. 2010. Effects of wildfire on catchment runoff response: a modelling approach to detect changes in snow-dominated forested catchments. *Hydrology Research* 41(5):378–390.

USGS (U.S. Geological Survey). 1994. Ground Water Atlas of the United States Segment 7: Hydrologic Investigations Atlas 730-H, 33 p.

USGS (U.S. Geological Survey). 2000. Principal Aquifers of the 48 Conterminous United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands, Version 1.0. Available: https://water.usgs.gov/GIS/metadata/usgswrd/XML/aquifers_us.xml#stdorder. Accessed: July 2021.

USGS (U.S. Geological Survey). 2020. National hydrography dataset.

Vose, R.S., D.R. Easterling, K.E. Kunkel, A.N. LeGrande, and M.F. Wehner. 2017. Temperature changes in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 185-206. doi: 10.7930/J0N29V45.

Water Education Foundation, 2021. What's an acre foot. Available: https://www.watereducation.org/general-information/whats-acre-foot. Accessed: August 2021.

Yonce, H.N., S. Saumya, J.B. Butcher, T.E. Johnson, S.H. Julius, and S.D. LeDuc. 2021. Forest riparian buffers reduce timber harvesting effects on stream temperature, but additional climate adaptation strategies are likely needed under future conditions. *Journal of Water and Climate Change* 12(5):1404–1419.

Forest Structure

The forest structure discussion is based on Carey's 2007 document, *Aiming for Healthy Forests: Active, Intentional Management for Multiple Values* (Carey 2007).

Seral Stages

This section describes general forest structure by seral forest stage and old-growth forests.

Early-Seral Stage

Early-seral forest stands are young forests where the overstory has been removed through either harvest or natural disturbance. Early-seral stands have varying biodiversity and structural complexity and generally fall into ecosystem reorganization and competitive exclusion (Carey 2007). Ecosystem reorganization occurs following natural disturbance or harvest and, in managed forests, consists of a period of revegetation. Stands in this phase may consist mostly of a few dominant species (e.g., if the stand is managed for harvest) or have a more diverse blend of species (e.g., if a stand is being managed to promote habitat characteristics). Simple early-seral forests have little legacy structure, low tree species diversity, little shrub or herbaceous vegetation, and little downed wood. Complex early-seral forests have greater retention of remnant overstory trees and snags, a regenerating tree cohort with multiple native species at low to moderate density, and moderate to abundant shrub and herbaceous vegetation.

The competitive exclusion phase occurs after ecosystem reorganization and consists of competition between vegetation species for light, water, and nutrients. Stands in this phase have more canopy closure and may lack understory species and shorter trees. Dominant and codominant trees may self-thin, with surviving trees being able to maintain relatively healthy crown ratios.[1] Where self-thinning does not occur, overstory trees may become tall and spindly, with poor crown and height-to-diameter ratios. Complex structure in the competitive exclusion phase is limited due to resource competition. Over time, openings around legacy structures or brushy patches help maintain understory shrubs and herbaceous vegetation. Young tree species with different growth rates and shade tolerance allow for canopy diversification, and legacy structures (large trees, snags, and downed wood) contribute to structural complexity.

Mid-Seral Stage

Mid-seral forest stands are generally 30 to 80 years old, but can be as old as 120 years, depending on disturbance history and stand density. They vary in structural diversity and their development is influenced by small-scale natural disturbance events. Stages in mid-seral stand development include biomass accumulation, understory reinitiation, and understory development.

[1] The crown ratio is the percent of total tree height that supports live foliage.

The biomass accumulation phase includes the development of woody biomass within relatively young mid-seral stands. Simple mid-seral stands in the biomass accumulation phase have canopy closure and limited understory vegetation. Complex mid-seral stands have reduced diversity compared to the competitive exclusion stage, but generally maintain dominant tree species diversity, and legacy structures provide openings for understory vegetation (Carey 2007).

In the understory initiation and development phases, a mid-seral stand begins to develop understory plant cover. Simple stands in this phase contain an overstory of uniformly spaced codominant trees with little species diversity. Complex stands in understory reinitiation contain overstory canopy heterogeneity, legacy components that contribute to patchiness, species competition in the midstory, and little vertical layering. Simple stands in understory development have more gaps in the canopy and more understory species than simple stands in understory reinitiation. Complex stands in understory developments can have varying degrees of canopy closure and a varied understory. These stands have begun to have vertical canopy layering and structure that supports nesting and roosting.

Late-Seral Stage

Late-seral forest stands in the study area usually begin to move into a late seral condition and are between 80 and 120 years old. Many habitat components for covered species may be present, but components are as abundant or functional as in old growth stands (i.e., ≥175 years old). Structural characteristics vary among late seral stands depending on previous management and natural disturbance. Large trees are present, down woody has begun to accumulate, and a diverse, vertically layered understory is present. As late-seral stands develop, natural and management-related disturbance create new openings for understory and tree seeding and move large wood from upslope to riparian areas.

Old-Growth Forests

Old-growth forest stands are usually more than 175 years old. Typical characteristics of old growth include moderate to high canopy closure; a patchy, multilayered, multispecies canopy with trees of several age classes, dominated by large overstory trees with a high incidence of large living trees, some with broken tops and other indications of old and decaying wood; numerous large snags; and heavy accumulations of down wood (ODF 2010a, 2010b).

Dominant Forest Structure by Alternative

Table 1 presents changes in extent of dominant forest structures under the no action alternative during the analysis period. Table 2 presents changes in extent of dominant forest structures under the proposed action compared to the no action alternative over the permit term. Changes under Alternatives 3 and 5 would vary slightly (up to 1 percent) from the proposed action.

Table 1. Overall Modeled Changes in Extent of Dominant Forest Structure Under the No Action Alternative during the Analysis Period

Structural Class	Dominant Type	Extent of Dominant Type (as Percent Acreage of Permit Area) 2023	2048	2073	2093
Early-seral	Douglas-fir	12	2	2	1
	Mixed conifer	3	9	8	8
	Western hemlock	1	7	7	7
Mid-seral	Douglas-fir	24	17	6	5
	Mixed conifer	20	8	6	6
	Western hemlock	5	2	7	7
	Hardwood	13	1	--	--
	Other tree species	1	--	2	3
Late-seral	Douglas-fir	6	14	17	19
	Mixed conifer	8	17	20	18
	Western hemlock	3	6	8	8
	Hardwood	2	11	11	10
	Other tree species	--	1	1	1
Old growth	Douglas-fir	<0.1 all types	<0.5 of all types	1	1
	Mixed conifer			1	2
	Western hemlock			--	1

Source: Forest model

Table 2. Modeled Changes in Extent of Dominant Forest Structure during the Permit Term under the Proposed Action Compared to No Action

		Extent of Dominant Type (Percent Acreage of Permit Area)							
Structural class	**Dominant Type**	**2023**	**Difference between No Action and Proposed Action**	**2048**	**Difference between No Action and Proposed Action**	**2073**	**Difference between No Action and Proposed Action**	**2093**	**Difference between No Action and Proposed Action**
Early-seral	Douglas-fir	12	0	4	2	2	0	1	0
	Mixed conifer	3	0	10	1	7	1	6	-2
	Western hemlock	1	0	11	4	8	1	10	3
Mid-seral	Douglas-fir	23	-1	19	2	12	6	9	4
	Mixed conifer	20	0	7	-1	7	1	7	1
	Western hemlock	5	0	2	0	11	4	9	2
	Hardwood	12	1	1	0	--	0	--	0
	Other tree species	0	-1	--		3	1	4	1
Late-seral	Douglas-fir	6	0	13	-1	12	-5	16	-3
	Mixed conifer	8	0	16	-1	15	-5	14	-4
	Western hemlock	3	0	5	-1	6	-2	6	-2
	Hardwood	2	0	11	0	10	-1	9	-1
	Other tree species	--		1	0	1	0	1	0
Old growth	Douglas-fir	<0.1 all types	0	<0.5 of all types	0	1	0	1	0
	Mixed conifer					2	1	2	0
	Western hemlock					1	1	1	0

Source: Forest model

Special-Status Plant Species Tables

Table 3 lists the names and federal and state status of these plants. Table 4 lists these species' habitat, range, and likelihood of occurrence in the study area.

Table 3. Known Occurrences of Threatened, Endangered, and Species of Concern Plants in Counties in the Study Area

Common Name	Scientific Name	Federal Status[a]	State Status[a]
Pink sandverbena	*Abronia umbellata var. breviflora*	SOC	LE
Red Mountain rockcress	*Arabis macdonaldiana*	LE	LE
Cox's mariposa-lily	*Calochortus coxii*	SOC	LE
Golden paintbrush	*Castilleja levisecta*	LT[b]	LE
White rock larkspur	*Delphinium leucophaeum*	SOC	LE
Peacock larkspur	*Delphinium pavonaceum*	SOC	LE
Willamette Valley daisy	*Erigeron decumbens*	LE	LE
Coast Range fawn-lily	*Erythronium elegans*	SOC	LT
Gentner's fritillaria	*Fritillaria gentneri*	LE	LE
Howellia	*Howellia aquatilis*	DL	LT
Western lily	*Lilium occidentale*	LE	LE
Big-flowered wooly meadow-foam	*Limnanthes pumila ssp. grandiflora*	LE	LE
Dwarf wooly meadow-foam	*Limnanthes pumila ssp. pumila*	SOC	LT
Bradshaw's lomatium	*Lomatium bradshawii*	DL	LE
Agate Desert lomatium	*Lomatium cookii*	LE	LE
Kincaid's lupine	*Lupinus oreganus*	LT	LT
Wolf's evening-primrose	*Oenothera wolfii*	SOC	LT
Silvery phacelia	*Phacelia argentea*	UR[c]	LT
Rough popcorn flower	*Plagiobothrys hirtus*	LE	LE
White-topped aster	*Sericocarpus rigidus*	SOC	LT
Nelson's sidalcea	*Sidalcea nelsoniana*	LT	LT
Cascade Head catchfly	*Silene douglasii var. oraria*	SOC	LT

Source: Oregon Biodiversity Information Center 2019
[a] DL = Delisted; LE = Listed as Endangered; LT = Listed as Threatened; SOC = Species of Concern; UR = Under Review
[b] Proposed for delisting (86 *Federal Register* 34695).
[c] Listing determination under the Endangered Species Act in review (RIN: 1018-BF89).

Table 4. Elevation, Habitat, and Geographic Range of Listed Threatened, Endangered, and Species of Concern Plants Known to Occur or Potentially Occur in Counties in the Study Area

Common Name	Scientific Name	Elevation Range	Habitat	Geographic Range	Occurrence Relative to Plan Area
Pink sandverbena	*Abronia umbellata* var. *breviflora*	Less than 328 feet	Occurs along broad beaches or mouths of creeks and rivers along the northern range and fine sand beaches, between high-tide and driftwood wrack lines, within moving sand, along the southern portion.	Vancouver Island to northern California.	Documented in Tillamook, Clatsop, Lane, Lincoln, Douglas, Coos, and Curry Counties. Not likely to occur in the study area due to habitat substrate.
Red Mountain rockcress	*Arabis macdonaldiana*	Below 4,920 feet	Occurs in dry, open woods or brushy slopes on serpentine soils.	Southwest Oregon and adjacent land in northern California.	Documented in Curry and Josephine Counties. Not likely to occur in the study area due to limited serpentine substrate, 46 acres, and small portion of the study area occurring within these counties (1.2%).
Cox's mariposa-lily	*Calochortus coxii*	840 to 2,780 feet	Occurs in grasslands, open woodlands, or forest margins with serpentine soil on gentle to moderate slopes.	Endemic to southwestern Oregon; restricted to a 30-mile serpentine ridge system.	Documented in Douglas County; which is 1.6% of the study area. Unlikely to occur due to the limited serpentine substrate and documented population area.
Golden paintbrush	*Castilleja levisecta*	10–300 feet	Occurs on sandy, well-drained glacial soils in grasslands such as mounded prairies and steep bluffs.	Current range believed to be within the Puget Trough between Washington and Vancouver Island.	Reintroduced to Lane and Benton Counties. Historically documented in Linn and Marion Counties but believed to be extirpated in Oregon. Does not occur in the study area.
White rock larkspur	*Delphinium leucophaeum*	125–500 feet	Occurs in loose, shallow soils that are high in organic matter and sand within basalt cliffs, dry roadside ditches, or edges of oak woodlands.	Northern Willamette Oregon.	Documented in Washington, Marion, Clackamas, and Yamhill Counties. Unlikely since habitat type limited in forestland and comprises less than 1% of the study area.

Common Name	Scientific Name	Elevation Range	Habitat	Geographic Range	Occurrence Relative to Plan Area
Peacock larkspur	*Delphinium pavonaceum*	150–400 feet	Occurs in low, silty soils along with Willamette River floodplain, wet prairies, and edges of ash and oak woodlands. Can also occur along fences and roadsides.	Middle of Willamette Valley.	Documented in Lane, Marion, Benton, Polk, and Clackamas Counties but primarily occurs in Benton and Polk Counties, which make up 3% of the study area. Forest management activities unlikely to occur where habitat type is present.
Willamette Valley daisy	*Erigeron decumbens*	240–950 feet	Occurs in seasonally flooded and well-drained prairies.	Northwestern Willamette Valley.	Documented in Washington, Lane, Linn, Marion, Polk, Benton, Clackamas, and Yamhill Counties. Forest management activities unlikely to occur where habitat type is present.
Coast Range fawn-lily	*Erythronium elegans*	Above 2,600 feet	Occurs in a variety of habitats including meadows, brushland, coniferous forest, and edge of sphagnum bogs.	Northern Coast Range in Oregon.	Documented in Tillamook, Lincoln, Polk, and Yamhill Counties. Isolated populations may occur within the study area with forest management activities listed as a threat to the species.
Gentner's fritillaria	*Fritillaria gentneri*	1,004–5,066 feet	Occurs in a range of habitats and soils but prefers the area of transition between meadow and oak woodland.	Josephine County and south to northern California.	Documented in Josephine and Jackson Counties with the largest population near Jacksonville, Oregon. Unlikely given only 1.3% of the study area occurs within these counties.
Howellia	*Howellia aquatilis*	10–4,501 feet	Occurs in small, vernal, freshwater, ephemeral wetlands and ponds, oxbow sloughs, and marsh edges.	Throughout the Pacific Northwest.	Previously documented in Clackamas, Marion, and Benton Counties. Last documented in 2002 in William Finley National Wildlife Refuge. Based on habitat type and historic documentation, species is unlikely to occur in the study area.

Common Name	Scientific Name	Elevation Range	Habitat	Geographic Range	Occurrence Relative to Plan Area
Western lily	*Lilium occidentale*	Just above sea level to 400 feet	Occurs in freshwater fens, bog edges, coastal prairies, and scrubs. Rarely occurs in spruce forests but do not thrive.	Pacific coastline from Coos County south to Humboldt County.	Documented in Coos and Curry Counties. Forest management activities unlikely to occur where habitat type is present.
Big-flowered wooly meadow-foam	*Limnanthes pumila* ssp. *grandiflora*	~1,969 feet	Occurs in the wet inner boundary of vernal pools.	Agate Desert region, north of Medford.	Documented in Jackson County. Does not occur in the study area.
Dwarf wooly meadow-foam	*Limnanthes pumila* ssp. *pumila*	1,230–1,310 feet	Often occurs in edges of vernal pools, but also on wet trails, roads, or small streams on volcanic soil.	Summits of Upper and Lower Table Rocks.	Documented in Jackson County, north of Medford. Does not occur in the study area.
Bradshaw's lomatium	*Lomatium bradshawii*	164– 984 feet	Occurs in wet prairies in clay soils possibly near creeks or small rivers.	Willamette Valley from Clark County to southwestern Washington.	Documented in Lane, Linn, Marion, and Benton Counties. Forest management activities unlikely to occur where habitat type is present.
Agate Desert lomatium	*Lomatium cookii*	984–1,640 feet	Occurs in ephemeral wet meadows on clay loam soils formed from serpentine outcrops in Josephine County. Occur at the edges of vernal pools in Jackson County.	Illinois River Valley and the Rogue River Valley northeast of Medford.	Documented in Josephine and Jackson Counties. Population closest to the plan area is along the Illinois River Valley. Forest management activities unlikely to occur where habitat type is present.
Kincaid's lupine	*Lupinus oreganus*	Below 2,750 feet	Occurs in upland prairies and transitional areas between grassland and forest.	Lewis County, Washington south to Douglas County, Oregon.	Documented in Washington, Lane, Linn, Marion, Benton, Polk and Yamhill Counties. May occur within the study area with forest management activities listed as a threat to the species.
Wolf's evening-primrose	*Oenothera wolfii*	-1–2,534 feet	Occurs in well-drained sandy soil along coastal bluffs and strands, as well as some roadsides.	Southern Oregon to the northern California coast.	Documented in Curry County, 0.2% of the study area. Does not occur based on habitat type and coastal location.
Silvery phacelia	*Phacelia argentea*	Below 65 feet	Occurs in coastal areas on sand above the high tide line, sand dunes, and coastal bluffs.	Coast in Coos County, Oregon south to Del Norte, California.	Documented in Coos and Curry Counties. Does not occur based on habitat type.

Common Name	Scientific Name	Elevation Range	Habitat	Geographic Range	Occurrence Relative to Plan Area
Rough popcorn flower	*Plagiobothrys hirtus*	100–900 feet	Occurs in seasonally wet ponds on silt clay soils.	Sutherlin Creek, Calapooya Creek, and Yoncalla Creek Watersheds.	Documented in Douglas County. Does not occur based on habitat type and documented location.
White-topped aster	*Sericocarpus rigidus*	90–1,250 feet	Occurs in grassy, seasonally moist prairies and savannah habitats. Populations occurring in Oregon are found on deep, poorly draining soils.	Southern portion of Vancouver Island south to Willamette Valley.	Documented in Lane, Linn, Marion, and Clackamas Counties. Forest management activities unlikely to occur where habitat type is present.
Nelson's sidalcea	*Sidalcea nelsoniana*	140–2,000 feet	Occurs in open prairies at the edges of streams, sloughs, ditches, drainage swales fences, and roadsides. Also found in fallow fields and sometimes in woody shrubs and edges of ash woodland or coniferous forests.	Willamette Valley and the western side of the Coast Range. Extends from Lewis County, Washington south to Benton County, Oregon.	Documented in Tillamook, Clatsop, Washington, Linn, Marion, Polk, Benton, Clackamas, Columbia, and Yamhill Counties. Forest management activities unlikely to occur where habitat type is present.
Cascade Head catchfly	*Silene douglasii* var. *oraria*	150–1,500 feet	Occurs in ocean-facing steep coastal bluffs, ledges, and slopes on rocky, shallow soils and exposed bedrock.	Oswald West State Park, Cape Lookout State Park, and Cascade Head Preserve.	Documented in Tillamook County. Does not occur in the study area.

Wetlands

This section discusses forest management in wetlands as required under federal and state regulations and as stipulated in the current forest management plans (ODF 2010a, 2010b).

Under Oregon Administrative Rules (OAR) 629-642, Water Protection Rules Vegetation Retention Along Streams, would apply to the riverine wetlands in the study area and is further discussed below with riparian impacts. OAR 629-655, Water Protection Rules: Protection Measures for "Other Wetlands", Seeps, and Springs, would be applicable to all other wetlands in the study area. Under this regulation, forest management activities within wetlands greater than 0.25 acre must protect soil and understory from any disturbance that results in "reduced water quality, hydraulic function, or soil productivity" or accelerates wetland conversion to upland. In addition, habitat features such as snags or downed trees must remain in place unless deemed a fire hazard. Wetlands under 0.25 acre largely follow the same measures as above with less guidance on treatment of snags and downed trees.

In addition to OAR 629-655, the no action alternative would follow management prescriptions described in Appendix J, Table J-3, Management Prescriptions for Lakes, Ponds, and Wetlands, of the current forest management plans. This management plan establishes a 25-foot no harvest zone from the ordinary high water mark or the wetland boundary, whichever is farthest along with a 100-foot riparian management area (RMA) for those wetlands greater than 1 acre. Vegetation within these areas would be managed to achieve mature forest conditions based on site-specific prescription based on wetland classification. Wetlands between 0.25 and 1 acre in size will also have an established 25-foot no harvest zone along with a 50-foot RMA from the ordinary high water mark or wetland boundary. Harvest activities are allowed in these areas but must retain at least 50 percent of existing live trees or 110 square feet of basal area per acre (whichever is greater). Tree retention preference would be for representative tree species with a tree diameter of 20 inches diameter at breast height or greater. Management protection for wetlands less than 0.25 acre would depend on if the wetland was associated with a fish- or non-fish-bearing waterway. Wetlands associated with a fish-bearing stream would require a 50-foot RMA and measures like wetlands at least 0.25 acre in size. Wetlands associated with non-fish-bearing wetlands would receive a 25-foot RMA with hardwood and bushes retained for protection of hydrological function and wildlife habitat. Estuaries, bogs, and wetlands of significant size (greater than 8 acres) are considered "significant wetlands" and would require additional protection and restrictions under OAR 629-645.

References

Carey, A. B. 2007. *Aiming for Healthy Forests: Active, Intentional Management for Multiple Values*. General Technical Report PNW-GTR-721. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

ODF (Oregon Department of Forestry). 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

ODF (Oregon Department of Forestry). 2010b. *Southwest Oregon State Forests Management Plan*. Revised Plan. April. Available: .

Oregon Biodiversity Information Center. 2019. *Rare, Threatened and Endangered Species of Oregon*. Institute for Natural Resources, Portland State University, Portland, OR.

Appendix 3.6-A
Fish and Stream-Dependent Species Technical Supplement

Fish and Stream-Dependent Species Habitat

Forest management prior to the late 1970s rarely recognized the structural importance of large wood in streams and rivers. Historical use of splash dams and log drives in the Oregon Coast range greatly reduced the amount of large wood in streams and rivers. These practices have also had lasting impacts on stream morphology and substrate, including a decrease in the number of deep pools present and an increased amount of exposed bedrock substrate (Miller 2010). Stream cleaning (removing wood from channels) was a common practice based on the mistaken belief that in-stream wood impeded fish passage (House and Boehne 1987). Much of this “stream cleaning” was the removal of wood that fell into the channel during harvest of the stream’s riparian corridor, as historical logging practices harvested timber to the stream edge. Timber harvest within the riparian corridor greatly diminished the recruitment potential of large wood to channels leading to further impairment of conditions for fish and stream dependent species.

For example, considering Oregon Coast coho as an indicator species for evaluating stream conditions and primary limiting factors, the loss of stream complexity has been shown to be a limiting factor, especially complexity of habitat during the winter affecting juvenile coho survival (ODFW 2007). The lack of habitat complexity, often driven by reduced large wood (Jones et al. 2014), has resulted in a reduction in the abundance, size, and stability of pools, which are important habitat for many aquatic species, as well as reduced stable recruitment areas for spawning gravels used by salmon. The reduction of wood has also changed streams’ relationships with off-channel habitat by reducing the distribution and abundance of side channels, backwaters, and other off-channel habitats formed by wood. Nutrient cycling is also affected by lowered large wood levels, including lowered retention rates of salmon carcasses. Thus, in summary, stream complexity is most limiting in much of the study area driven primarily by the lack of wood. However, there are other contributing factors, such as change in winter peak flows, summer low flows, water temperatures, fine sediment in substrates, and water quality issues such as nutrients, suspended sediments, and pollutants in a few isolated locations.

Most streams in Coast Range ecoregion (the majority of the study area is in this region) receive the majority of their precipitation as rain during the winter months (with streams at the highest elevations receiving snow). Streams in the Cascades ecoregion (the second-highest ecoregion in the study area) in the study area are mostly located at mid-elevations and are in the rain-snow transition zone, which can experience high peak flows during a rain-on-snow event (ODF 2010a). Most streams in both regions experience relatively dry summers and the lowest streamflows are typically in late summer.

Peak flows can increase in a drainage with loss of forest cover due to soil compaction and decreased water use by trees (Moore and Wondzell 2005). Increasing road density also increases peak flows due to additional impervious surfaces. Where soil depth to bedrock is shallow and bedrock material is nonporous, these peak flow increases are even more severe. The degree to which the road network is hydrologically connected to the stream network depends on where roads are located and the design and condition of their drainage features, and the more hydrologically connected they are the more impact they have on peak flows. The stream and road density and the percent of road covering in the study area is reported in Section 3.4, *Water Resources*. In the future, peak scouring flows in late winter and early spring are expected to increase in many areas due to changed hydrologic patterns from climate change (Maurer et al. 2018), exacerbating these effects.

Summer low flows can be affected by timber harvest. Summer flows may be initially higher in streams flowing from clearcut watersheds because of a reduction in water uptake by plants, but this is short-lived. As the forest regrows, water uptake by growing trees increases and summer low flows may decrease. Downstream effects of timber harvest are more complex and reduced as more subwatersheds with different forest ages contribute to streamflow. Summer low flows are expected to decrease even further in the future due to changed hydrology from climate change, making protection of existing flows even more important.

Fish and stream-dependent species in the study area are adapted to peak flows of their historic patterns, including lower magnitudes and less frequency. Beneficially, floods and high flows provide species access to off-channel features and can assist in lowering levels of invasive species. Salmonids use higher flows during upstream migration and lamprey juveniles are triggered by them for downstream migration. High flows are also an important contributor to habitat forming processes, as well as transportation of wood and sediment. However, excessive peak flows (higher in magnitude and frequency than historically) can force species from preferred habitats; scour streambeds dislodging salmonid eggs, fry, and other species; and cause direct mortality. Lower summer low flows can reduce survival of fish and stream-dependent species by decreasing the habitat area and complexity, increasing exposure of juvenile or adult fish to predators, causing migration difficulties, contributing to higher water temperatures, decreasing dissolved oxygen, and increasing pollutant concentration.

As mentioned above, historical logging practices prior to the Northwest Oregon State Forests Management Plan (ODF 2010a) and Southwest Oregon State Forests Management Plan (ODF 2010b) often logged up to the edge of stream, and in addition to affecting large wood this also removed shade that protected cool stream temperatures. The removal of vegetation in the riparian corridor can increase stream temperatures by decreasing shade, especially in small and medium sized streams. The Oregon Department of Forestry (ODF) has modified riparian buffer rules several times to improve stream shade, with the purpose of protecting cool stream temperatures. The most recent buffer revision was in 2020 (Oregon Administrative Rules [OAR] 629-642-0105, 629-642-0110) to better protect small and medium fish-bearing streams that have salmon, steelhead (*Oncorhynchus mykiss*), or bull trout (*Salvelinus confluentus*) present. The result of revised rules for shade has been a steadily improving amount of shade to streams (Reeves et al. 2016). Aquatic shade is in good condition throughout most of the northwestern portion of the study area (greater than 70 percent shade), with red alder (*Alnus rubra*) providing the majority of the shade and the amount of shade on streams is improving in all regions of the Oregon Coast (ODFW 2019). When groundwater springs and seeps are disconnected from streams, which can also result from removal of riparian vegetation, or from road or other construction, stream temperatures can also be affected. In the future, summer temperatures in streams are expected to increase due to the increased air temperatures predicted by climate change, making protection of existing areas of cool temperatures through riparian connection and maintenance of groundwater springs or seeps even more important.

Stream temperatures can adversely affect the survival of aquatic species, especially the hottest summer temperatures when exceeding sublethal or lethal thresholds. Riparian shade along fish-bearing and non-fish-bearing perennial streams is important for protecting ambient stream temperatures, as is continued connection to groundwater springs or seeps. Temperatures above sublethal and lethal thresholds affect species survival, limit distribution of species in streams, and can create a barrier to migration to complete a species life history.

While sediment input to streams is natural process and contributes material for streambed and bank features, human causes have exacerbated sediment input, especially fine sediment. Timber harvest and associated roads are a source of increased shallow-rapid landslides and sediment entering streams in the study area. Sediment entering streams during rain events from disturbed grounds following timber harvest affects water quality and increases the amount of fine sediment in the streambed. Unpaved forest roads in the study area may contribute additional fine sediment to channels. Landslides, increased in frequency and severity by forest clearcuts and road failures on steep slopes, can input coarse and fine sediments, as well as wood to channels, having both beneficial and adverse effects on species.

Fine sediment within the substrate of stream pool-tailouts, glides, and riffles can reduce the survival of incubating salmonid eggs and alevins by altering oxygen exchange within the substrate and can trap emerging fry causing direct mortality. Fine sediment also affects species diversity and production of additional fish and stream-dependent animals including benthic invertebrates, which are important prey for salmonids and other native creatures.

Passage barriers at stream road crossings can reduce habitat available to fish populations. Table 1 lists three fish passage barriers associated with the plan area and identified as priority by the Oregon Department of Fish and Wildlife (ODFW). Overall, there are 195 full barriers, 110 partial barriers, and 268 barriers of unknown status in the plan area, with 133 passable stream crossings (Table 2). The majority of known complete and partial barriers in the plan area are in the Northern Oregon Coastal basin. The barriers are widely distributed across the subwatersheds in this basin. Over one-third of the mapped structures in the Northern Oregon Coastal basin are unknown status, scattered over 70 subwatersheds within the plan area.

Table 1. ODFW-Identified Priority Fish Passage Barriers in the Plan Area

Stream	HUC 12 Subwatershed	Status
Gnat Creek	Gnat Creek-Frontal Columbia River	Unknown
South Fork Wilson River	South Fork Wilson River	Partial Barrier
Tributary to Deer Creek	Middle Big Elk Creek	Barrier

Table 2. Number of Complete Migration Barriers, Partial Migration Barriers, Stream Crossings with Unknown Status, and Passable Structures in the Permit Area by Basin and Number of Subwatersheds within Each Basin and Permit Area

Basin (HUC 6)	# Complete Barriers	# Partial Barriers	# Unknown Status	# Passable	Total
Klamath (180102)	0	0	0	0	0
Lower Columbia (170800)	18 (6 subwatersheds)	11 stream crossings (11 subwatersheds)	38 (10 subwatersheds)	4 (3 subwatersheds)	71
Northern California Coastal (180101)	0	0	0	0	0
Northern Oregon Coastal (171002)	130 (35 subwatersheds)	87 (38 subwatersheds)	185 (70 subwatersheds)	117 (21 subwatersheds)	519
Southern Oregon Coastal (171003)	7 (5 subwatersheds)	11 (6 subwatersheds)	12 (7 subwatersheds)	2 (2 subwatersheds)	32
Willamette (170900)	40 (12 subwatersheds)	1 (1 subwatershed)	33 (11 subwatersheds)	10 (8 subwatersheds)	84
Total	195	110	268	133	706

Source: Bowers 2020

Fish and Stream-Dependent Species

Species distributions relevant to the study area for covered and noncovered species are briefly described in this section, as well as basic life history, habitat, and threats information. Table 3 lists the geographic extent of species evaluated and data sources used.

Table 3. Data Sources Used for Distribution Data of Evaluated Fish and Stream-Dependent Wildlife

Species Common Name	Ecoregion(s)[a]	HUC 6 Watershed(s)	Data Sources	Additional Data Source Notes
Oregon Coast coho	Coast Range (1); Klamath Mountains/ California High North Coast Range (2); Cascades (3)	171002, 171003	Streamnet, ODF	GIS data
Oregon Coast spring-run Chinook	Coast Range (1)	171002, 171003	Native Fish Society et al. 2019	Description in reference
Lower Columbia River coho	Coast Range (2); Willamette Valley (2); Cascades (2)	170800, 170900	Streamnet, ODF	GIS data
Upper Willamette River spring-run Chinook	Willamette Valley (1); Cascades (1)	170900	Streamnet, ODF	GIS data

Species Common Name	Ecoregion(s)[a]	HUC 6 Watershed(s)	Data Sources	Additional Data Source Notes
Upper Willamette River steelhead	Willamette Valley (1); Coast Range (2); Cascades (2)	170900	Streamnet, ODF	GIS data
Columbia River chum	Coast Range (1); Cascades (3)	170800	Streamnet, ODF	GIS data
Southern Oregon/ Northern California Coastal spring-run Chinook	Coast Range (1)	171003, 180107	California Trout 2019	Description in reference
Southern Oregon/ Northern California Coast coho	Klamath Mountains/ California High North Coast Range (1); Coast Range (3)	171003, 180102	Streamnet, ODF	GIS data
Lower Columbia River Chinook	Willamette Valley (2); Cascades (3)	170800, 170900	Streamnet, ODF	GIS data
Eulachon	Coast Range (1); Willamette Valley (2); Cascades (1)	170800, 171003	Gilroy et al. 2021	Description in reference
Columbia torrent salamander	Coast Range (1)	170800, 171002	Oregon Department of Forestry 2019	GIS data
Cascade torrent salamander	Cascades (1)	170800, 170900	Oregon Department of Forestry 2019	GIS data
Chum (Coastal SMU/Pacific Coast ESU)	Coast Range (1)	171003, 171002	Oregon Department of Fish and Wildlife 2005	Description in reference
Lower Columbia River steelhead	Willamette Valley; Cascades	170800, 170900	Myers et al. 2006	Description in reference
Oregon Coast steelhead	Coast Range (1)	171002	Busby et al. 1996	Description in reference
Bull trout	Cascades (2); Willamette Valley (2)	170800, 170900, 180102	FWS	GIS data
Coastal cutthroat trout	Coast Range (1); Klamath Mountains/ California High North Coast Range (1); Cascades (1)	170800, 170900, 171002, 171003, 180101	ODFW	GIS data
Umpqua chub	Cascades (1); Coast Range (1); Klamath Mountains/ California High North Coast Range (1)	171002, 171003	NatureServe	GIS data

Species Common Name	Ecoregion(s)[a]	HUC 6 Watershed(s)	Data Sources	Additional Data Source Notes
Oregon chub	Cascades (1); Willamette Valley (1); Coast Range (2)	170800, 170900	NatureServe	GIS data
Pacific lamprey	Coast Range (1); Willamette Valley (2); Klamath Mountain/California High North Coast Range (2); Cascades (3)	170800, 170900, 171002, 171003	ODFW	GIS data
Oregon western brook lamprey	Throughout	Throughout	Oregon Native Fish Status Report	Description in reference
Sculpin (coast range, mottled, reticulated, riffle, prickly, Paiute)	Throughout	170800, 170900, 171003, possibly more	ODFW	GIS data
Millicoma dace	Coast Range (1)	171003	Meeuwig and Harrison 2019	Description in reference
Other dace (Columbia River, speckled, longnose, leopard)	Throughout	170800, 170900, 171002, 171003, 180102	ODFW Nature Serve	GIS data
Redside shiner	Willamette Valley (1); Coast Range (1); Klamath Mountains/ California High North Coast Range (1); Cascades (3)	170800, 170900, 171002, 171003	ODFW	GIS data
Largescale sucker	Willamette Valley (1); Cascades (2); Klamath Mountains/ California High North Coast Range (2); Coast Range (3)	170800, 170900, 171002, 171003	ODFW	GIS data
Peamouth	Willamette Valley (1); Coast Range (1); Klamath Mountains/ California High North Coast Range (3)	170800, 170900	ODFW	GIS data
Three-spine stickleback	Willamette Valley (1); Coast Range (1); Klamath Mountains/ California High North Coast Range (2); Cascades (3); Eastern Cascades Slopes and Foothills (3)	170800, 170900, 171002, 171003	ODFW	GIS data

Species Common Name	Ecoregion(s)[a]	HUC 6 Watershed(s)	Data Sources	Additional Data Source Notes
Aquatic insects	Ubiquitous	Ubiquitous		
Spurred bizarre caddisfly	Coast Range (1)	171002, possibly others	Xerces Society 2016	Description in reference
A rhyacophilid caddisfly (*Rhyacophila chandleri*)	Cascades; Willamette Valley; possibly Coast Range	170900, 171002, possibly others	Xerces Society 2012	Description in reference
Haddock's Rhyacophilan Caddisfly (*Rhyacophila haddoki*)	Willamette Valley; Coast Range; Klamath Mountains/ California High North Coast Range	171003, 100900	Brenner 2005	Description in reference
A rhyacophilid caddisfly (*Rhyacophila leechi)*	Willamette Valley, Klamath Mountains/ California High North Coast Range	170900, 171003	Xerces Society 2008	Description in reference
Floater mussels	Coast Range (1); Willamette Valley (1); Klamath Mountains/ California High North Coast Range (2); Eastern Cascades Slopes and Foothills (3); Cascades (3)	170800, 171002, 170900, 171003, 180102	Xerces and CTUIR 2021	GIS data
Western ridged mussel	Willamette Valley (1); Klamath Mountains/ California High North Coast Range (2); Coast Range (3); Cascades (3); Eastern Cascades Slopes and Foothills (3)	170800, 170900, 171003, 180102	Xerces and CTUIR 2021	GIS data
Western pearlshell	Coast Range (1); Willamette Valley (1); Klamath Mountains/ California High North Coast Range (1); Cascades (2); Eastern Cascades Slopes and Foothills (3)	170800, 171002, 170900, 171003, 180102	Xerces and CTUIR 2021	GIS data
Coastal tailed frog	Cascades (1); Klamath Mountains/California High North Coast Range (1); Coast Range (1); Willamette Valley (3)	170800, 170900, 171002, 171003, 180101, 180102	ODFW	GIS data

Species Common Name	Ecoregion(s)[a]	HUC 6 Watershed(s)	Data Sources	Additional Data Source Notes
Cope's giant salamander	Coast Range (1); Cascades (1); Willamette Valley (3)	170800, 170900, 171002	ODFW	GIS data
Southern torrent salamander	Coast Range (1); Klamath Mountains/California North Coast Range (1), Cascades (2); Willamette Valley (3)	170900, 171002, 171003, 180101	ODFW	GIS data
Coastal giant salamander	Throughout	Throughout	Jones et al. 2005	Description in reference
Rough-skinned newt	Throughout	Throughout	Tippery and Jones 2011	Description in reference

[a] Ecoregion: 1 (majority of range), 2 (significant amount of range), 3 (negligible amount of range).
CTUIR = Confederated Tribes of the Umatilla Indian Reservation; GIS = geographic information systems;
ODFW = Oregon Department of Fish and Wildlife

Salmonids in the permit area spend a substantial portion of their life cycle in freshwater, from eggs to rearing juveniles as well as after their time at sea as upstream migrating pre-spawners and spawners and may be adversely affected by forest management activities occurring near or in their range as well as affected by any downstream effects of activities. Salmonids are sensitive to changes in stream temperature, as well as to fine sediment inputs that can smother their redds (nests of eggs), reductions of flow refuge such as large wood, changes in flow and substrate composition, and disconnection from off-channel waterbodies, among other habitat characteristics.

Oregon Coast Coho (Covered)

Oregon Coast coho salmon (*Oncorhynchus kisutch*) are listed as a threatened species under the Endangered Species Act (ESA) (2008) and as a sensitive species under the Oregon State Sensitive Species List (OAR 635-100-0040). Critical habitat was designated for this Evolutionarily Significant Unit (ESU) in 2008 (73 FR 7815), and a recovery plan has been approved for the coho ESU (NMFS 2016a). These salmon are located along the Oregon Coast from the Necanicum River to the Sixes River, as well as the Pacific Ocean. There are five biogeographic strata across the ESU with 56 historical populations, of which 11 are considered to be independent. Of these 11, 10 are included within the study area. Oregon Coast coho habitat could be affected by plan and permit areas throughout the majority of the Coast Range ecoregion, as well as those in the northern and middle portion of the Klamath Mountains/California High North Coast Range.

The life cycle of the of the Oregon Coast coho is typically around 3 years with 18 months spent in freshwater and 18 months spent in the ocean before returning to freshwater to spawn from September to November. Some male coho known as jacks do not follow this timeline and return to spawn once reaching sexual maturity after only 6 months at sea. Most Oregon Coast coho follow a yearling-type life history strategy in which juveniles migrate to the sea between March and June as smolts and utilize estuarine habitats for acclimation. More recent research has shown that there are also a significant number of coho fry that move downstream to wetlands and estuarine habitats from their natal streams and have life history strategies involving presmolt migrations (NMFS 2016b). These juveniles inhabit small rivers in streams and are able to live in large river systems as well. In the plan area, juveniles prefer habitat with low-velocity water (pools), cover, and large woody debris. Juveniles seek out cooler water and are typically absent in streams with weekly temperatures exceeding 18 to 21 degrees Celsius (°C). Major threats to the Oregon Coast coho in the study area include loss of stream complexity and decreases in water quality (HCP Appendix C, *Species Accounts*).

Oregon Coast Spring-Run Chinook (Covered)

Oregon Coast spring-run Chinook (*Oncorhynchus tshawytscha*) inhabit coastal rivers from the south of the Columbia River to the southern portion of Cape Blanco. The nine river systems in which they are found include the Tillamook River and tributaries, the Nestucca River, the Siletz River and tributaries, Alsea River and tributaries, the Siuslaw River, the North Umpqua River and tributaries, the Coos River, and the Coquille River and tributaries, though the Coos River and Siuslaw River populations are thought to be extinct (Native Fish Society et al. 2019). It is unclear exactly how much of the Oregon Coast spring-run Chinook distribution overlaps with the plan or permit area, but the species could be affected by plan and permit activities in the Coast Range ecoregion. The Oregon Coast spring-run Chinook may have only recently diverged from the fall-run Chinook as they are very similar genetically and may still interbreed (Waples et al. 2004). Petitions to federally list the species as threatened or endangered under the ESA were denied in August 2021 due to their similarities to the fall-run Chinook. They do not meet the ESU criteria to be considered separate from the fall-run, and therefore, do not meet the criteria to be an ESA-listed species (89 FR 45970). There is currently no critical habitat designated for the species.

Chinook can be found in freshwater in a multitude of different habitats depending on the stage in the life cycle. Adults find deep areas of cold water to sexually mature from spring until fall when they spawn. Juveniles rear and migrate in freshwater habitats for 3 months to a year before traveling to the ocean (Quinn 2018; Native Fish Society et al. 2019). Habitat degradation due to logging and other forms of human infrastructure (i.e., roads, dams, and barriers) are threats to the Chinook populations, and the genetic distinctness between the spring- and fall-run species is likely reduced due to the mixing of species released by hatcheries.

Lower Columbia River Coho (Covered)

Lower Columbia River coho salmon were listed as threatened under the ESA in 2005 and endangered under the Oregon State Endangered Species Act (Oregon Revised Statutes 496.171–496.192, 498.026). Critical habitat was designated for the Lower Columbia River coho ESU in 2016 (81 FR 9250), and in 2013, a recovery plan was approved (NMFS 2013; 78 FR 41911). The Big White Salmon River, Hood River, Willamette River and its tributaries downstream of Willamette Falls, and Columbia River and its tributaries provide the habitat for these salmon with four independent populations intersecting the study area (Figure 1). Lower Columbia River coho habitat could be affected by plan and permit area activities in the northern portion of the Coast Range (HCP Appendix C).

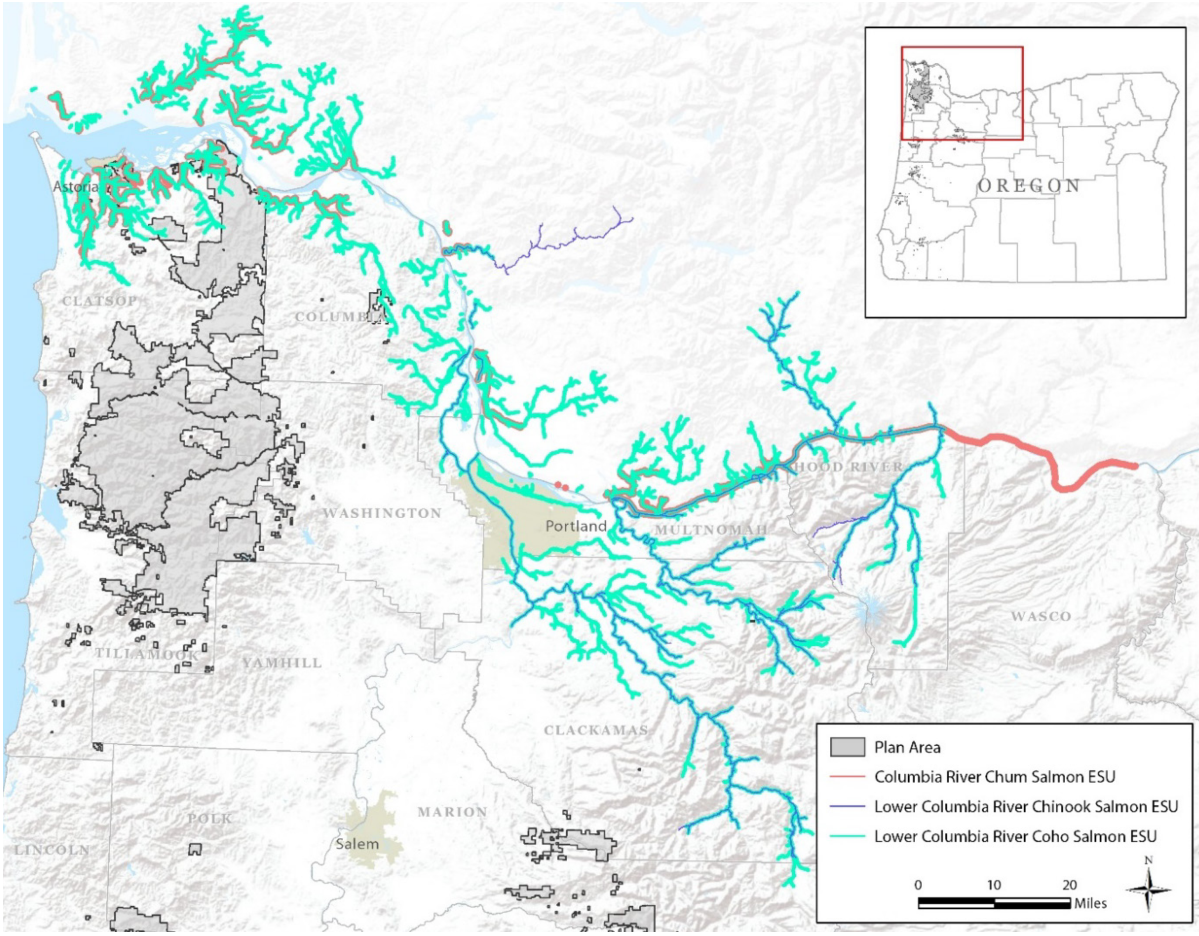
Lower Columbia River coho follow a very similar life history cycle to the Oregon Coast coho. Coho seek out small headwater creeks and tributaries for spawning that other species are seemingly unable to reach. This lowers the level of competition for spawning grounds and provides the ideal conditions for incubation and rearing activities. This habit is also related to the biggest threat to the Lower Columbia River coho, loss and degradation of tributary habitat. Other threats to this species that have been identified include harvest, hatchery production, and hydropower impacts (HCP Appendix C).

Upper Willamette River Spring-Run Chinook (Covered)

Upper Willamette River spring-run Chinook are a part of the Upper Willamette River Chinook ESU that spawn upstream of Willamette Falls in the Willamette River basin and downstream of Willamette Falls in the Clackamas River. Salmon from six different artificial propagation programs are also included in this ESU, and the reintroduction of fish to some areas in the Upper Willamette River basin is still occurring (HCP Appendix C). They are currently listed a threatened species under the ESA and as a sensitive-critical species under the Oregon State Sensitive Species List (OAR 635-100-0040). Critical habitat was designated for the Chinook ESU in 2005 (70 FR 52630) with a recovery plan approved in 2011 (ODFW and NMFS 2011). Upper Willamette River spring-run Chinook habitat could be affected by plan and permit area in the Cascades.

Chinook have two freshwater life history types which are stream-type (yearlings) and ocean-type (subyearlings). The majority of the juvenile fish are stream-type meaning they stay in freshwater for a year or more (12–14 months), and the rest fall into the ocean-type category leaving freshwater within their first year after emergence. Adults return to freshwater after 1.5 to 4 years at sea to find large headwater streams in the Upper Willamette basin to spawn. Cold, oxygen rich water with a temperature below 16°C is necessary for spawning as well as a substrate of gravel and cobble. The area must also be generally silt-free as silt can prevent the necessary amount of oxygen to reach the eggs and results in low rates of success in incubation (Jensen et al. 2009). Threats to the Upper Willamette River Chinook ESU include human impacts, and the reduction of access to and degradation of spawning and rearing habitat, already resulting in the reduction of the population. Major threats include flood control and hydropower management, land management, other species, harvest management, and hatchery management (HCP Appendix C).

Figure 1. Distributions of Lower Columbia Chinook, Coho, and Chum in the Study Area



Upper Willamette River Steelhead (Covered)

Upper Willamette River steelhead is a distinct population segment (DPS) of salmon that is listed as a threatened species under the ESA and listed as a sensitive species under the Oregon State Sensitive Species List (OAR 635-100-0040). Critical habitat was designated for the species in 2005 (70 FR 52630), and a recovery plan was approved in 2011 (ODFW and NMFS 2011). This DPS has four independent populations located in the Molalla River, North Santiam River, South Santiam River, and Calapooia River and includes winter-run steelhead upstream of Willamette falls up to and including the Calapooia River (71 FR 833). The Upper Willamette River steelhead habitat could be affected by plan and permit area activities in the Cascades, as well as the northeast portion of the Coast Range ecoregion.

Headwater tributaries are preferred by adults for spawning, and the juveniles will stay in these waters for anywhere from 1 to 4 years before migrating to the ocean. The remainder of the steelhead's life history varies greatly, and unlike other salmonids they are repeat spawners. The greatest threats to the steelhead population are a result of human impact with splash dams, poorly located, constructed, or maintained roads, and timber harvest (HCP Appendix C).

Columbia River Chum (Covered)

Columbia River chum are present in the Columbia River, as well as its tributaries that originate in Oregon and Washington (Figure 1). This ESU also includes salmon naturally spawned in the Pacific Ocean and salmon from two artificial propagation programs. Columbia River chum were once present throughout the Lower Columbia River basin, but their distribution has been limited since the construction of Bonneville Dam. These salmon are now almost exclusively located below the dam with only a few adults found above the dam (HCP Appendix C). They are federally listed as a threatened species under the ESA and as a sensitive-critical species under the Oregon State Sensitive Species List (OAR 635-100-0040). The Oregon State Lower Columbia River Conservation and Recovery Plan was approved in 2013 (NMFS 2013; 78 FR 41911), and critical habitat was designated in 2000 (65 FR 7764) and revised in 2005 (70 FR 52630). The Cascade, Coast, and Gorge are the three major population groups within the ESU with independent populations from the Coastal and Cascade major population group intersecting the study area. Columbia River chum habitat could be affected by covered activities in the Coast Range and lower Cascades ecoregion.

The freshwater residency of the Columbia River chum is relatively short as the fry typically head toward estuary habitats after emergence. Juveniles can spend up to a year in freshwater. Those that spawn in large rivers or higher up in drainages spend more time in freshwater prior to outmigration. Estuarine habitats play an important role in the life history of the chum providing a place for foraging and growth before finishing their journey to the sea. Chum spend between 2 and 6 years at sea before migrating back to freshwater. The majority of chum tend to stay relatively close to the sea and do not pass any substantial barriers, typically spawning in areas of upwelling within the lower mainstem of the rivers or even within the tidal zone. Clean gravel is essential for spawning with preferred temperatures ranging from 4 to 16°C (HCP Appendix C). Channel stability and fine sediment have a great impact on the chum salmon population, with channel instability and the presence of fine sediments both causing a decrease in the survival rate of eggs and alevins (Jensen et al. 2009). Human development has had a multitude of adverse effects on the population with all streams within the ESU being altered by human infrastructure. This along with other forms of human impact have posed the biggest threat to the Columbia River chum populations.

Southern Oregon/Northern California Coastal Spring-Run Chinook (Covered)

Southern Oregon/Northern California Coastal spring-run Chinook inhabit southern Oregon and northern California coastal streams. Though their distribution is primarily in California, the density of individuals is higher in Oregon. Only a very small portion of their distribution abuts the plan area along the Elk River in southern Oregon (California Trout 2019). In August 2021, the 12-month findings were presented with decisions on petitions to list both the Southern Oregon/Northern California Coastal spring-run Chinook and the Oregon Coast spring-run Chinook as threatened or endangered under the ESA. The decision was made that the Southern Oregon/Northern California Coastal spring-run Chinook did not meet the ESU policy criteria to be considered a separate ESU from Southern Oregon/Northern California fall-run Chinook populations. Because it is not a separate ESU, listing the species under the ESA was not warranted (86 FR 45970). They are, however, listed as a sensitive species under the Oregon Sensitive Species List (OAR 635-100-0040).

Adult Chinook migrate to freshwater spawning grounds in late fall, and spawning typically occurs between September and December for fish in the Klamath River and between November and

December for those in the Smith River (California Trout 2019). Spawning occurs in the middle reaches of coastal tributaries as well as smaller tributaries with large cobble substrate that allows sufficient amounts of oxygen to reach the embryos. Water temperatures between 5 and 13°C are necessary for embryo survival, and temperatures need to remain below 20°C for juvenile rearing activities (CDFW 2015). Rearing of juveniles in freshwater habitats occurs in areas with cover and habitat complexity and lasts for a few months before the juveniles start migrating to the ocean. It is possible that extended rearing in freshwater habitats leads to a higher rate of ocean survival (CDFW 2015). After migrating, the Chinook will remain in the ocean habitat to grow and become sexually mature at around 3 years of age. Primary threats to the Southern Oregon/Northern California Coastal spring-run Chinook are logging, habitat alteration (particularly estuary alteration), and agriculture (California Trout 2019).

Southern Oregon/Northern California Coast Coho (Covered)

Southern Oregon/Northern California Coast coho were listed as a threatened species under the ESA in 1997 and are listed as a sensitive species under the Oregon State Sensitive Species List (OAR 635-100-0040). In 1999, critical habitat was designated for the species (64 FR 24049), and a recovery plan for the species was approved in 2014 (NMFS 2014a, 2014b; 79 FR 58750). This ESU includes rivers and streams along the coast of Oregon and California from Cape Blanco to Punta Gorda with most rivers in Oregon originating from the Oregon Coast Range. Of the 12 potentially independent populations within this ESU, six of them intersect with the study area, with the Smith River and Middle Rogue and Applegate Rivers being independent populations covering the highest percentage of stream miles within the study area. Southern Oregon/Northern California Coast coho could be affected by plan and permit area activities in the middle to southern portion of the Klamath Mountains/California High North Coast Range ecoregion (HCP Appendix C).

The life history and habitat requirements of Southern Oregon/Northern California Coast coho are quite similar to those of the Oregon Coast coho. Coho salmon prefer small headwater streams and tributaries for spawning that are difficult to reach and, therefore, inaccessible by many other salmon species. These streams are preferable because they provide the salmon with ideal spawning grounds that include cool, oxygen rich water. Juvenile coho prefer habitats with slow water, high channel complexity, and cover and are found in the highest densities in backwater pools in small streams (HCP Appendix C). The emigration of juveniles occurs at around 15 months of age and happens in waves from April to June with differences in timing being affected by factors such as fish size, temperatures, dissolved oxygen, and food availability. Once at sea, adults will often mature for 2 years before returning to their natal streams; however, there are instances of some males returning to spawn after 6 months (HCP Appendix C). This ESU is currently at high risk of extinction with threats within the study area of land and water management impacts on habitat quality, water quality, and habitat access (ODFW 2008).

Lower Columbia River Chinook (Covered)

Lower Columbia River Chinook were federally listed as threatened under the ESA in 2005 and are listed as a sensitive species under the Oregon State Sensitive Species List (OAR 635-100-0400). Critical habitat was also designated for this ESU in 2005 (70 FR 52630), and the Oregon State Lower Columbia River Conservation and Recovery Plan was approved in 2013 (NMFS 2013; 78 FR 41911). This ESU includes both fall- and spring-run salmon in the Salmon River, Hood River, rivers downstream of Salmon and Hood Rivers, and the Willamette River and its tributaries downstream of

Willamette Falls. There are six independent populations within this ESU; however, none of them intersect the plan area (Figure 1). Lower Columbia River Chinook have very minimal habitat that is near plan and permit area activities and are unlikely to be affected by any activities in the plan area.

The two different classifications for the Chinook, fall run and spring run, result in different life histories and appearances. The spring-run Chinook are also known as "stream-type" as they remain in the freshwater habitat for a year before going to the ocean. Conversely, the fall-run Chinook migrate to the ocean from 1 to 4 months old and are known as "ocean-type" (HCP Appendix C). The fall-run fish tend to have a darker coloration, a higher level of maturation, and a higher dependance on estuary habitats. Habitat requirements are similar for the two life history types despite the differences in timing with both spawning and rearing activities occurring in the different habitats of tributaries and mainstream rivers. Gravel and cobble substrate located in riffles and pool tailouts are ideal for spawning with slower water being preferred for rearing activities. Once the juveniles migrate to the ocean, they will remain there for 1 to 5 years to mature before returning to the freshwater habitat to spawn. Each life history type also faces its own unique set of threats with varying degrees of impact; however, habitat degradation, water quality, and food availability are some of the top threats (HCP Appendix C).

Eulachon (Covered)

Eulachon (*Thaleichthys pacificus*) in Oregon mostly originate in the Columbia River Basin. They have historically only been found in consistently large spawning populations in Oregon in the Umpqua River, but have also been found in other areas including the Siuslaw River, Winchuck River, Chetco River, Pistol River, Rogue River, Elk River, Sixes River, Coquille River, Coos River, Yaquina River, Tenmile Creek, Hunter Creek, and Euchre Creek (NMFS 2017). Eulachon in the Columbia Basin may be affected by plan and permit area activities in the northern section of the Coast Range ecoregion. Eulachon in the Umpqua River may be affected by plan and permit area activities along Umpqua River tributaries, and those in Tenmile Creek may be affected by plan and permit area activities along its tributaries. They are currently listed as a threatened species under the ESA (75 FR 13012). Critical habitat was designated in 2011 (76 FR 65324), and a recovery plan for the species was approved in 2017 (NMFS 2017; 81 FR 72572).

Eulachon spawn in the lower reaches of large rivers that are usually fed by either glaciers or snowpack and deposit eggs over a variety of sediment (Hay and McCarter 2000). Sand is the preferred substrate because it allows the eggs to stick and become securely attached, but small gravel, cobble, and detritus are also used. Once eggs hatch, the larval eulachon are carried towards the ocean on currents and are deposited into estuarine habitats. They remain there for an uncertain amount of time before being further transported to the ocean, where they remain for 3 to 5 years in deep waters. When returning to freshwater to spawn, eulachon express variability in spawning sites since they spend such a short amount of time in their natal streams as juveniles (Hay and McCarter 2000). The greatest threats to the eulachon population currently are climate change, construction of dams and other forms of water diversion, and bycatch (Gilroy et al. 2021).

Columbia and Cascade Torrent Salamander (Covered)

The Columbia torrent salamander (*Rhyacotriton kezeri*) and Cascade torrent salamander (*Rhyacotriton cascadae*) are both a part of the *Rhyacotritonidae* family of salamanders that contains four species. Both of these species are listed as sensitive species under the Oregon State Sensitive Species List (OAR 635-100-0040), and their status at the federal level is under review as of 2015

(FWS-R1-ES-2015-008). No critical habitat has been designated for either species of torrent salamander. There are many similarities between the species, with the most notable differences occurring in their distribution and habitat requirements.

Overall, Columbia torrent salamanders and Cascade torrent salamanders, both found in the study area, use a variety of stream types throughout their life cycle and are most often associated with headwater streams. Torrent salamanders can be found living in or on the banks of intermittent (spatially or temporally) and small, perennial headwater streams (Olson and Weaver 2007; Olson pers. comm.). Larvae are not resistant to desiccation, and require permanent water sources (perennial reaches, or permanent seeps or springs) during their development or moist underground habitat. It is possible that the entire life cycle of torrent salamanders may be completed in nonperennial stream habitat where year-round hyporheic flows and moist bank habitat exist (Olson and Weaver 2007; Olson pers. comm.); living in these areas could reduce competition or provide additional resources and suitable habitat. Cool stream temperatures, reduced sedimentation, and reduced predation and competition are habitat requirements for all life stages. Torrent salamanders rely on intact forest canopies and an undisturbed forest floor for movement and population connectivity.

Columbia torrent salamanders have a range that stretches from the coastal regions of southwestern Washington to northwestern Oregon. Occurrences within the study area are mostly located in Clatsop County, south of the Clatsop State Forest, but there have also been occurrences in Tillamook, Washington, and Yamhill Counties (ODF 2019). Columbia torrent salamander have a distribution throughout the northern portion of the Coast Range ecoregion and could be affected by plan and permit area activities here. They tend to occupy different habitats throughout their lives with juveniles preferring the rocky substrate of cold, fast-moving streams in forest areas and the adults preferring the splash zones of those streams.

Cascade torrent salamanders can be found at higher elevations than the Columbia salamander reaching elevations of over 4,000 feet. Their range in Oregon includes Multnomah, Hood River, Clackamas, Marion, Linn, and Lane Counties with occurrences in the study area being in Linn, Marion, Clackamas, and Lane Counties (ODF 2019). Cascade torrent salamanders have a distribution throughout the middle and northern portion of the Cascades ecoregion and could be affected by plan and permit area activities here. Since they are typically found at higher elevations, they prefer high-gradient water sources that are cold (less than 14°C) and shallow. A substrate of cobble and gravel without the presence of fine sediment is also necessary, as well as moist forest providing a leaf canopy and understory (HCP Appendix C).

Both the Cascade and Columbia torrent salamanders exhibit a rather sedimentary lifestyle with upstream movements occurring more frequently than downstream. They are also more likely to move parallel to their streams as opposed to perpendicular potentially due to their inability to travel effectively through the forest, especially where forest cover is inadequate or the terrain is interrupted by a road network. Although timing of reproduction varies between the two species, their reproductive strategy is similar. They both have prolonged periods of courtship and mating and deposit their eggs on a rocky substrate with clear flowing water (HCP Appendix C). It is also suspected that torrent salamanders nest communally; however, there is not enough consistent data to confirm this (Russell et al. 2002). Increases in water temperature and sedimentation and alterations to the geomorphology and hydrology of streams are the primary threats to the torrent salamander populations (Lannoo 2005). Interruptions to forest connectivity, predation and competition, decreased forest cover, and direct injury or mortality from human trampling or crushing by machinery or fallen trees are additional threats.

Chum (Coastal SMU/Pacific Coast ESU)

Chum (Coastal species management unit [SMU]/Pacific Coast ESU) is an ESU of chum salmon that includes all naturally occurring populations from the Pacific Coast of Washington to southern Oregon and populations from the Strait of Juan de Fuca west of the Elwha River. There were estimated to be 13 historic populations of coastal chum salmon, but only eight of those populations are presumed to currently exist. The five southernmost populations within this SMU are either extinct or presumed to be extinct. The remaining eight populations are located in the Necanicum River basin, Nehalem River basin, Nestucca River basin, Salmon River basin, Siletz River basin, Yaquina River basin, Neskowin Creek, Sand Lake tributaries, Tillamook Bay tributaries, and Netarts Bay tributaries (ODFW 2005). This species in not currently listed under the ESA, but they are listed on the Oregon Sensitive Species List as a sensitive-critical species (OAR 635-100-0040).

Chum spawn in the shallower, slower-moving lower reaches of mainstream rivers and tributaries to mainstreams with low gradients (ODFW 2014). They can travel long distances for spawning since they are traveling in low-gradient streams, but they are not likely to attempt to go over blockages. Areas of stream at the head of riffles are preferred for spawning activities, and incubation times varied greatly depending on water temperature, dissolved oxygen levels, gravel size, and salinity. Chum do not require as specific conditions for spawning and do not require as high levels of dissolved oxygen as other salmonids. Fry emerge from the eggs and quickly begin their migration to the ocean between February and May and remain in estuarine habitats for less than 1 month before finishing their migration. Chum reach maturity while at sea between 3 and 5 years of age and then return to their natal streams to spawn (Johnson et al. 1997). Threats to chum populations include changes in ocean conditions, habitat loss, and degraded water quality as a result of agricultural and logging practices.

Lower Columbia River Steelhead

Lower Columbia River steelhead were listed as a threatened species under the ESA in March 1998 (63 FR 13347), and critical habitat was designated for the species in September 2005. They are also listed as a sensitive-critical species under the Oregon Sensitive Species List (OAR 635-100-0040). Included in this DPS are naturally occurring steelhead originating in and between the Cowlitz River, Wind River, Willamette River, and Hood River, as well as fish from eight artificial propagation programs (Myers et al. 2006). Both the winter run and summer run populations are also included in this DPS with many similarities between the two. Fish from above Willamette Falls in the upper Willamette River basin are not included in this DPS.

Spawning for Lower Columbia River steelhead is slightly variable between winter and summer-run populations. Summer-run fish enter freshwater streams as sexually immature fish between May and October and spawn between January and June. Winter-run steelhead are sexually mature upon entering freshwater for spawning between December and May. Spawning for these fish occurs between February and June. The area in which the two populations spawn also varies within the same watersheds with summer steelhead spawning above barrier falls that are impassable by winter-run populations (Meyers et al. 2006). Both populations prefer to spawn in smaller streams and side channels that are cool, well oxygenated, and contain a gravel substrate. Riffles and pool tailouts are used for spawning activities, but deeper freshwater habitats such as pools are also necessary as holding areas for adults returning to spawn (NatureServe 2021a). After emergence, juvenile steelhead spend 1 to 4 years in freshwater habitat before migrating to the ocean. Once in the ocean, steelhead remain in the saltwater habitat for 1 to 4 years before returning to spawn between 4 and 6 years of age. Steelhead have the ability to spawn more than once; however, it is not very common with repeat spawner rates of 5.9 and 8.1 percent for summer and winter steelhead, respectively (Myers et al. 2006). Persistent threats to the population include hatchery interactions, habitat degradation, and the construction of dams. These threats have already caused significant declines to the Lower Columbia River steelhead populations (NMFS 2016b).

Oregon Coast Steelhead

Oregon Coast steelhead include fish from the river basins on the Oregon Coast that are north of Cape Blanco with most of the rivers draining in the Coast Range Mountains. This ESU excludes fish occurring in streams tributary to the Columbia River. This ESU includes mostly winter steelhead with only two native populations of summer steelhead that occur in the Siletz River and the North Umpqua River. This ESU is not considered to be at current risk of extinction and is, therefore, not listed under the ESA. Although there is still some debate on the topic, it is likely that this ESU will become endangered in the future since natural stocks do not appear to be replacing themselves (Busby et al. 1996). The Oregon Coast steelhead are listed as a sensitive species under the Oregon Sensitive Species List (OAR 635-100-0040).

With mostly winter-run steelhead in this ESU, adults return to freshwater for spawning in late fall to late winter (November–April) and spawn a few days or weeks after returning. Adult steelhead travel further upstream in tributaries for spawning than most other salmonids and prefer cooler headwater streams with a small gravel substrate. Juvenile steelhead also require cool streams, as well as vegetative cover and wood/boulders that create stream complexity. The juveniles will remain in these freshwater habitats for anywhere from 1 to 4 years with the average length of stay being 2 years. Migration to the ocean begins in the spring, and fish will remain at sea to grow from 1 to 4 years. Adults that survive spawning events will also travel to the ocean and return to freshwater the following year to spawn again (Fitzpatrick 1999). The primary threat to Oregon Coast steelhead populations are hatchery interactions that result in genetic introgression and competition (Busby et al. 1996). Habitat degradation and alteration including increased sedimentation also pose a threat to this ESU (Fitzpatrick 1999).

Bull Trout

Bull trout were federally listed as a threatened species under the ESA in June, 1998 (63 FR 31647). They are also listed as sensitive or sensitive-critical species under the Oregon Sensitive Species List, depending on the SMU (OAR 635-100-0040). The species currently occupies about 21 percent of their historic range with current Oregon populations being located in the Columbia and Snake Rivers, their tributaries, and streams in the Klamath basin. There are also experimental populations of bull trout located in Clackamas River subbasin and the Willamette River upstream of Willamette Falls and up to its confluence with the Columbia River (FWS 2015a). Bull trout may be affected by plan and permit area activities in the Cascades and Willamette Valley ecoregions.

Bull trout have very specific habitat requirements that include cold water temperatures, clean substrate, complex habitat with different types of stream features and cover, and connection between spawning and feeding grounds. Water temperatures below 15°C are generally required for bull trout to be present, and water temperatures of 9°C or lower are required for spawning to occur

(McPhail and Baxter 1996). Spawning for bull trout occurs in smaller headwater streams in the fall when water temperatures are lower. There are both resident and migrant species of bull trout with residents remaining in their natal streams and migrants moving to larger bodies of water, such as lakes and larger rivers, only returning to their natal stream to spawn. For migrant bull trout, reliable connectivity between spawning and feeding grounds is a vital habitat requirement as that allows for successful breeding over the lifetime of the fish. There are many threats to the bull trout population considering their level of specificity in habitat requirements, including habitat degradation and fragmentation, poor water quality, and competition with nonnative species (FWS 2015a).

Coastal Cutthroat Trout

Coastal cutthroat trout (*Oncorhynchus clarkii*) were once listed as an endangered species but were delisted in April 2000 after a review that determined that they did not meet the criteria. Although this ESU is no longer listed, it is still considered to be a vulnerable species (Jelks et al. 2008). Both the Lower Columbia SMU and the Southwestern Washington/Columbia River ESU are listed as sensitive populations within this species under the Oregon Sensitive Species List (OAR 635-100-0040). This ESU is present along the Pacific Coast from California to Alaska. In Oregon, the species is located from the coast to the Cascade Mountain Range and is typically found less than 100 kilometers inland (Johnson et al. 1999). They are found from Fifteenmile Creek to the Columbia River Estuary, Willamette River and its tributaries from Willamette Falls to the Columbia River, and tributaries of Gray's Harbor and Willapa Bay (FWS 2015b).

Coastal cutthroat trout are an extremely flexible species that can be placed into four different categories: resident, fluvial, adfluvial, and anadromous. Residents are found in headwater tributaries and coastal streams and do not leave their natal streams. Fluvial cutthroats are found in larger river systems for most of their lives but travel to smaller tributaries for spawning events. The adfluvial cutthroats also spawn in tributaries, but juveniles and surviving adults migrate to coastal lakes. Finally, the anadromous populations spawn in tributaries and migrate to estuaries and the ocean to grow before returning to natal streams for spawning events. Those fish that do migrate to the ocean stay there very briefly (only a few months) and do not travel more than 40 miles from the shore (Fitzpatrick 1999). With the many different life history strategies, the cutthroat uses a variety of freshwater habitats and can be found in many different reaches of freshwater river systems. Adults in freshwater habitats require deep, cool pools with cover to provide protection, and cool, shallow water with gravel substrate for spawning events. Spawning occurs from December to June, peaking in February, and tails of pools in streams with low flow and low gradient are selected for spawning grounds (Johnson et al. 1999). There are currently no major threats to the population, but past threats that may still have an effect are habitat degradation/estuary degradation, construction of dams and other barriers, and forest management (FWS 2015b).

Umpqua Chub

Umpqua chub are recognized as an Oregon State sensitive species (OAR 635-100-0040). Recent sampling efforts are indicative of a decline in Umpqua chub abundance over the last few decades. Umpqua chub are endemic to streams of the Umpqua River drainage (ODFW 2021). Their habitat most overlaps with the study area in the Cow Creek–South Umpqua River drainage, as well as some along Elk Creek (ODFW 2021).

Umpqua chub prefer areas with slower water velocity, such as runs, pools, sloughs, and glides, or areas with slow water microhabitats (behind rocks, logs, in backwaters) in otherwise swift habitats.

Umpqua chub prefer shifting benthic habitats (erosional or depositional), and are associated with aquatic and riparian vegetation. Spawning requirements are thought to be similar to Oregon chub, with the generation time of Umpqua chub thought to be about 3 to 4 years (see below) (Bangs pers. comm.; ODFW 2021). Nonnative species, such as smallmouth bass are considered a threat to Umpqua chub, as is disconnection of floodplain habitat from streams and actions that decrease riparian integrity and native aquatic plants.

Oregon Chub

Oregon chub were previously listed as an endangered species in 1993, but were removed from the list in 2015 (80 FR 9125) after the success of the species recovery plan, and their populations continue to improve (Bangs et al. 2019). They are currently listed as a sensitive species across their range in Oregon (OAR 635-100-0040). The Oregon chub, endemic to the Willamette River drainage, now occupies portions all of its historic distribution of the Willamette River and its tributaries including the Clackamas River, Middle Fork Willamette River, Luckiamute River, Santiam River, Calapooia River, Mary's River, Long Tom River, Mackenzie River, and Coast Fork Willamette River basins. In addition to the historic range, there are now some additional naturally occurring populations in the Molalla River, Yamhill River, and the mainstem Willamette River (FWS 2014).

The Oregon chub is a small minnow that reaches maturity at about 2 years of age, and can live up to 9 years (FWS 2015b). Chub inhabit slack water off-channel habitats with little to no water flow such as beaver ponds, side channels, low-gradient tributaries, and flooded marshes that provide plenty of vegetative cover and a silt or organic substrate. Adult chubs spawn in the summer from May to August when water temperatures are above 16°C and takes place in the cover of vegetation (FWS 2014). Presence of aquatic vegetation is important to Oregon chub (FWS 2015b). Although the Oregon chub is not currently at risk of extinction, there are still many threats to populations. These threats include habitat alteration, introduction of invasive species, and the construction of dams and flood control projects, as well as presence of invasive species (FWS 2014, 2015b). The reduction of natural river meandering and flow through dams and levees especially has reduced the amount and suitability of habitat for the species, and climate change is expected to be a threat into the future (FWS 2015b).

Pacific Lamprey

Pacific lamprey (*Entosphenus tridentatus*) is a species of lamprey that is both anadromous and parasitic (in the ocean). Pacific lamprey are listed as a sensitive species at the state level and are listed as "at risk" of extinction (OAR 635-100-0040). A petition to list the species under the ESA was filed in 2003; however, it was unsuccessful due to a lack of necessary information (Gunckel et al. 2009). They are found in the marine and estuarine habitat off of the coast of Oregon and in the freshwater habitats in the Columbia River Basin and its tributaries (Clemens et al. 2019).

The life history of the Pacific lamprey begins with eggs being laid in depressions in the substrate made by the parent in slow moving water of pool tailouts, scour pools, or low-gradient riffles. A substrate of gravel and cobble is necessary for the nest depressions to be made with very few large rocks and fine sediment present (Gunckel et al. 2009). When larval lamprey emerge from their eggs, they partially bury themselves in fine sediment, often in stream-edge depositional areas (silt or sand), where they filter feed. Anadromous juveniles have a long period of downstream migration, and move in association with high flow events (Lamprey Technical Workgroup 2020). As adults, they make their way to estuaries or the ocean and become parasitic. They remain in the ocean feeding on fish for several years before returning to the freshwater to spawn and die (Nawa 2003). Among all lamprey life stages, a wide variety of stream habitat characteristics are necessary, thus, habitat and channel complexity is important to lamprey. There are many threats to the lamprey population with the main threats being artificial barriers to migration, water quantity and quality, habitat degradation, and predation/bycatch (Clemens et al. 2019).

Oregon Western Brook Lamprey

Oregon western brook lamprey is found near the coast and has a distribution throughout forested coastal basins, but there are very few located in the Columbia River basins above the Bonneville Dam (Nawa 2003). They are found in stream and river freshwater systems and are unable to move into saltwater. Many of the populations of western brook lamprey are also believed to be isolated due to their inability to migrate long distances within river systems (Nawa 2003). The Oregon western brook lamprey is currently not listed federally under the ESA, but it is listed as a sensitive species at high risk of extinction at the state level in Oregon (OAR 635-100-0040).

Oregon western brook lamprey are a species of lamprey that are different from most other lamprey as they are not parasitic and remain in freshwater throughout their life cycle. The larval stage of their life history is very similar to that of the Pacific lamprey. Eggs are deposited into gravel/cobble nests made from depressions in the substrate, and the larval forms partially bury themselves in fine sediment/sand once they emerge from the eggs. Western brook lamprey also spawn in slower waters; however, they are typically found in headwaters and lower order streams (Gunckel et al. 2009). They will remain burrowed and filter feed for 2 to 7 years. Once the lamprey mature into their adult forms, they will migrate short distances to spawn. They do not feed as adults and, therefore, die after spawning occurs. Many of the threats to Pacific lamprey are also threats to the western brook lamprey; however, they are more susceptible to changes as they are restricted to certain sections of stream. The threats to lamprey include changes in water quantity and quality, passage barriers, and habitat degradation (Nawa 2003).

Sculpin

The native species of sculpin located in the study area are the coastrange sculpin (*Cottus aleuticus*), mottled sculpin (*Cottus bairdii*), reticulate sculpin (*Cottus perplexus*), riffle sculpin (*Cottus gulosus*), prickly sculpin (*Cottus asper*), and Paiute sculpin (*Cottus beldingii*). All of these species are considered to be of least concern by the International Union for Conservation of Nature (IUCN) Red List with stable populations, and are not listed under the ESA (IUCN 2021). Sculpins are bottom dwellers that are found in both freshwater and marine environments, occupying areas of shallow water in both. In marine environments, they prefer tidal pools, and in freshwater, they occupy small headwater streams, lakes, and shallow portions of lowland rivers (Daw 2021). In Oregon in particular, sculpins are found in Pacific coastal streams, the Lower Columbia basin, and Columbia drainages, with distributions varying for each species (ODFW 2005). Spawning throughout the species typically occurs in spring and requires a substrate of large gravel for nests (Daw 2021). Specific habitat requirements and spawning practices vary between the species. Little is known about the threats that face these sculpin species; however, some of the threats that have faced similar species are habitat loss and degradation caused by human activities such as agriculture and logging (Mongillo and Hallock 1998).

Millicoma Dace

Millicoma dace (*Rhinichthys cataractae* ssp.) are an Oregon State sensitive species (OAR 635-100-0040). They are a form of longnose dace endemic to the Coos River drainage; their distribution most overlaps with the study area in the area of the Millicoma River, Marlow Creek, Palouse and Sullivan Creeks. Some researchers argue that Millicoma Dace should be assigned to their own species based on genetic analysis and having unique morphological characteristics (Meeuwig and Harrison 2019).

Millicoma dace may use a variety of habitat types including fast water. Little is known on the specifics of life history, behavior, physiological requirements, and ecology of this dace (Meeuwig and Harrison 2019). Lack of cobble and gravel, poor habitat complexity, and poor riparian conditions (including lack of beaver habitat) are threats to their population (Meeuwig and Harrison 2019).

Dace

The native species of dace (*Leuciscus leuciscus*) that are found in the study area are the Columbia River dace/northern pikeminnow (*Ptychocheilus oregonensis*), longnose dace (*Rhinichthys cataractae*), leopard dace (*Rhinichthys falcatus*), and speckled dace (*Rhinichthys osculus*). All four of these dace species are listed as species of least concern under the IUCN Red List with three of the four species having stable populations and the speckled dace having a decreasing population (IUCN 2021). The longnose dace, Columbia River dace, and speckled dace are widespread throughout Oregon, and the leopard dace is distributed throughout the Fraser and Columbia-Snake basins (ODFW 2005). Habitat requirements vary greatly across the species as they are found in many types of freshwater habitats including lakes, rivers, and streams. Spawning requirements are relatively similar between the species with spawning events occurring between spring and summer in reaches with shallow water and a substrate of gravel or cobble. Threats to their populations could include nonnative species, habitat alteration, and reduction in water quantity (NatureServe 2021b–2021e).

Additional Native Non-Game Fish

Other native non-game species of fish that occur within the study area are the redside shiner (*Richardsonius balteatus*), largescale sucker (*Catostomus macrochelius*), peamouth (*Mylocheilus caurinus*), and three-spine stickleback (*Gasterosteus aculeatus*). All of these species are currently listed as species of least concern with stable population trends (IUCN 2021). With the exception of the three-spined stickleback, all of the species live exclusively in freshwater habitats and are found in the study area at all life history stages. The three-spined stickleback, however, has two life-history strategies with one being exclusive to freshwater and the other being anadromous with adults living at sea and returning to freshwater to breed (NatureServe 2019).

Aquatic Insects

Numerous species of stream-dependent aquatic insects and invertebrates reside in the study area including mayflies (*Ephemeroptera*), stoneflies (*Plecoptera*), dragonflies (*Anisoptera*), damselflies (*Zygoptera*), true bugs (*Hemiptera*), beetles (*Coleoptera*), neuropterans (*Neuroptera*), megalopterans (*Pterygota*), molluscs (*Mollusca*) and more. These species have a range of conservation statuses.

Native aquatic insects and invertebrates are inherently adapted to historic stream conditions. Temperatures, flows, large wood presence, riparian conditions, and water quality conditions of their historic environment are best to support their populations, which are important to nutrient cycling, habitat stability, and food sources for other aquatic organisms. Threats to aquatic insects include reduced riparian integrity, decreased stream flows, increased stream temperatures, increased fine sediment, and decreased water quality.

Spurred Bizarre Caddisfly

The imperiled spurred bizarre caddisfly (*Trichoptera*), whose larvae are unknown, may inhabit upper forested streams in the study area. It has been found in Oregon and California, and in Oregon is primarily known from Lincoln County. Watersheds it has been found in include the Upper Willamette, Siletz-Yaquina, and Alsea Rivers, though it may be present in other locations.

The larvae are aquatic, but unknown for this species. Only the small, moth-like adults have been found near creeks, streams, rivers and springs between June and August. They are found at mid-elevation sites. Other species of larvae in the *Lepidostomatidae* family are primarily shredders, and are found in lotic habitat. This species likely builds cases out of sand grains. Threats to the species include altered hydrology, pollution, and sedimentation (Xerces Society for Invertebrate Conservation 2016).

Rhyacophilid Caddisflies

A few species of very rare rhyacophilid caddisflies in the study area are rated as imperiled or vulnerable by NatureServe. These include *Rhyacophila chandleri, Rhyacophila haddoki, and Rhyacophila leechi.* These caddisflies inhabit small, cold streams that have low accumulations of fine sediment. They are likely found in fishless and potentially seasonal streams. Rhycophilid larvae are freshwater aquatic caseless caddisflies until they construct a pupal chamber. Most rhyacophilid larvae construct enclosures of rock and sand that they secure to a stable rock. Threats include increases to stream temperature, changes in stream flows, and pollution (Xerces Society for Invertebrate Conservation 2012).

Floater Mussels

Floater mussels are a genus of mussels with five species west of the Continental Divide, with four of those species occurring in the study area. The species with distributions that occur in the study area are the California floater (*Anodonta californiensis*), winged floater (*Anodonta nuttalliana*), Oregon floater (*Anodonta oregonensis*), and western floater (*Anodonta kennerlyi*). They are found throughout the watersheds of Oregon, although they are restricted to low elevation watersheds and are not found in the watersheds of the Cascades (Nedeau et al. 2009). None of these species are listed under the ESA, and the Oregon floater is the only one on the IUCN Red List as a species of least concern. There is still little known about this genus, and there is much debate over species distinction in particular as they are hard to classify due to their lack of identifying hinge teeth and variation in shell features (Nedeau et al. 2009). There are also some debates concerning the proper taxonomy of all floater species.

The life history of floater species is very similar across the genus with fertilization occurring in the late summer or early fall and embryos developing over the winter. During the following spring and summer, glochidia are released into the water to attach to the fins or gills of their host fish where they will stay for several weeks. Floaters are not highly host specific species as are other species of mussels. After that period of fish parasitism, they detach to fall to the bottom and burry themselves in the sediment. This is where they will remain for the remainder of their lives, reaching sexual maturity after 4 to 5 years. Floater mussel are habitat generalists that can be found in many different freshwater habitats including lakes, reservoirs, and low-gradient reaches of rivers. Their habitat requirements include waters with high nutrient levels and a substrate of fine sediment and silt. They are relatively tolerant to low oxygen levels, but are very vulnerable to fluctuations in water quantity as they are not usually able to make it to deep waters. Threats to the floater populations include water diversion and extraction that cause water level fluctuations, habitat degradation through events such as dredging and pollution, construction of barriers blocking fish passage, and interactions with nonnative species (Nedeau et al. 2009).

Western Ridged Mussel

Western ridged mussels (*Gonidea*) have a distribution that includes Washington, Oregon, California, Idaho, Nevada, Montana, and British Columbia. They can be found throughout Oregon but are no longer found in many of the sites that they historically occurred. Of the 87 total sites that the western ridged mussels historically occurred, there are no longer mussels detected in 46 percent of the sites (Blevins et al. 2020). Populations in northwest Oregon are much more sporadic than those in the southern portions of the state, and they are more common on the eastern side of Oregon than the western side. Although not currently listed under the ESA, a petition has been filed to list it as an endangered species that is currently under review.

Creeks and rivers with constantly flowing clean water are the typical habitat for the western ridged mussel. A coarse substrate or a bed of firm mud are also necessary as the mussels burrow into the substrate as adults. Mussel reproduction occurs between June and July when water temperatures are between 17 to 23°C. It is at this point that glochidia are released and attach to host fish species that they will parasitize for anywhere between 2 weeks to 4 months (Blevins et al. 2020). As adults, the mussels burrow into the sediment (usually in groups creating mussel beds) and filter feed for the remainder of their lives. Because mussels are filter feeders, they are more susceptible to pollutants in the water, and require clean water for survival. Major threats to the species include pollution, loss of host species, human infrastructure, and activities such as dredging and mining (Blevins et al. 2020).

Western Pearlshell

The western pearlshell (*Margaritifera falcata*) is not a listed species under the ESA, but it is listed on the IUCN Red List as a near threatened species with a decreasing population trend in March 2016 (Blevins et al. 2016). Their distribution includes Pacific drainages from California to southern Alaska and east to the headwaters of the Mississippi River. There are western pearlshell populations throughout the study area, but their geographic range is shrinking (Nedeau et al. 2009).

The habitat of the western pearlshell coincides with that of salmonid populations. This includes cold, clear streams and rivers with a sand, gravel, or cobble substrate. Areas with boulders that provide a more stable environment and banks with a weaker current and stable substrate are preferred western pearlshell habitat. Fertilization in this species occurs in the early spring, and the glochidia are released in May to early July to attach to host fish. Fish species that are hosts for western pearlshells include cutthroat trout, rainbow trout, Chinook salmon, coho salmon, sockeye salmon, speckled dace, Lahontan redside, Tahoe sucker, brook trout, and brown trout (Nedeau et al. 2009). They will parasitize the host fish for growth and dispersal before detaching and burrowing in the substrate. They become sexually mature after 9 to 12 years and have lifespans around 60 to 70 years. Threats to the Western Pearlshell population include water diversion, construction of barriers, interactions with nonnative species, and pollution (Nedeau et al. 2009).

Coastal Tailed Frog

Coastal tailed frogs (*Ascaphus truei*) are listed as a species of least concern on the IUCN Red List and are not listed under the ESA. At the state level, they are listed as a sensitive species under the Oregon Sensitive Species List (OAR-635-100-0040). They are distributed along the west coast from British Columbia to Northern California and are found from sea level to elevations of 1,600 meters in some places. Their range also stretches from the Coast Range in the west to the Cascades in the east (Jones et al. 2005a).

Mating season for coastal tailed frog occurs in late summer and early fall, but the females store the sperm until the following June or early July when they deposit eggs onto the underside of rocks in the water. Tadpoles hatch from the eggs in late summer or fall, and tadpoles will not develop into frogs for 1 to 4 years. The duration of the tadpole period differs at different elevations with individuals at higher elevations or areas with low temperatures having a longer larval period, and those at low elevations having a shorter larval period. In addition to the longer larval period for frogs at higher elevations, they may also require an additional 5 to 6 years to reach maturity. Coastal tailed frog habitat consists of cold, rocky mountain streams in the forest. They can also be found in the vegetation throughout the forest and on stream banks. Timber harvest and road construction both cause increases of stream sedimentation and increases in water temperatures which both threaten coastal tailed frog populations (Jones et al. 2005a).

Cope’s Giant Salamander

Cope’s giant salamanders (*Dicamptodon copei*) can be found in western Washington and Oregon with a range that overlaps that of the Coastal giant salamander. The majority of Oregon populations being recorded in coastal range and western side of the Cascade Range with a few recorded individuals in between those two ranges. The average elevation at which these salamanders are found is 475 meters, but they can be found at elevations of 1,593 meters. The Oregon counties in which they are located are Hood River, Wasco, Clackamas, Multnomah, Clatsop, Washington, and Tillamook (Foster et al. 2015). The Cope’s giant salamander is considered a sensitive species in Oregon (OAR 635-100-0040).

Unlike many other salamander species, the Cope’s giant salamander is predominantly found in its aquatic, larval form as they are able to become sexually mature without reaching their terrestrial, adult form. Because of this, they are found mostly in the cold water of small, high-gradient streams located within moist coniferous forests. During the day, they typically remain in the stream in areas of slow-moving water and covered by objects, such as rocks. If the conditions are damp enough, they can be seen moving along the stream at night. Coarse substrate cobble with the absence of fine sediments is a crucial habitat requirement for the species as it plays a role in breeding activities. Breeding occurs from spring to fall with peaks in spring and fall, and eggs are deposited into nest chambers that are typically located under stones or in undercut banks. Road construction and timber harvest are the main threats to the Cope’s giant salamander as these activities alter the habitat and microclimate of the species (Foster et al. 2015).

Southern Torrent Salamander

The southern torrent salamander (*Rhyacotriton variegatus*) is distributed throughout the Coast Range from the Nestucca River down to Dark Gulch, California. In Oregon, their populations extends eastward to the North Umpqua River drainage of the Cascade Range. The southern torrent salamander distribution is spotty throughout their range likely due to a lack of suitable habitat (Jones et al. 2005b). It is currently listed as a species of least concern with a stable population trend on the IUCN Red List and is not listed under the ESA. A petition to list the species was submitted in 1994, but after review, it was decided that their listing was not warranted (65 FR 35951). In Oregon, however, they are listed as a sensitive species under the Oregon Sensitive Species List (OAR 635-100-0040).

Salamanders mate in spring and summer with eggs being laid in gravel and developing after about 200 days. Mating and courtship events have not yet been observed in the field, but it is likely that they occur in shallow reaches of streams, springs, and seeps. It is also likely that these salamanders are communal nesters. The larvae take 3 to 3.5 years to metamorphosize after hatching and another 1 to 1.5 years after that to reach sexual maturity (Jones et al. 2005b). Southern torrent salamanders are usually found very close to freshwater as they are much more susceptible to desiccation than other salamander species. They require cold water between 6.5 and 15°C and clear water typically in headwater streams, springs, and seeps in moist, mature forests. The freshwater habitats must also have a coarse substrate of gravel or cobble to provide cover for individuals and moist riparian vegetation for movement from the stream. Threats to this particular species are mostly related to their specificity in habitat. Events such as logging and clear-cutting that cause habitat alteration, temperature increases, and increased sedimentation are the greatest threat to the species (Jones et al. 2005b).

Coastal Giant Salamander

The coastal giant salamander (formerly known as the Pacific giant salamander) has the broadest range of the giant salamanders that overlaps with both the Cope's giant and California giant salamanders. It extends from southern British Columbia to northwestern California with an Oregon population that can be found from the coast to as far east as Wasco County. They are located from sea level to elevations of 7,086 feet with a majority being found below 3,149 feet (Stebbins 2003).

The life history of the coastal giant salamander is thought to be very similar to other species of giant salamander, however courtship and mating rituals have not been observed. Coastal giant eggs are typically laid in streams on the underside of rocks and logs that have formed underground water chambers and have been found from the spring to the fall. Females tend to the eggs until they hatch into aquatic larvae that will typically metamorphose within 18–24 months (or more) after hatching (Jones et al. 2005c). This is also a species that can exhibit paedomorphosis in the correct conditions (typically in perennial habitats). The aquatic, larval stages of life history can be found in streams, lakes, and ponds typically with a moist surrounding forest. Adults are terrestrial and can also be found near these same habitats but can also be found in the surrounding forest usually under cover. Some habitat requirements for the salamanders include coarse substrate with little fine sediment, high stream gradients, cold, oxygenated water, and a high level of stream complexity with a mix of pools, riffle, and run habitats (Jones et al. 2005c). It is also noted that within-stream conditions were better predictors for the presence abundance of coastal giant salamanders than the forest conditions were (Jones et al. 2005c). The biggest current threat to the coastal giant salamander population is logging, which usually results in water temperature increases and an increase in the presence of fine substrate in the water. The increase of young forests over old growth forests in areas that have been logged also decreases the number of individuals in those areas (Foster et al. 2015).

Rough-Skinned Newt

Rough-skinned newts (*Taricha granulosa*) have a North American range that spans the Pacific coast from southern Alaska to central California. In Oregon, specifically, they are located from the coast all the way to the Cascades reaching elevations of up to 2,800 meters (Stebbins 2003). Their habitat is based around the presence of slow-moving freshwater containing aquatic vegetation such as pools in streams, ponds, lakes, and backwaters that they use for breeding grounds. Although they spend much of their time on land, they can be found in a variety of different terrestrial habitats with the presence of the freshwater source being the main habitat requirement. Newts migrate in large groups to breeding sites during breeding season (between late December and July) and deposit eggs onto aquatic plants in the freshwater source. The timing of migration, breeding, and hatching events vary by location and conditions. Both the eggs and adults possess a strong neurotoxin that is used as a form of defense against predators. The rough-skinned newt is currently listed as a species of least concern, but the biggest threat to the population is mortality occurring while crossing roads (IUCN 2015).

Response to Changes in Baseline Conditions

This section describes the difference in ODF responses to changes in baseline conditions between the proposed action and Alternatives 3 through 5 and the no action alternative related to potential effects on fish and stream-dependent wildlife. Under ESA Section 10, the HCP is required to identify anticipated and possible changed circumstances, and ODF is required to maintain financial reserves to fund certain remedial actions. Appendix 3.6-B, *Terrestrial Wildlife Species Technical Supplement*, provides additional background on these assurances, including definitions of key terms.

Climate change is predicted to have substantial effects on rivers and streams in the project area (Spies 2018). Warmer and drier summers may alter streams and rivers by lowering flows, decreasing water quality, increasing stream temperatures, causing disconnections to off-channel habitat, and potentially drying important migration or refuge habitat, and decreasing overall habitat quantity. Increased magnitude and shifted timing of winter storms will cause bed scour, erosion, and flood events when fauna are not adapted to respond to such events, either due to their life stage or evolved behavioral responses that do not longer align with shifts in frequency and magnitude of storms. Increased frequency and intensity in wildfire will increase potential fine sediment inputs to streams and rivers, decrease riparian shading and other riparian benefits, and cause temporary shifts in stream chemistry. Climate change may also increase the spread of invasive species, especially warm water fauna, increasing competition, predation, and pathogens for native species.

Under the proposed action and Alternatives 3 through 5, ODF will work with the Department of Agriculture to identify measures to eradicate aquatic invasive plants, if necessary. ODF will fund these remedial measures to manage aquatic invasive plants under the conditions specified in HCP Chapter 7, Section 7.3.3.3. If aquatic invasive animals or pathogens are determined to have become a limiting factor for covered species, ODF will coordinate with ODFW on potential treatments, though the HCP does not require changed circumstance actions related to aquatic invasive animals or pathogens. ODF does not have comparable commitments under the no action alternative.

The proposed action and Alternatives 3 through 5 commit to an adaptive response to increased stream temperature as a changed circumstance. If data show that the HCP's riparian buffers (RCAs) are not functioning as intended to protect stream temperature, ODF will implement adaptive management of stream buffers, conduct floodplain and off-channel reconnection, encourage large wood production, place large wood structures, and encourage beaver habitat. ODF does not have comparable commitments under the no action alternative.

References

Bangs, B.L., M.S. Collver, and M.H. Meeuwig. 2019. 2018 Oregon Chub Investigations- ODFW Progress Report Series. Oregon Department of Fish and Wildlife. 126 pps.

Bangs, Brian. Aquatic Ecologist. U.S. Fish and Wildlife Service. August 12, 2021—Email to Laura McMullen, ICF, regarding Umpqua chub distribution.

Blevins, E., S. Jepsen, J. Brim Box, and D. Nez. 2016. *Margaritifera falcata* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T91109639A114128748. Available: https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T91109639A91109660.en. Accessed: September 10, 2021.

Blevins, E., S. Jepsen, and S. Selvaggio. 2020. The Xerces Society for Invertebrate Conservation hereby formally petitions to list the western ridged mussel (*Gonidea angulata*) as an endangered species under the Endangered Species Act, 16 USC § 1531 et seq. This petition is filed under 5 USC 553 (e) and 50 CFR 424.14 (a), which grants interested parties the right to petition for issue of a rule from the Secretary of the Interior.

Bowers, J. 2020. Oregon Fish Passage Barrier Data Standard (OFPBDS) dataset. Oregon Department of Fish and Wildlife. Accessed July 26, 2021.

Brenner, G. 2005. Species Fact Sheet- *Rhyacophila haddoki.* Prepared for the Forest Service and BLM Interagency Special Status and Sensitive Species Program.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-27. 261 pp.

California Department of Fish and Wildlife (CDFW). 2015. Southern Oregon - Northern California Coastal Chinook salmon 2015 FSSC Account. Fish Species of Special Concern. California Department of Fish and Wildlife. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=104376. Accessed: September 7, 2021.

California Trout. 2019. Southern Oregon/Northern California Coast Chinook Salmon. Available: https://caltrout.org/sos/species-accounts/salmon/chinook-salmon/southern-oregonnorthern-california-coast-chinook-salmon. Accessed: July 28, 2021.

Clemens, B.J., L. Weitkamp, K. Siwicke, J. Wade, J. Harris, J. Hess, L. Porter, K. Parker, T. Sutton and A.M. Orlov. 2019. Marine biology of the pacific lamprey *Entosphenus tridentatus*. *Revies in Fish Biology and Fisheries* 29:767–788.

Daw, S. 2021. Sculpins. Klamath Inventory and Monitoring Network Featured Creature.

Fitzpatrick, M.S. 1999. *Coastal Steelhead Trout: Life in the Watershed*. Oregon Sea Grant, Oregon State University.

Foster, Alex D., D.H. Olson, and L.L.C. Lawrence. 2015. A review of the biology and conservation of the Cope's giant salamander Dicamptodon copei Nussbaum, 1970 (Amphibia: Caudata: Dicamptodontidae) in the Pacific northwestern region of the USA. *Life: The Excitement of Biology* 2(4):210–246.

FWS (U.S. Fish and Wildlife Service). 2014. Post-delisting Monitoring Plan for the Oregon Chub (*Oregonichthys crameri*). Portland, OR. 45 pp.

FWS (U.S. Fish and Wildlife Service). 2015a. Recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, OR. xii + 179 pages.

FWS (U.S. Fish and Wildlife Service). 2015b. Removing the Oregon Chub From the Federal List of Endangered and Threatened Wildlife. *Federal Register*, 80 FR 9126. February 2015.

Gilroy, M., C. Ingel, L. Lloyd, and J. Zamon. 2021. Eulachon-A Fish Unique to Our West Coast. Poster. Available: https://www.calfish.org/FisheriesManagement/SpeciesPages/Eulachon.aspx. Accessed: July 28, 2021.

Gunckel, S.L., K.K. Jones, and S.E. Jacobs. 2009. Spawning distribution and habitat use of adult Pacific and western brook lampreys in Smith River, Oregon. *American Fisheries Society Symposium* 72:173–189.

Hay, D.E. and P.B. McCarter. 2000. *Status of the Eulachon* Thaleichthys pacificus *in Canada*. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, Research Document 2000-145. Ottawa, Ontario.

House, R.A., and P.L. Boehne. 1987. The effect of stream cleaning on salmonid habitat and populations in a coastal Oregon drainage. *Western Journal of Applied Forestry* 2(3):84–87.

International Union for Conservation of Nature (IUCN). 2015. *Taricha granulosa*. *The IUCN Red List of Threatened Species* 2015: e.T59469A78909317. Available: https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T59469A78909317.en. Accessed: September 2, 2021.

International Union for Conservation of Nature (IUCN). 2021. *The IUCN Red List of Threatened Species*. Version 2021-1. Available: https://www.iucnredlist.org. Accessed: September 2, 2021.

Jelks, H.L., S.J. Walsh, N.M. Burkhead, S. Contreras-Balderas, E. Díaz-Pardo, D.A. Hendrickson, J. Lyons, N.E. Mandrak, F. McCormick, J.S. Nelson, S.P. Platania, B.A. Porter, C.B. Renaud, J. Jacobo Schmitter-Soto, E.B. Taylor, and M.L. Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. *Fisheries* 33(8):372–407.

Jensen, D.W., E.A. Steel, A.H. Fullerton, and G.R. Pess. 2009. Impact of fine sediment on egg-to-fry survival of pacific salmon: a meta-analysis of published studies. *Reviews in Fisheries Science* 17(3):348–359.

Johnson, O.W., W.S. Grant, R.G. Kope, K.G. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status review of coastal cutthroat trout from Washington. Oregon, and California. U.S. Dept. Commer., NOAA Tech Memo. NMFS-NWFSC-37, 292 p.

Jones, L.L.C., P. William, and D.H. Olson. 2005a. Coastal Tailed Frog. *Amphibians of the Pacific Northwest* (pp. 154–157). Seattle Audubon Society.

Jones, L.L.C., P. William, and D.H. Olson. 2005b. Southern Torrent Salamander. In *Amphibians of the Pacific Northwest* (pp. 70–73). Seattle Audubon Society.

Jones, L.L.C., P. William, and D.H. Olson. 2005c. Coastal Giant Salamander. *Amphibians of the Pacific Northwest* (pp. 54–57). Seattle Audubon Society.

Jones, K.K., K. Anlauf-Dunn, P.S. Jacobsen, M. Strickland, L. Tennant, and S.E. Tippery. 2014. Effectiveness of instream wood treatments to restore stream complexity and winter rearing habitat for juvenile coho salmon. *Transactions of the American Fisheries Society* 143(2): 334–345.

Lamprey Technical Workgroup. 2020. Best management guidelines for native lampreys during in-water work. Original Version 1.0, May 4, 2020. 26 pp. + Appendices. Available: https://www.fwx.gov/pacificlamprey/LTWGMainpage.cfm.

Lannoo, M., ed. 2005. *Amphibian Declines: The Conservation Status of United States Species*. University of California Press, Berkeley, CA.

Maurer, E.P., G. Kayser, L. Doyle, and A.W. Wood. 2018. Adjusting flood peak frequency changes to account for climate change impacts in the Western United States. *Journal of Water Resources Planning and Management* 144(3). Online at https://doi.org/10.1061/(ASCE)WR.1943-5452.0000903

McPhail, J.D., and J.S. Baxter. 1996. *A review of bull trout (Salvelinus confluentus) life-history and habitat use in relation to compensation and improvement opportunities*. Ministry of Environment, Lands and Parks.

Meeuwig, M.H., and A.S. Harrison. 2019. Millicoma Dace: current status, future research, and management considerations. Conservation and Recovery-Oregon Department of Fish and Wildlife. September 23, 2019. 16 pps.

Miller, R. R. 2010. Is the past present? Historical splash-dam mapping and stream disturbance detection in the Oregon Coastal Province.

Mongillo, P., and M. Hallock. 1998. *Washington state status report for the margined sculpin*. Washington Department of Fish and Wildlife, Fish Management Program.

Moore, R.D., and S.M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: a review. *Journal of the American Water Resources Association* 41(4):763–784.

Myers, J.M.,C.A. Busack, D. Rawding, A.R. Marshall, D.J. Teel, D.M. Van Doornik, and M.T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and the lower Columbia River basins.

Native Fish Society, Center for Biological Diversity, and Umpqua Watersheds. 2019. Petition to List the Oregon Coast ESU of Spring-Run Chinook Salmon (*Oncorhynchus tshawytscha*) under the Endangered Species Act. September 24.

NatureServe. 2019. *Gasterosteus aculeatus*. *The IUCN Red List of Threatened Species* 2019: e.T8951A58295405. Available: https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T8951A58295405.en. Accessed: September 1, 2021.

NatureServe. 2021a. NatureServe Explorer [Steelhead- Lower Columbia River]. NatureServe, Arlington, VA. Available: https://explorer.natureserve.org/. Accessed: September 8, 2021.

NatureServe. 2021b. NatureServe Explorer [Leopard Dace]. NatureServe, Arlington, VA. Available: https://explorer.natureserve.org/. Accessed: September 9, 2021.

NatureServe. 2021c. NatureServe Explorer [Longnose Dace]. NatureServe, Arlington, VA. Available: https://explorer.natureserve.org/. Accessed: September 9, 2021.

NatureServe. 2021d. NatureServe Explorer [Northern Pikeminnow]. NatureServe, Arlington, VA. Available: https://explorer.natureserve.org/. Accessed: September 9, 2021.

NatureServe. 2021e. NatureServe Explorer [Speckled Dace]. NatureServe, Arlington, VA. Available: https://explorer.natureserve.org/. Accessed: September 9, 2021.

Nawa, R. 2003. A petition for rules to list Pacific lamprey (*Lampetra tridentata*); river lamprey (*Lampetra ayresi*); western brook lamprey (*Lampetra richardsoni*); and Kern Brook lamprey (*Lampetra hubbsi*) as threatened or endangered under the Endangered Species Act. Letter to the U.S. Fish and Wildlife Service, Washington, D.C.

Nedeau, E., A.K. Smith, and J. Stone. 2009. *Freshwater Mussels of the Pacific Northwest*. Xerces Society for Invertebrate Conservation.

NMFS (National Marine Fisheries Service). 2013. *ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead. Northwest Region*. June.

NMFS (National Marine Fisheries Service). 2014a. *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon* (Oncorhynchus kisutch). *West Coast Region.* Arcata, CA. Available: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/southern_oregon_northern_california_coast/southern_oregon_northern_california_coast_salmon_recovery_domain.html.

NMFS (National Marine Fisheries Service). 2014b. Final Endangered Species Act (ESA) recovery plan for the Southern Oregon/Northern California Coast coho salmon (*Oncorhynchus kisutch*) Evolutionarily Significant Unit (ESU) (Final Recovery Plan). *Federal Register*, 79 FR 58750. September 20.

NMFS (National Marine Fisheries Service). 2016a. *Recovery Plan for Oregon Coast Coho Salmon Evolutionarily Significant Unit*. National Marine Fisheries Service, West Coast Region, Portland, OR.

NMFS (National Marine Fisheries Service). 2016b. Summary & Evaluation of Lower Columbia River Chinook Salmon Columbia River Chum Salmon Lower Columbia River Coho Salmon Lower Columbia River Steelhead. May 26, 2016.

NMFS (National Marine Fisheries Service). 2017*. Recovery Plan for the Southern Distinct Population Segment of Eulachon* (Thaleichthys pacificus). National Marine Fisheries Service, West Coast Region, Protected Resources Division, Portland, OR, 97232. September.

ODF (Oregon Department of Forestry). 2010a. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf.

ODF (Oregon Department of Forestry). 2010b. *Southwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/Documents/AboutODF/2010FMPSouthwestOregon.pdf.

ODF (Oregon Department of Forestry). 2019. Webmap. [Full citation pending]

ODFW. (Oregon Department of Fish and Wildlife). 2005 Oregon Native Fish Status Report: Volume II Assessment Methods & Population Results- Appendix A. Inventory of Oregon Native Freshwater Fish Species. https://www.dfw.state.or.us/fish/ONFSR/docs/volume-2-final.pdf.

ODFW (Oregon Department of Fish and Wildlife). 2007. *Oregon Coast Coho Conservation Plan*. Prepared by Prepared by Oregon Department of Fish and Wildlife In Partnership with State and Federal Natural Resource Agencies. March 16, 2007.

ODFW (Oregon Department of Fish and Wildlife). 2008. *Limiting Factors and Threats to the Recovery of Oregon Coho Populations in the Southern Oregon-Northern California Coast Evolutionarily Significant Unit: Results of Expert Panel Deliberations*. September 5.

ODFW (Oregon Department of Fish and Wildlife). 2014. Coastal Multi-Species Conservation and Management Plan. June 2014. Oregon Department of Fish and Wildlife, Salem, OR.

Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS). 2011. Upper Willamette River conservation and recovery plan for Chinook Salmon and steelhead.

ODFW (Oregon Department of Fish and Wildlife). 2021. ODFW Sensitive Species List. Available: https://www.dfw.state.or.us/wildlife/diversity/species/docs/Sensitive_Species_List.pdf.

Olson, Dede, Research Ecologist Team Leader. Personal communication. November 30, 2021—Email to Laura McMullen, ICF.

Olson, D.H., and G. Weaver. 2007. Vertebrate assemblages associated with headwater hydrology in western Oregon managed forests. *Forest Science* 53(2):343–355.

Quinn, Thomas P. 2018. *The Behavior and Ecology of Pacific Salmon and Trout*. University of Washington Press. Seattle, WA.

Reeves, Gordon H.; Pickard, Brian R.; Johnson, K. Norman. 2016. *An initial evaluation of potential options for managing riparian reserves of the Aquatic Conservation Strategy of the Northwest Forest Plan*. Gen. Tech. Rep. PNW-GTR-937. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 97 p.

Russell, K.R., A.A. Gonyaw, J.D. Strom, K.E. Diemer, and K.C. Murk. 2002. Three new nests of the Columbia torrent salamander, rhyacotriton kezeri, in Oregon with observations of nesting behavior. *Northwestern Naturalist* 83(1):19–22.

Spies, T.A., P.A. Stine, R. Gravenmier, J.W. Long, M.J. Reilly, and R. Mazza. 2018. *Synthesis of Science to Inform Land Management in the Northwest Forest Permit Area*. General Technical Report PNWGTR-970. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Stebbins, R.C. 2003. *A field guide to western reptiles and amphibians*. Third edition. Houghton Mifflin Company, Boston.

Tippery, S. E. and K. K. Jones. 2011. Amphibian Distribution in Wadeable Streams and Ponds in Western and Southeast Oregon, 2009-1010. Oregon Department of Fish and Wildlife, Fish Research Project, Progress Report, Corvallis.

Waples, R., D.J. Teel, J.M. Myers, and A.R. Marshall. 2004. Life-history divergence in chinook salmon; historic contingency and parallel evolution. *Evolution* 58(2):386–403.

Xerces Society for Invertebrate Conservation. 2008. Species Fact Sheet-*Rhyacophila chandleri.* Prepared for the Forest Service and BLM Interagency Special Status and Sensitive Species Program.

Xerces Society for Invertebrate Conservation. 2012. Species Fact Sheet-*Rhyacophila chandleri.* Prepared for the Forest Service and BLM Interagency Special Status and Sensitive Species Program.

Xerces Society for Invertebrate Conservation. 2016. Species Fact Sheet-*Lepidostoma astanea.* Prepared for the Forest Service and BLM Interagency Special Status and Sensitive Species Program.

Xerces Society for Invertebrate Conservation and the Confederated Tribes of the Umatilla Indian Reservation Mussel Project. 2021. Western Freshwater Mussel Database. Available: http://www.xerces.org/endangered-species/freshwater-mussels/database.

Appendix 3.6-B
Terrestrial Wildlife Species Technical Supplement

Species and Modeling Information

Covered Species

The following subsections summarize the status, habitat requirements, and environmental stressors relevant to each of the Western Oregon State Forests Habitat Conservation Plan (HCP) terrestrial covered species. The methods for developing habitat models used to analyze effects on covered species are described in the HCP Appendix E, Table 1 of the Terrestrial Modeling section. The forest modeling that predicts habitat changes over time is described in EIS Appendix 3.1-B, *Forest Management Modeling*.

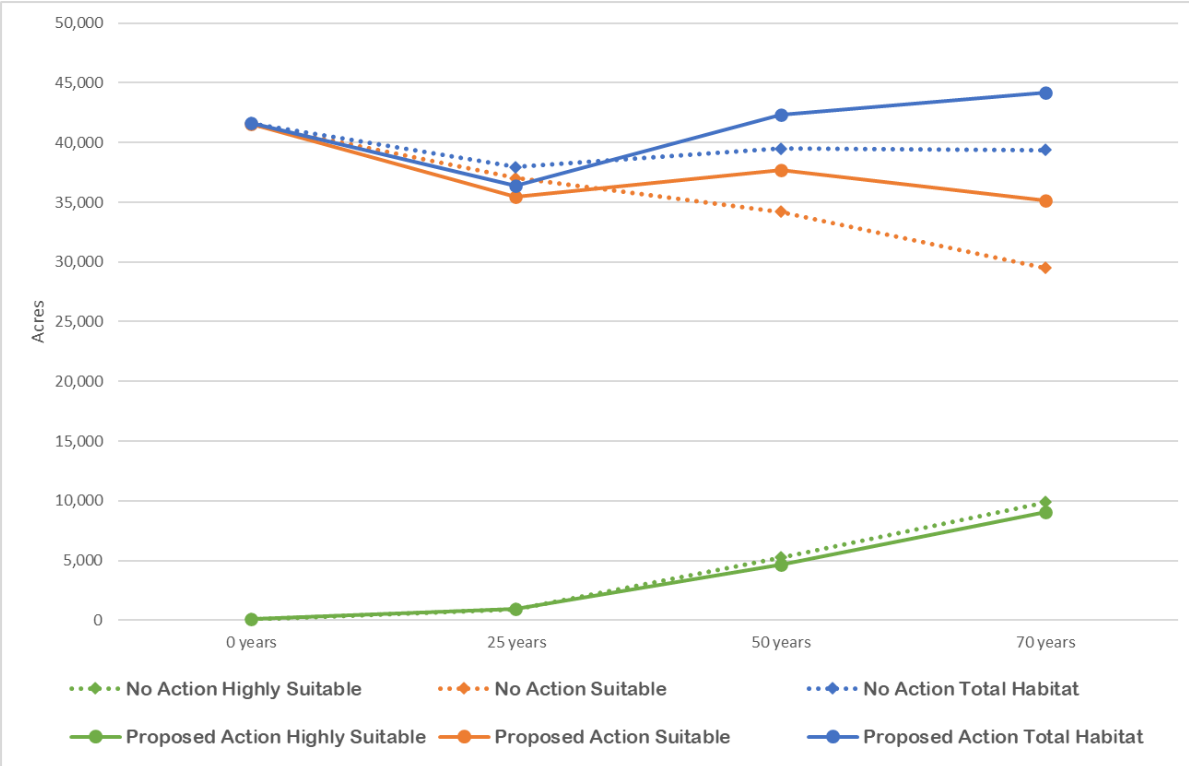
Additional detail for each terrestrial species is provided in Appendix C of the HCP.

Oregon Slender Salamander

The Oregon slender salamander is a candidate for federal listing as threatened or endangered (Federal Docket No. FWS-Rl- ES2015-0057). Most of the species' range is on the western slopes of the Cascades, but it is also found on the eastern slope (AmphibiaWeb 2021). Primary Oregon slender salamander habitat characteristics include moisture, downed wood, and older forests (more than 76 years), although the species may occur in younger forests if legacy downed wood is retained. The Oregon slender salamander is threatened by activities that affect surface substrate and ground cover including downed wood, soil compaction, fire, chemical application, changes in microhabitat and microclimate regimes, and climate change.

Based on the Oregon slender salamander model projections, the total amount of habitat would decrease throughout the analysis period under the no action alternative, while under the proposed action, the total amount of habitat would decrease during the first 25 years and then increase by the end of the analysis period to an amount greater than under the no action alternative (Figure 1). Under both the no action alternative and proposed action, the projected amounts of modeled highly suitable habitat would increase throughout the analysis period (Figure 1). The projected amounts of modeled habitat for this species under Alternative 4 would be the same as the proposed action during the first 50 years of the analysis period. All modeled habitat projections would be within 0.5 percent of the proposed action projections under Alternatives 3 and 5 by the end of the analysis period.

Figure 1. Modeled Oregon Slender Salamander Habitat (acres) in the Permit Area—No Action Alternative and Proposed Action



Source: Oregon Slender Salamander Habitat Model

Northern Spotted Owl

The northern spotted owl is state and federally listed as threatened. Critical habitat has been designated for the species and recently revised (86 *Federal Register* [FR] 62606-62666) and a recovery plan has been completed and revised (FWS 2011a). The current range of the northern spotted owl extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (FWS 2011a). The U.S. Fish and Wildlife Service (FWS) identifies past and current habitat loss and competition from barred owls as the greatest threats to the species (FWS 2020). Climate change and high-severity wildfires are also stressors on the species (FWS 2020).

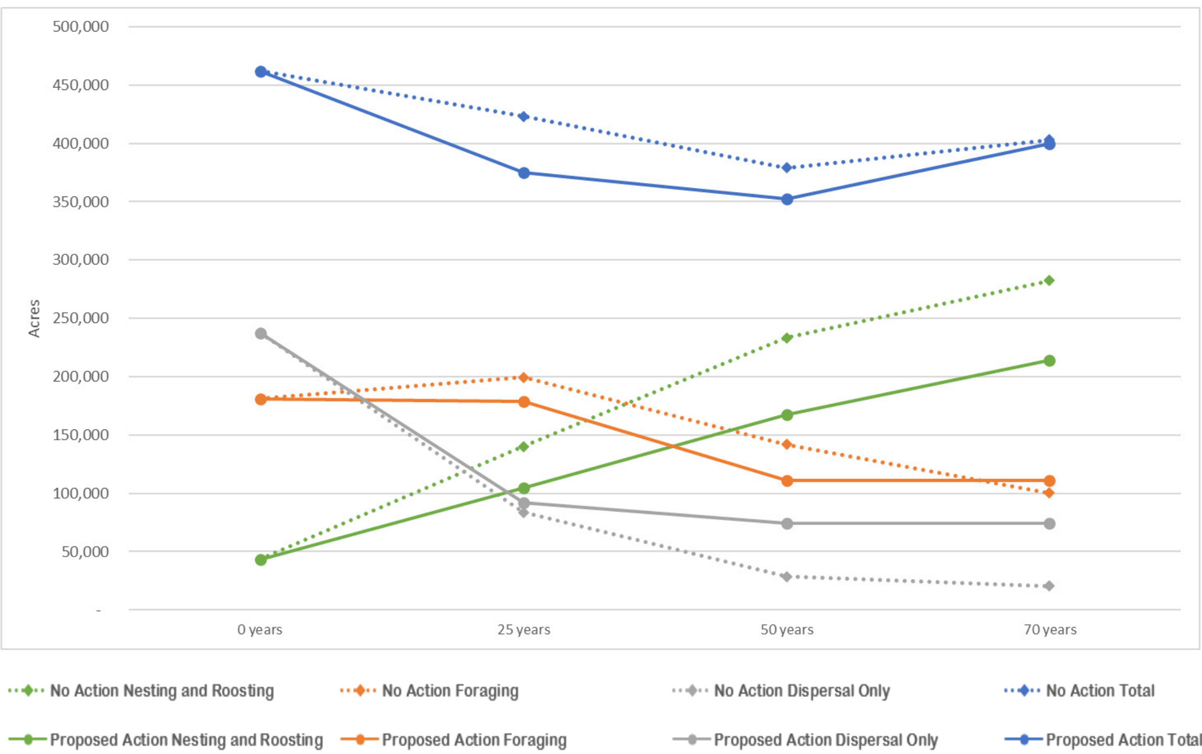
Northern spotted owl occurs in the plan area in the Coast Range counties of Clatsop, Tillamook, Washington, Yamhill, Polk, Lincoln, Benton, Lane, Douglas, Coos, Curry, Josephine, and Jackson and the Western Cascade counties of Clackamas, Marion, and Linn. The permit area includes 20 active northern spotted owl activity centers confirmed to be occupied by pairs.[1] There are 142 northern spotted owl sites with activity centers located outside of the permit area but within the provincial radius of permit area lands (the *provincial radius* is a circle centered around the activities with a 1.2- to 1.3-mile radius depending on location). Using the provincial radius, owl circles that overlap the permit area include 119 sites with confirmed pairs, 5 sites with unconfirmed pairs, and 18 sites with

[1] *Active activity centers* are defined as those activity centers that have been confirmed at one point and have had less than 6 consecutive years of surveys with no observations.

resident single owls. Because northern spotted owl numbers continue to decline throughout the species' range, not all of these sites currently support owls.

Based on the northern spotted owl habitat model projections, total amount of nesting and roosting habitat would increase over the analysis period for both the no action alternative and the proposed action (Figure 2), though increases would be less under the proposed action. However, the model results for the proposed action reflect greater certainty than those for the no action alternative because they are based on the protection of designated HCAs for the duration of the permit term, whereas the no action alternative habitat results are based on avoidance due to assumed occupancy that is uncertain. Decreases in modeled foraging habitat over the permit term would trend similar to the no action alternative. Modeled dispersal habitat would decrease through year 25 and remain stable through the remainder of the permit term resulting in more dispersal habitat by the end of the permit term and greater habitat connectivity compared to the no action alternative. The projected amounts of modeled habitat for this species under Alternative 4 would be the same as the proposed action during the first 50 years of the analysis period. All modeled habitat projections would be similar to the proposed action projections under Alternatives 3 and 5 by the end of the analysis period, with less than 2 percent fewer acres under Alternative 3 and less than 4 percent fewer acres under Alternative 5.

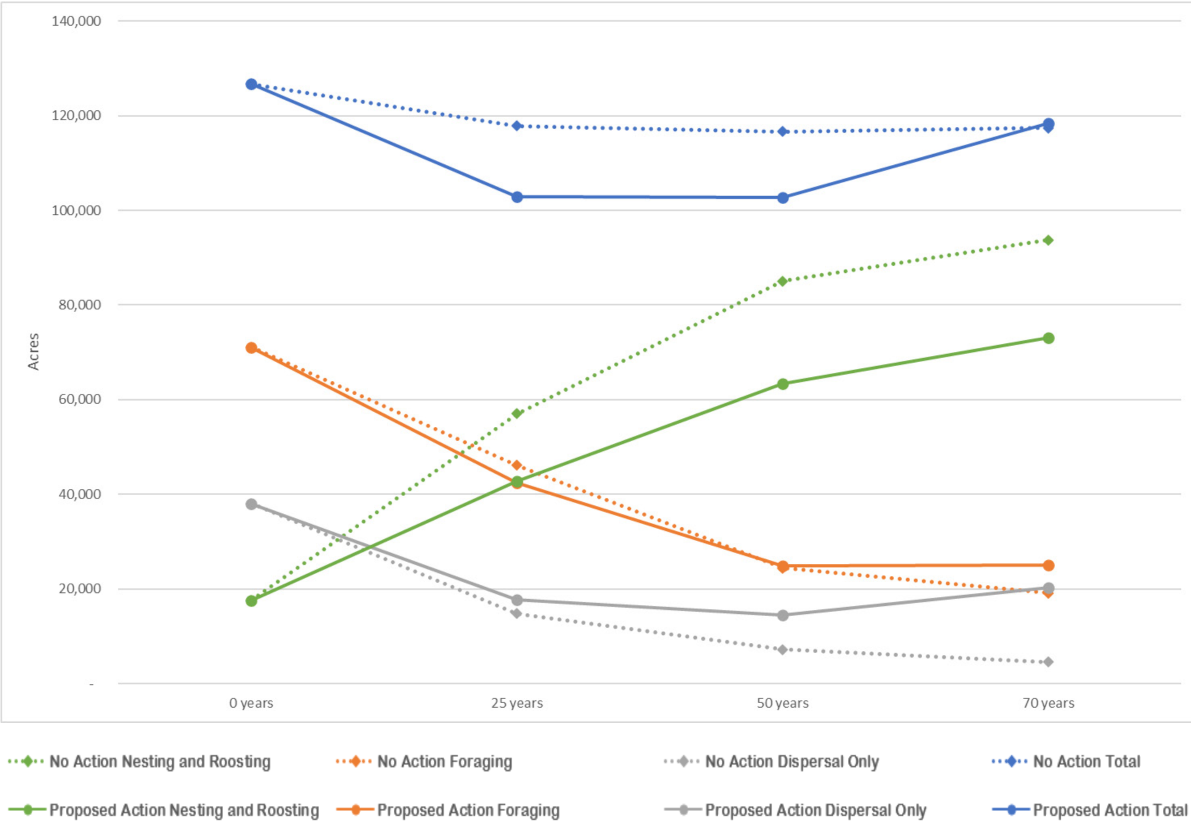
Figure 2. Modeled Northern Spotted Owl Suitable Habitat (acres) in the Permit Area—No Action Alternative and Proposed Action



Source: Northern Spotted Owl Habitat Model

Based on the northern spotted owl habitat model projections, habitat within designated critical habitat units would following similar trends as for the entire permit area (Figure 3).

Figure 3. Modeled Northern Spotted Owl Habitat (acres) within Designated Critical Habitat Units in the Permit Area—No Action Alternative and Proposed Action



Source: Northern Spotted Owl Habitat Model

Marbled Murrelet

The marbled murrelet is state and federally listed as threatened (57 FR 45328). Critical habitat was designated in 2016, and a recovery plan for the species was completed in 1997. Marbled murrelets breed along the Pacific coast of North America from the Bering Sea to the Santa Cruz mountains of California (Ralph et al. 1995; Burger 2002). Within the permit area, marbled murrelet nesting is concentrated in the northwest portion of the permit area (i.e., the Tillamook and Astoria Districts) and in the central Oregon Coast area (West Oregon District) near the Elliott State Forest and Siuslaw National Forest.

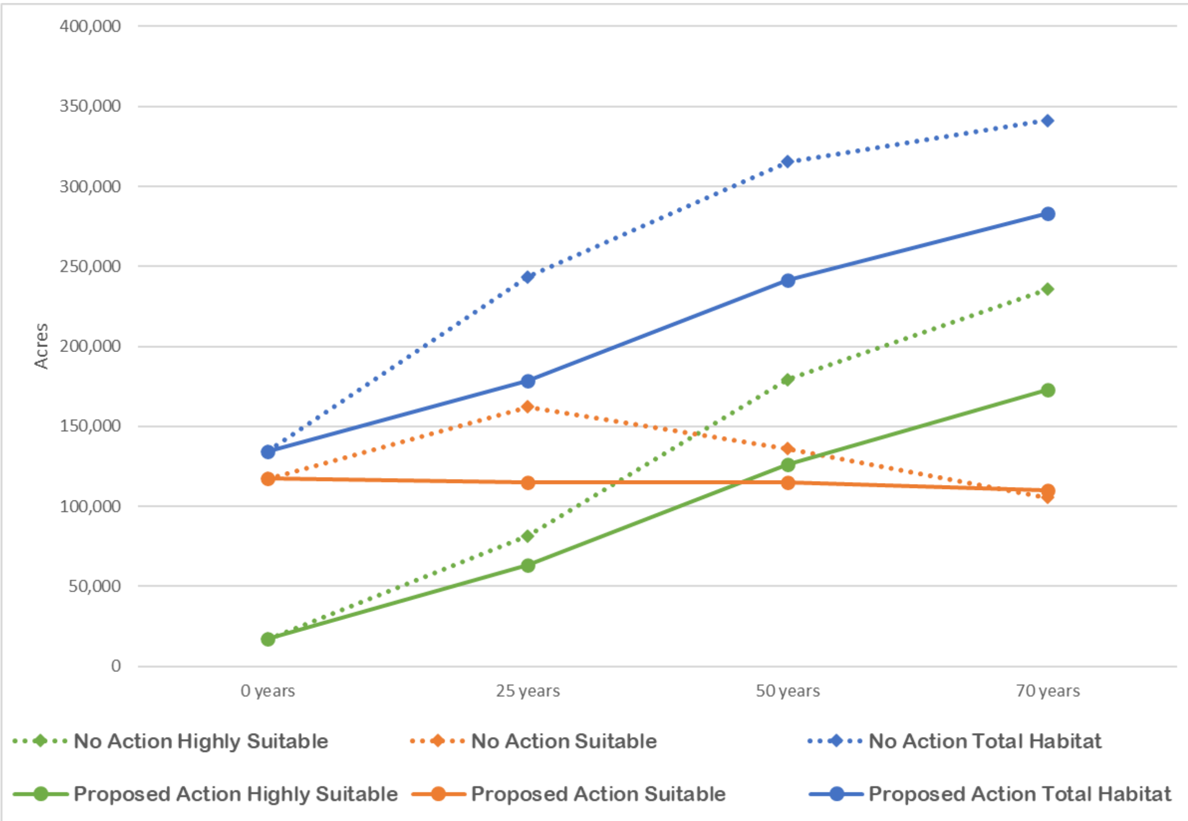
Marbled murrelets nest in trees up to 55 miles inland (Spies et al. 2018), typically in large conifers in late-successional forests. Murrelet nesting habitat requirements include nesting platforms, adequate canopy cover over the nest, large patch size of mature forest, and within commuting distance to the marine environment to allow foraging (McShane et al. 2004; Ralph et al. 1995; Spies et al. 2018).

Threats to marbled murrelets include loss and degradation of late-seral forests due to harvest and wildfires, habitat fragmentation, and climate change (Raphael et al. 2018; Spies et al. 2018; ODFW 2018).

Based on the marbled murrelet model projections, the amount of highly suitable modeled habitat and total modeled habitat would increase throughout the analysis period for both the no action alternative and the proposed action but to a lesser degree under the proposed action (Figure 4).

However, the model results for the proposed action reflect greater certainty than those for the no action alternative, as described for northern spotted owl. The projected amounts of modeled habitat for this species under Alternative 4 would be the same as the proposed action during the first 50 years of the analysis period. All modeled habitat projections under Alternatives 3 and 5 are similar to the proposed action by the end of the analysis period, with less than 1 percent fewer acres under Alternative 3 and between 2 and 4 percent fewer acres under Alternative 5.

Figure 4. Modeled Marbled Murrelet Suitable Habitat (acres) in the Permit Area—No Action Alternative and Proposed Action



Source: Marbled Murrelet Habitat Model

Coastal Marten

The coastal marten is federally listed as threatened (83 FR 50574). Coastal martens historically occurred in the coastal forests of Oregon and California, but they have not been detected since 1980 throughout much of the species' historic range despite extensive surveys (FWS 2018). There are no known recent occurrences of coastal martens in the permit area, although Oregon Department of Forestry (ODF) lands are located within the species' known range and suitable habitat is present in the permit area.

Martens require suitable resting and denning structures, including large-diameter trees with horizontal limbs, cavities in snags, and downed hollowed logs. In the Central Coastal Oregon Extant Population Area they also use squirrel nests and basal hollows from overturned trees (FWS 2018). Martens select enough habitat to allow home ranges with enough sources of seasonally available food to ensure food is available year-round, with den sites, and with access to mates while not overlapping with same-sex individuals (Katnik et al. 1994). Types of structures needed for resting, denning, and foraging can vary within season, so a diversity of resting structures in a home range is important. The distribution of habitat patches large enough to support multiple home ranges in the landscape affects habitat selection and the ability of martens to disperse to new, suitable home ranges (FWS 2018).

A habitat model was not developed to analyze effects on coastal marten. Instead, the forest model, described in Appendix 3.1-B, was used to estimate effects on this species as described in Section 3.6, *Fish and Wildlife*.

Red Tree Vole

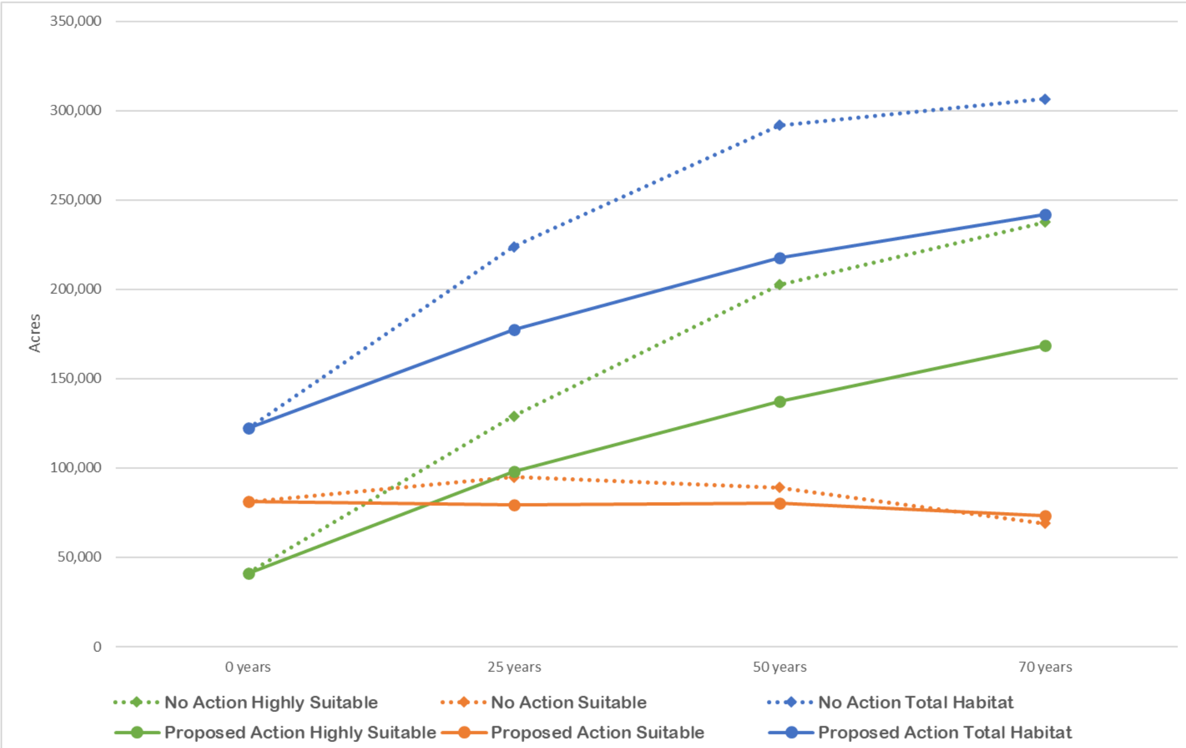
The North Oregon Coast distinct population segment (DPS) of red tree vole is a federal candidate for listing as threatened or endangered (84 FR 69707–69712). The range of this DPS includes the Oregon Coast Range from the Columbia River south to the Siuslaw River, and eastward to the western edge of the Willamette Valley (FWS 2011b).

Red tree vole occurs primarily in structurally complex late-seral conifer or mixed conifer-hardwood forests (FWS 2011b; Rosenberg et al. 2016; Linnell et al. 2017). Attributes of late-successional forest positively correlated with habitat suitability include large-diameter trees; density of large conifers; percent of conifer cover; percent of food source trees such as Douglas-fir, Sitka spruce, and western hemlock; structural diversity; and extent of old forest cover.

The North Oregon Coast DPS of red tree vole is primarily threatened by habitat loss and fragmentation from timber harvest and wildfire (FWS 2011b). Logging and relatively short rotation intervals preclude the development of late-successional forest habitat and maintain forests in early seral stages. Fragmentation by continued logging on short rotation intervals adjacent to old forest habitat further isolates and diminishes the quality of remnant patches of old forest habitat (Forsman et al 2016). Active management, such as thinning, can also reduce vole numbers or eliminate them (Forsman et al 2016).

Based on the red tree vole model projections, the amount of highly suitable modeled habitat and total modeled habitat would increase throughout the analysis period for both the no action alternative and the proposed action but less substantially under the proposed action (Figure 5). However, the model results for the proposed action reflect greater certainty than those for the no action alternative, as described for northern spotted owl. The projected amounts of modeled habitat for this species under Alternative 4 would be the same as the proposed action during the first 50 years of the analysis period. All modeled habitat projections under Alternatives 3 and 5 are similar to the proposed action by the end of the analysis period, with less than 1.5 percent fewer acres under Alternative 3 and less than 4 percent fewer acres under Alternative 5.

Figure 5. Modeled Red Tree Vole Habitat (acres) in the Permit Area—No Action Alternative and Proposed Action



Source: Red Tree Vole Habitat Model

Noncovered Wildlife Species

Tables 1 through 3 describe habitat requirements for the noncovered wildlife species evaluated in the environmental impact statement (EIS).

Table 1. Noncovered Forest-Dependent Wildlife Species Evaluated in the Environmental Impact Statement

Species Common Name	Habitat Requirements
Hoary bat	Late-seral forests.
Wolverine	Subalpine and alpine forests for foraging and steep, snowy habitat above the timberline for dens. Conservation of lowland valleys needed to allow for movement between high-elevation refugia.
Townsend's big-eared bat	Usually caves, mines, and isolated buildings, but occasionally use hollow trees for roosting.
Ringtail	Low-elevation forests with large-diameter snags and logs for dens. Typically associated with late-seral forests. They may also use riparian and rocky areas.
Fisher	Forests with moderate to dense canopy cover and diverse structural stages and plant communities.
Silver-haired bat	Late-seral conifer forests.
Fringed myotis	Forest habitat with large snags and rock features for day, night, and maternity roosts, and caves and mines for hibernacula.
Long-legged myotis	Late-seral conifer forests or other forested habitat with late-seral components.

Species Common Name	Habitat Requirements
Gray wolf	Forested landscape with adequate prey (e.g., deer, elk).
California myotis	Forests with large snags for day roosts.
Western gray squirrel	Oak woodlands, oak savannas, and mixed oak-pine-fir woodlands.
Sierra Nevada red fox	High-elevation meadows and forests.
Olive-sided flycatcher	Open mature forests, often near water and with tall, prominent trees and/or snags. Forest openings (e.g., burns, harvested forest), and forest edges.
Northern goshawk	Large, forested areas with a mosaic of tree stages, forest openings, and habitat components (e.g., snags, downed logs). Open forest floor for access to ground-dwelling prey.
Pileated woodpecker	Mixed coniferous forests, especially late-successional stands. Large-diameter trees and snags for nest and roost sites and large-diameter snags and logs for foraging sites.
Purple martin	Abundant tree cavities for nesting, in close proximity to water and large forest openings for foraging.
White-headed woodpecker	Mature trees for foraging and snags for nesting, in open ponderosa pine woodlands.
Flammulated owl	Mid-elevation forests (3,880–4,600 feet) with small, dense thickets for roosting and open patches of grassland/meadow for foraging. Medium to large snags or deformed trees with existing woodpecker holes/cavities for nesting.
Great gray owl	Late-seral forests for nesting, and grassy openings for foraging.
Black-backed woodpecker	Forests, usually above 5,000 feet. Dead trees with heartrot for nesting and with high densities of wood-boring beetles for foraging. Large-scale forest disturbances that produce a high density of snags (e.g., forest fires, disease pockets, and bark beetle outbreaks).
American three-toed woodpecker	Forests, usually above 5,000 feet. Dead trees with heartrot for nesting and with high densities of wood-boring beetles for foraging. Large-scale forest disturbances that produce a high density of snags (e.g., forest fires, disease pockets, and bark beetle outbreaks).
Common nighthawk	Forest clearings for nesting.
Lewis's woodpecker	Large snags for nesting (especially soft or well-decayed snags), and relatively open canopy for flycatching.
Chipping sparrow	Open forests and drier woodland edges. Sparse, herbaceous understories for foraging.
Acorn woodpecker	Oak woodlands with high canopies and relatively open understories. Dead limbs or snags for storing acorns.
Slender-billed nuthatch	Mature, large-diameter oak trees for foraging and nesting cavities. High canopy cover in connected patches.
Del Norte salamander	Closed-canopy coastal forests with mixed hardwood/conifer.
Clouded salamander	Forest habitat including burned areas. Talus, debris, or large, decaying logs.
Larch Mountain salamander	Moist forest floor microclimates; may require late-seral forests, especially those with gravel or fractured rock in the soil.
Siskiyou Mountains salamander	Cool, moist, forest floor microhabitats in late-seral forests.
Oregon shoulderband	Moist forest floor with ground cover, including talus, rock fissures, or woody debris.

Table 2. Noncovered Riparian-Dependent Wildlife Species Evaluated in the EIS

Species Common Name	Habitat Requirements
Mammals	
Columbian white-tailed deer	Columbia River DPS: riparian habitat along the Columbia River. Umpqua population: riparian areas and lower-elevation oak woodlands.
Birds	
Yellow-breasted chat	Dense, brushy thickets, typically near streams.
Mountain quail	Shrubby riparian habitat adjacent to grassy uplands.
Willow flycatcher	Dense riparian shrub habitat, especially willows.
Invertebrates	
Pacific walker	Semi-aquatic snails that inhabit riparian areas, typically among wet vegetation.

Table 3. Noncovered Wetland-Dependent Wildlife Species Evaluated in the EIS

Species Common Name	Habitat Requirements
Birds	
American white pelican	Use shallow-water areas for cooperative feeding. Nest on islands in rivers, lakes, and freshwater marshes.
Short-eared owl	Large expanses of marshes and wet prairies.
Red-necked grebe	Lakes and ponds within forested landscape. Deep water for foraging and marshy emergent vegetation for nesting.
Reptiles	
Western pond turtle	Marshes, streams, rivers, ponds, and lakes.
Painted turtle	Marshy ponds, small lakes, slow-moving streams, and off-channel portions of rivers.
Amphibians	
Western toad	Wetlands, ponds, and lakes for breeding.
Northern red-legged frog	Shallow-water ponds and wetlands with emergent vegetation. For breeding, they require forested sites with exposed (sunny), still-water habitat.
Cascades frog	Mountain meadows, bogs, ponds, or potholes above 2,400 feet elevation.
Oregon spotted frog	Permanent ponds, marshes, and meandering streams through meadows.
Invertebrates	
Stonefly (unnamed)	Seasonally dry, low-elevation stream beds. Currently known only to an approximately 0.25-mile stretch of a single stream on the West Fork of Willow Creek (near Eugene, OR).
Robust walker	Perennial streams and rivulets.
Black petaltail	Forested areas with access to moist seeps.
Siskiyou hesperian	Spring seeps, under leaf litter.
Beller’s ground beetle	Sphagnum bogs with open water
Columbia Gorge hesperian	Associated with seeps and springs.
Insular blue butterfly	Wet, open habitat, e.g., bogs, meadows, ditches
Mardon skipper butterfly	Meadows
Franklin’s bumble bee	Meadows
Great spangled fritillary	Associated with violets

Responses to Changes in Baseline Conditions

This section describes the difference in ODF responses to changes in baseline conditions, such as catastrophic events, between the proposed action and Alternatives 3 through 5 and the no action alternative for the *Western Oregon State Forests* HCP EIS.

Changed and Unforeseen Circumstances and Responses Defined in the Western Oregon State Forests HCP

Many changes in circumstances during the term of an incidental take permit can reasonably be anticipated and planned for in the HCP (e.g., listing of new species, fire or other natural catastrophic event in areas prone to such events). An HCP must describe the modifications in the project or activity that will be implemented if these circumstances arise. These are termed *changed circumstances*. *Unforeseen circumstances* are changes in circumstances that result in a substantial and adverse change in the status of a covered species in the geographic area covered by an HCP that could not reasonably have been anticipated at the time of the HCP's negotiation and development (e.g., the eruption of Mount St. Helens).

As defined in the HCP Chapter 7, temporary change in species habitat quality from natural events including fire, storm, or exotic species invasion events would constitute a changed circumstance if up to 50 percent of any one HCA is affected in 1 calendar year, or up to 5,000 acres of HCAs collectively are affected in 1 calendar year, from any combination of these events. Events collectively exceeding either of these thresholds would be considered an unforeseen circumstance. Other changed and unforeseen circumstances defined in the HCP include aquatic invasive plants, nonnative fish and disease/parasites, and stream temperature changes. These topics are discussed in Appendix 3.6-A, *Fish and Stream-Dependent Species Technical Supplement*.

If natural events considered to be changed circumstances were to occur and the Stay-Ahead provision[2] for habitat conservation were not being met as a result, ODF would be required to defer harvest in other areas with the aim of providing temporary refuge for the covered species that is not meeting the Stay-Ahead provision. The deferment would be observed until the Stay-Ahead provision for the covered species is met, or until the end of the 10-year district implementation plan cycle, whichever comes first. If, despite deferments, the Stay-Ahead provision is not met by the end of the implementation plan cycle, the 10-year comprehensive review would identify opportunities to meet the Stay-Ahead requirement during the next implementation plan. In no event would deferments associated with any specific disturbance event exceed 20 years. Potential deferments would not result in reductions to implementation plan harvest volume or acres in total but would shift harvest priorities to locations that would allow the portion of the permit area affected by the natural event to recover for a period of time before harvest in the area resumes.

If natural events considered to be unforeseen circumstances were to occur, ODF would not be required to commit any additional land or financial compensation or additional harvest restrictions, although ODF would continue to be subject to the forest practices rules and any other applicable laws. The HCP states, "ODF will not be obligated to address unforeseen circumstances but will work

[2] The *Stay-Ahead provision* is the HCP's commitment for habitat conservation acres to stay ahead of impact acres throughout the permit term.

with the [FWS] and [National Marine Fisheries Service] to address them within the funding and other constraints of the HCP should they occur."

Historical and Projected Future Catastrophic Events

Storms and fires regularly affect forests in western Oregon. The frequency, intensity, and duration of these events are expected increase with climate change. Severe storms have historically affected a large fraction of western Oregon. Where relatively detailed and complete records are available from 1950 to 2020, approximately one severe storm has occurred every 2 years in the Pacific Northwest (Appendix 3.2, *Disturbance and Climate Change*), all of which have been important in the mid- and northern Oregon Coast Range. Severe storms cause extensive destruction in the form of blowdown,[3] landslides, and flooding and generally affect a substantial fraction of one geographic area (e.g., northern Coast Range). Strong winds, predominantly during major cyclones, have accounted for 80 percent of regional tree mortality (Kirk and Franklin 1992). In the Oregon Coast Range blowdown occurrence has been much more pronounced in managed forests than in naturally late-successional forests (Schmidt et al. 2001). By the end of the 70-year analysis period, the record will likely contain the most severe storms ever recorded in western Oregon as a result of increased intensity of atmospheric river events (Hagos et al. 2016; Warner et al. 2015).

Major fires have burned a long-term average of about 0.5 percent of western Oregon per year since records have been kept. Between 1950 and 2020, an average of 40,315 acres burned per year. The vast majority (85 percent) of fires between 1967 and 2020 were smaller than 1 acre, and together accounted for 0.2 percent of total burned acres. The seven recorded fires that exceeded 100,000 acres accounted for 58 percent of the total burned acreage, and the 28 fires of 10,000 to 100,000 acres in size accounted for another 28 percent. Thus, although fires that burn over 10,000 acres are far less common than small fires, they account for most of the burned acreage. Table 1 in Appendix 3.2 lists acres burned in the large fires known to have occurred in western Oregon in recorded history. Given the increased frequency, severity, and extent of fires predicted with climate change, burned area would be expected to exceed the 0.5 percent annual average in western Oregon.

The HCP includes 264 HCAs, totaling 274,617 acres, averaging approximately 1,000 acres, and ranging in size from 1 acre to 47,376 acres. Disturbance of up to 50 percent of any one HCA or up to 5,000 acres of HCAs collectively in given year (i.e., changed circumstances) is expected to happen regularly over the analysis period, and disturbances that exceed these thresholds (i.e., unforeseen circumstances) are likely to occur during the analysis period.

Potential Effects of Response to Changes in Baseline Conditions under the Proposed Action Compared with No Action Alternative

Under the no action alternative, ODF would avoid habitat occupied by federally listed species. As such, if a catastrophic event affects areas occupied by covered species and those species are able to move to an undisturbed portion of the permit area, ODF would avoid those newly occupied areas to avoid take.

[3] *Blowdown* is loss of timber when trees are either blown down or broken off. It is usually measured in units of board feet because nearly all inventories of this damage are performed in connection with timber management activities.

Under the proposed action (with the HCP), HCAs would remain static, except for temporary refugia required under changed circumstances provisions. If a catastrophic event removed covered species' habitat in a large portion of the HCAs, take allowances would not be adjusted and harvest of occupied or potentially occupied habitat outside the HCAs would continue, except for the temporary protections under changed circumstances defined in the HCP. ODF's response would depend on whether the event is categorized as changed or unforeseen circumstance, as follows.

- If the event constitutes a changed circumstance, the temporary habitat refugia outside the affected HCAs, if needed to meet the Stay-Ahead requirements, could be deferred from harvest up to 20 years. Given that mature forests can take several decades to recover to pre-disturbance conditions, particularly with reburns,[4] affected areas may not have recovered, or covered species would not have been able to shift back into the affected areas in this timeframe.
- If the event is large enough to be categorized as an unforeseen circumstance, ODF would not be required to commit any additional restrictions or financial compensation to offset effects on the mitigation lands beyond those already specified in the HCP. Although not explicitly stated, ODF would likely provide the level of response required in the HCP under changed circumstances, with no more than 5,000 acres of deferred harvest (to offset impacts on up to 5,000 acres under changed circumstances). For example, if 50,000 acres in the HCAs burned in a given year, ODF would not be obligated to offset more than 5,000 of those acres with deferred harvest but would still retain full take authorization. If a substantial amount of habitat occupied by covered species were to be burned in the HCAs, occupied habitat outside the HCAs would still remain available for covered activities, potentially causing declines in populations of covered species.

References Cited

AmphibiaWeb. 2021. *AmphibiaWeb: Information on amphibian biology and conservation. [web application]*. *Batrachoseps wrighti*. Berkeley, California. Accessed: 19 November 2021.

Burger, A. E., Canadian Wildlife Service, and Pacific and Yukon Region. 2002. *Conservation Assessment of Marbled Murrelets in British Columbia: A Review of the Biology, Populations, Habitat Associations, and Conservation*. Canadian Wildlife Service, Pacific and Yukon Region, Delta, BC.

Forsman, E.D., J.K. Swingle, R.J. Davis, B.L. Biswell, and L.S. Andrews. 2016. Tree voles: an evaluation of their distribution and habitat relationships based on recent and historical studies, habitat models, and vegetation change. USFS General Technical Report PNW-GTR-948. October

FWS (U.S. Fish and Wildlife Service). 2011a. *Revised Recovery Plan for the Northern Spotted Owl* (Strix occidentalis caurina). U.S. Fish and Wildlife Service, Portland, OR, USA.

FWS (U.S. Fish and Wildlife Service). 2011b. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List a Distinct Population Segment of the Red Tree Vole as Endangered or Threatened. 76 FR 63720-63762.

FWS (U.S. Fish and Wildlife Service). 2018. *Species Status Assessment for the Coastal Marten*. Version 2.0. July 2018. U.S. Fish and Wildlife Service. Region 8. Arcata, CA.

[4] As described in Appendix 3.2, *Disturbance and Climate Change Technical Supplement*, reburns may occur soon or up to several decades after the initial fire, commonly affecting one-third to two-thirds of the initially burned areas.

FWS (U.S. Fish and Wildlife Service). 2020. *Endangered and Threatened Wildlife and Plants; 12-Month Finding for the Northern Spotted Owl.* 50 CFR Part 17. Federal Register / Vol. 85, No. 241 / December 15, 2016. P. 8144.

Hagos, S.M., L.R. Leung, J. Yoon, J. Lu, and Y. Gao. 2016. A projection of changes in landfalling atmospheric river frequency and extreme precipitation over western North America from the Large Ensemble CESM simulations. *Geophys. Res. Lett.* 43(3):1357–1363.

Katnik, D.D., D.J. Harrison, and T.P. Hodgman. 1994. Spatial Relations in a Harvested Population of Martens in Maine. *Journal of Wildlife Management* 58:600–607.

Kirk, R., and J.F. Franklin. 1992. *The Olympic Rain Forest*. University of Washington Press, Seattle, WA.

Linnell, M.A., R.J. Davis, D.B. Lesmeister, and J.K. Swingle. 2017. Conservation and Relative Habitat Suitability for an Arboreal Mammal Associated with Old Forest. *Forest Ecology and Management* 402:1–11

McShane, C., T. Hamer, H. Carter, V. L. Friesen, D. Ainley, R. Tressler, S. K. Nelson, A. E. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. *Evaluation Report for the 5-Year Status Review of the Marbled Murrelet in Washington, Oregon, and California*. Page 370.

ODFW (Oregon Department of Fish and Wildlife). 2018. *Status Review of the Marbled Murrelet (Brachyramphus marmoratus) in Oregon and Evaluation of Criteria to Reclassify the Species from Threatened to Endangered under the Oregon Endangered Species Act*. Page 134.

Ralph, J.C., G.L. Hunt, Jr., M.G. Raphael, and J.F. Piatt. 1995. *Ecology and Conservation of the Marbled Murrelet.* Page 13. General Technical Report PSW-GTR-152, U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Raphael, M.G., G.A. Falxa, and A.E. Burger. 2018. *Marbled Murrelet*. Chapter 5 in T.A. Spies, P.A. Stine, R. Gravenmier, J.W. Long, and J.W. Reilly (eds.), Synthesis of Science to Inform Land Management in the Northwest Forest Permit Area. General Technical Report PNW-GTR-966. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Rosenberg, D.K., R.J. Davis, K.J. Van Norman, J.R. Dunk, E.D. Forsman, and R.D. Huff. 2016. *Patterns of Red Tree Vole Distribution and Habitat Suitability: Implications for Surveys and Conservation Planning*. Ecosphere 7(12):e01630. 10.1002/ecs2.1630.

Schmidt, K.M., J.J. Roering, J.D. Stock, W.E. Dietrich, D.R. Montgomery, and T. Schaub. 2001. The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range. *Canadian Geotechnical Journal* 38(5):995–1024.

Spies, T.A., P.A. Stine, R. Gravenmier, J.W. Long, M.J. Reilly, and R. Mazza. 2018. *Synthesis of Science to Inform Land Management in the Northwest Forest Permit Area*. General Technical Report PNWGTR-970. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Warner, M.D., C.F. Mass, and E.P. Salathé. 2015. Changes in Winter Atmospheric Rivers along the North American West Coast in CMIP5 Climate Models. *Journal of Hydrometeorology* 16(1):118–128.

Appendix 3.10
Cultural Resources Technical Supplement

Cultural Setting Context Statement

Precontact Context

Archaeological evidence for the human habitation of western Oregon dates back at least 11,500 years (Davis et al. 2011). The early evidence of humans in this region is limited, likely at least in part because habitation and use sites along the coast were inundated by eustatic sea level rise and other geological processes following the end of the Pleistocene epoch (McLaren et al. 2019). However, early Paleolithic sites in the Northern Great Basin area of eastern Oregon and Cooper's Ferry, Idaho suggest that the larger region has been occupied for more than 16,000 years (Smith et al. 2019; Jenkins et al. 2012). Numerous sites in western Oregon have contained projectile points characteristic of the Paleo-Indian culture, which was thought to have prioritized hunting large mammals (Connolly 1994). As climatic change at the end of the Pleistocene saw western Oregon become warmer and drier, people in the region turned to broad-spectrum hunting, fishing, and plant gathering in what became known as the Archaic era. By 8,000 years before present, archaeological evidence shows that people had spread across western Oregon, primarily living along the lower Columbia River, in the river valleys, and around coastal estuaries. Around 3,000 years ago, the mobile, broad-spectrum resource gathering and foraging pattern was largely replaced by a more sedentary, collector strategy with a heavy emphasis on riverine and streamside resources (Cox 2016). By 2,000 years before present, the collector pattern was widespread and pit house villages were established at fishing sites along inland rivers, while plank houses villages were built along the coast (Byram 2006a; Pullen 1996). Plant food processing tools such as mortars, metates, and pestles indicate the significance of plant food resources, while projectiles, scrapers, and a variety of flaked stone tools show a continued emphasis on hunting upland mammals. This pattern continued to persist into the historic past and is characteristic of the ethnographic lifeways of the diverse groups living in western Oregon at the time of historic contact.

Ethnographic Context

The area of potential effects (APE) encompasses the traditional ranges of numerous Native American groups present during the period of contact between Native Americans and Europeans and European Americans. These groups included the Clatskine, Chinook, Tillamook, Siletz, Alsea, Molala, Kalapuya, Klamath, Siuslaw, Coos, Coquille, Tututni, Takelma, Yaquina, Chetco, Willamette, Tenino, and Umpqua. Many descendants of these groups are now affiliated with federally recognized tribes throughout the Pacific Northwest. The precontact peoples in the region spoke a range of languages, including Salish, Takelman-Kalapuyan, Penutian, well as Athabascan dialects among tribes in the southwest (Loy et al. 2001). Territorial boundaries of these groups often overlap and ties were cemented both within and between linguistic groups. Multiple groups may have used portions of this region for seasonal hunting, gathering, and fishing, and extensive trade networks brought resources and raw materials from region to region (Pullen 1996). Most groups in western Oregon practiced the seasonal round, occupying upland camps in the spring and summer to collect resources such as large game, root vegetables, and grasses for weaving—and retreating to lowland villages, often near productive fishing grounds, during the winter months (Pullen 1996). Native Americans in the region also practiced prescribing burning, usually in the late summer, as a way of renewing and reshaping forests and grasslands (Carloni 2006; Cox 2016).

Historic Context

In the late 19th and early 20th centuries, logging activities left an enduring mark on the landscape of western Oregon. The state's first lumber mills were established in the Willamette Valley in the 1830s and 1840s. The California Gold Rush, which began in the late 1840s, created a large demand for timber in the western United States. A national demand for the state's timber emerged after the completion of the Northern Pacific transcontinental railroad, which arrived in Portland in 1883. At this same time, the timberlands in Michigan, Minnesota, and Wisconsin were rapidly diminishing. In the 20th century, logging activity extended into new parts of the state, thanks to new railroads and, somewhat later, the development of logging trucks. The state's wood-products market nearly collapsed during the Great Depression but returned at the outset of World War II. The postwar logging industry has been marked by increasingly mechanized logging practices, the consolidation of forestland in a smaller number of hands, and new environmental protections. As a result, logging continues to play a role in the state's economy, but it is an industry that operates on a sharply reduced labor base and one which has declined in economic importance over years (Robbins 2021).

In 1911, the state legislature created ODF. Initially, its primary purpose was the control of forest fires. It was also empowered to acquire land, although it did not do so until additional legislation passed in the 1920s and 1930s made that activity easier. ODF acquired land in many ways, but it often involved tax foreclosure or the foreclosure of land that had been recently ravaged by fire. Some of this land, such as the forestland now comprising Clatsop and Santiam state forests, had been heavily logged—either by private landowners or large timber companies—in the late 19th and early 20th centuries. The Tillamook and Western Lane forest districts exemplify instances in which land was acquired following large or repeated fire events (Oregon Department of Forestry 2010). Today, approximately 3 percent of the state's forestland is owned by the state, and approximately 60 percent of the state's forestland is owned by the federal government (Oregon Forest Resources Institute 2021).

Cultural Resources Records Search Tables

Table 1. Previously Conducted Archaeological Investigations

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #31733	Report missing from SHPO Database	*Silver Falls State Park Beachie Creek 2021 Fire Salvage Project*	Unknown
Survey Report; #31633	Roulette and Lynch 2020	*Results of an Archaeological Reconnaissance of the Shellburg Falls Campground, Marion County, Oregon Applied Archaeological Research, Inc.*	Yes, 35MA00419
Survey Report; #31506	Rennaker and Raymond 2021	*Green Creek, Samson Creek, and Illingsworth Creek Fish Passage Restoration Project, Tillamook County, Oregon*	None
Survey Report; #31486	Van Roggen et al. 2020	*Cultural Resource Inventory for the Fishhawk Lake Reserve and Community Fishhawk Lake Dam Spillway and Fish Passage Improvements, Clatsop County, Oregon*	None
Survey Report; #31000	Perrin and Henderson 2020	*North Fork and Gates Hill Road Chip Seal Cultural Resources Report, Marion County, Oregon*	None
Survey Report; #30532	Tipton and Schmidt 2019	*Allston-Driscoll No 2 Access Road Maintenance Phase I and II Clatsop and Columbia Counties, Oregon*	None
Thesis for Master of Arts; #30272	Kelly 2001	*Prehistoric Land-Use Patterns in the North Santiam Subbasin, On the Western Slopes of the Oregon Cascade Range. (Thesis)*	None
Thesis for Master of Arts; #30271	Kachadoorian 2003	*A Preliminary Archaeological Predictive Model for the US 30 Transportation Corridor, Portland, Oregon to Astoria, Oregon (Thesis)*	None
Survey Report; #29935	Minor 2018	*Cultural Resource Survey for the South Fork Trask River Bridge Project, Tillamook County, Oregon*	None
Survey Report; #29892	Goodwin 2018	*Archaeological Survey for Proposed WCCCA South Saddle Mountain Telecommunications Facility, Wash. County, Oregon*	None
Survey Report; #29569	Roulette and Finley 2017	*Results of a Cultural Resources Study of the Nedonna Beach to Tillamook Fiber Optic Cable Installation Route, Tillamook County, Oregon*	None
Survey Report; #29293	Ellis and Taylor 2017	*Cultural Resources Survey for Clean Water Service's Upper Sunday Pit Location for the Downstream Dam Option Project, Washington County, Oregon*	None
Survey Report; #29292	Smith and Casperson 2017	*Shively Clark Harvest Plan Roseburg District Bureau of Land Management Cultural Resources Survey Report*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #29163	Fortin and Fagan 2016	*Eugene to Grants Pass Line Mile Post 101.39 Pipe Replacement Project Cultural Resource Survey Summary and Recommendations, Canyonville, Douglas County, Oregon*	None
Survey Report; #29038	Hennessey and Perkins 2017	*Cultural Resources Survey for the FY17 Chemawa District Priority Poles in Linn, Polk, Tillamook, Washington, and Yamhill Counties, Oregon*	None
Survey Report; #28918	Snyder 2017	*Cultural Resources Survey of the Steven Berg CSP17 Project, Clatsop County, Oregon*	None
Survey Report; #28598	Neuzil and Heppner 2016a	*Cultural Resources Inventory of the Colm-5 Project Area, Columbia County, Oregon*	None
Survey Report; #28589	Beckham 2003	*Stump Farming on the Upper Wilson River: A Brief History of Life at Jones Creek, 1886-1920, Tillamook County, Oregon*	None
Survey Report; #28588	Minor 2002	*Preliminary Archaeological Investigations at the Walter J. Smith Homestead Site, Tillamook County, Oregon*	Yes, 35TI00081
Survey Report; #28552	Neuzil and Heppner 2016b	*Cultural Resources Inventory of the COLM-4 Project Area, Columbia County, Oregon*	None
Survey Report; #28417	Curtis et al. 2016	*A Cultural Resource Inventory of the Elliott State Forest*	Yes, 35DO01513
Survey Report; #28365	Newsome 2016	*Cultural Resource Survey for the Santiam-Toledo No. 1 Transmission Line Access Road Project, Structures 51/4 to 67/5, Lincoln County, Oregon*	None
Survey Report; #28241	Roulette et al. 2015	*Results of Cultural Resources Studies Related to BPA's Lane-Wendson No. 1 Transmission Line Rebuilding*	None
Survey Report; #27755	Simpson 2015	*A Cultural Resources Assessment for T-Mobile West, LLC Candidate PO02058A (Hwy 26W Music Rd) - Proposed Installation, Clatsop County, Oregon*	None
Survey Report; #27139	Finley 2015	*Results of a Cultural Resources Study of the OR1 Reservoir Cell Site (Trileaf #615104), Astoria, Clatsop County, Oregon*	None
Survey Report; #26786	Shannon and Ellis 2013	*Ethnographic Report for Portland General Electric's Cascade Crossing Transmission Project, Morrow, Gilliam, Sherman, Wasco, Clackamas, and Marion Counties, Oregon*	None
Survey Report; #26784	Ellis et al. 2013	*Archaeological Survey Report for the Western Component of Portland General Electric's Cascade Crossing Transmission Project, Oregon*	Yes, 35MA00306
Survey Report; #26684	Baker 2014	*Green Peter Cell Tower Cultural Resources Survey*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #26184	Greenberg 2013	*Phase 1 Archaeological Investigation for Abn Engineering, LLC Project, F73407 Round Top, Timber, Washington County, Oregon*	None
Survey Report; #26040	Kolar 2013a	*Cultural Resource Investigations for Bonneville Power Administration's Keeler-Forest Grove, Forest-Tillamook No. 1 Transmission Line Rebuild/ Reconductor Project (OR 2012 029) In Washington and Tillamook Counties, Oregon*	None
Survey Report; #26024	Smith and Gall 2013	*Archaeological Survey of the Green Peter Project Area, Linn County, Oregon*	None
Survey Report; #25820	Kolar 2013b	*Archaeological Survey for Geotech Testing along the Forest Grove-Tillamook No. 1 115-kv Transmission Line Rebuild Project (OR 2012 029), Tillamook, Oregon*	None
Survey Report; #25436	Marcotte et al. 2012	*Bonneville Power Administration Submerged Cultural Resources Project, Lower Columbia River, Oregon and Washington: Literature Review*	None
Survey Report; #25058	Bennett-Rogers 2012	*A Restoration on the Upper Clatskanie River, Columbia County, Oregon*	None
Survey Report; #24804	Holschuh and Gall 2011	*Cultural Resource Survey of the Wilson River Telecommunications Facility, Tillamook County, Oregon*	None
Survey Report; #24632	Lehman et al. 2011	*Cultural Resources Survey of BPA's Lane-Wendson No. 1 Transmission Line Rebuild Project Area, Lane County, Oregon*	None
Survey Report; #24476	Roedel 2010	*Programmatic Agreement SHPO Tracking Beneke Creek Scour Project Clatsop County, Oregon*	Yes, Lithic isolate
Survey Report; #24405	Kelly and Dunn 2011	*Cultural Resource Inventory Report for the Margie Timber Sale*	None
Survey Report; #24197	Darby 2010	*Phase One Archaeological Survey: Foss Rd. @ MP 13.85 (Salmonberry Bridge) Repair Project*	None
Survey Report; #24125	Bard and McClintock 2008	*Oregon LNG Terminal and Oregon Pipeline Project Cultural Resources Survey and Evaluation Report*	None
Survey Report; #24021	Hale and Finley 2010	*Archaeological resources Study of Six 2009 ITS Rural and Urban Improvement Work Areas, Clackamas, Clatsop, Multnomah and Washington Counties, Oregon.*	None
Survey Report; #23719	Smith and Gall 2010	*Archaeological Survey of the Dunbar Ridge Telecommunications Facility, Tillamook County, Oregon*	None
Survey Report; #23515	McCurdy and Roulette 2010	*Results of an Archaeological Reconnaissance of the South Saddle Communication Tower Site, Washington County, Oregon*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #23486	McCurdy and Finley 2010	*Results of an Archaeological Reconnaissance of the Rector Ridge Communications Tower Site, Tillamook County, Oregon*	None
Survey Report; #23484	McCurdy and Finley 2010	*Results of an Archaeological Reconnaissance of the Niclai Mountain Communication Tower Site, Clatsop County, Oregon*	None
Survey Report; #23376	Ellis et al. 2010	*Cultural Resources Studies for the Palomar Gas Transmission Project: Phase I Investigations for Selected Portions of the Palomar Mainline and the Maupin and Warm Springs Alternatives; and Phase II Investigations for the Palomar Mainline.*	Yes, 35CLT00091
Survey Report; #23362	Jones and Budy 2001	*Cultural Resource Survey and Historic Overview of the Kelsey/Whiskey Project Area*	None
Survey Report; #23311	AECOM 2010	*Cultural Resources Inventory and Evaluation Report Westport Water Supply Project*	None
Survey Report; #23291	Hylton et al. 2007	*Cultural Resources Survey Report for the French Bug Project Planning Area, Willamette National Forest, Marion County, Oregon*	None
Survey Report; #23288	Kelly 2009	*Cultural Resource Inventory Report for the Sardine Timber Project*	None
Survey Report; #23240	Anderson 2010	*Results of an archaeological reconnaissance of the Wilson River communication tower site, Tillamook, Oregon*	None
Survey Report; #23239	Scheleen 2005	*South River Watershed Restoration—Culvert Replacements*	None
Survey Report; #23030	Brannan and Schmidt 2010	*A Cultural Resources Survey for the Driscoll Substation Expansion and Allston-Astoria No. 1 Transmission Line Rebuild*	None
Survey Report; #25545	Bert Rader 2009	*Rebuild of the Minto Fish Egg Collection Facility*	None
Survey Report; #23256	Worrel 2007	*Cultural Resource Inventory Report Re-Bear Timber Sale Post-Project Survey*	None
Survey Report; #22959	Lloyd-Jones and Fagan 2009	*Technical Memo: Archaeological Monitoring of Electrical Transmission Line undergrounding between Timber and Elsie, Oregon*	None
Survey Report; #22722	Lloyd-Jones et al. 2009	*Archaeological Resources Technical Report for the Proposed Realignment of US 26: Salmonberry Road- Viewpoint (SEC.), Sunset Highway (US 26), MP 32.2 to MP 32.8, Tillamook County, Oregon*	None
Survey Report; #22721	Butler et al. 2009	*Addendum to the Cultural Resource Inventory for the Palomar Gas Transmission Project, Wasco, Clackamas, Marion, Yamhill, Washington, Columbia, and Clatsop Counties, Oregon*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #22378	Finley and Heidrich 2009	*Results of a Cultural Resources Study of the Bonneville Power Administration's Keeler-Tillamook No. 1 Transmission Line Access Road Project, Washington and Tillamook Counties, Oregon*	None
Survey Report; #22362	Ricks and Oetting 2009	*Cultural Resource Survey And Historic Overview of the Kelsey/ Whiskey Project Area*	None
Survey Report; #22147	Baxter and O'Neill 2008	*Report of the Pedestrian Survey and Subsurface Reconnaissance of the Bundle 507 Bridges Project- McKay Creek (02365), Devil's Lake Fork (02472), Mills (01868) Bridges in Northwest Oregon*	None
Survey Report; #22053	O'Rourke 2008	*Cultural Resources Survey for the Proposed Miles Crossing Vacuum Sewer System Project, Miles Crossing Sanitary Sewer District, Clatsop County, Oregon*	None
Survey Report; #22023	Gaston 2008	*EWP2008, Clatsop and Columbia Counties*	None
Survey Report; #22019	Hale 2008	*Cultural Resource Survey Related to the Bonneville Power Administration's Tumble Creek-Hall Ridge Project, Marion County, Oregon*	None
Survey Report; #21902	Lloyd-Jones et al. 2008a	*Archaeological Survey of the Proposed West Oregon Electric Cooperative's Elsie to Timber Power Line Undergrounding Project, Clatsop, Columbia, Tillamook and Washington Counties, Oregon*	None
Survey Report; #21901	Lloyd-Jones et al. 2008b	*Archaeological Survey of the Proposed West Oregon Electric Cooperative's Elsie to Timber Power Line Undergrounding Project, Clatsop and Tillamook Counties, Oregon*	None
Survey Report; #21881	Carlisle and Musil 2008	*Archaeological Survey and Discovery Probing of the Sweet Home Creek Dispersed Camping Site (35CLT70) in Clatsop County, Oregon*	Yes, 35CLT00070
Survey Report; #21772	Diters 2008	*Nehalem CCC Camp Debris Stating Area*	Yes, Site # missing from database
Survey Report; #21701	Cook-Slette 2008	*Archaeological Reconnaissance Report for the Mt. Ashland LSR Project*	35JA00697
Survey Report; #21636	Knutson 2004	*Heritage Resource Reconnaissance Report for the Biscuit Fire Recovery Project*	None
Survey Report; #21521	Minor and Wenger 2007	*Archaeological Survey, Discovery Probing, and Construction Monitoring at Nehalem Falls Campground, Tillamook County, Oregon*	None
Survey Report; #20867	Winterhoff and Cabebe 2006	*Archaeological Survey of Bridge 01869A (Oregon Highway 6 over the Wilson River at Milepoint 11.8-Mills), Tillamook County, Oregon*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #20865	Winterhoff 2004	*Archaeological Survey of Bridge 01868 (OR 6 over Wilson River at MP 5.78), Tillamook County*	None
Survey Report; #20858	Winterhoff and Cabebe 2006	*Archaeological Survey of Bridge 02472 (Oregon Highway 6 over Devil's Lake Fork Wilson River at Milepoint 32.05), Tillamook County, Oregon*	None
Survey Report; #20857	Winterhoff and Long 2006	*Archaeological Survey of Bridge 00921 (Oregon Highway 30 over Gnat Creek at Mile Point 77.25) Clatsop county, Oregon*	None
Survey Report; #20803	Punke et al. 2006	*Archaeological Survey and Shovel Testing for Northwest Pipeline' Corporation's 2006 Eugene District Sutherlin and Windy Creek Restoration Projects, Douglas County, Oregon*	None
Survey Report; #20491	Punke and Fagan 2006	*Archaeological Shovel Testing for Northwest Pipeline Corporation's 2006 Eugene District Winchester to Grants Pass Pigging Project, Douglas and Josephine Counties, Oregon*	Yes, 35DO1047
Survey Report; #20489	Ogle et al. 2006	*Cultural Resource Survey of Northwest Pipeline Corporation's 2006 Eugene District Winchester to Grants Pass Pigging Project, Douglas and Josephine Counties, Oregon*	Yes, 35DO01047
Survey Report; #20418	Cabebe et al. 2006	*Archaeological Survey of Forty-Nine (49) Culverts and Seven (7) Staging Areas in Region 2 for the Oregon Department of Transportation*	None
Survey Report; #20359	Tasa et al. 2005	*Archaeological Resource Evaluation of Area 4 and Area 2, Oregon State Parks, 2004/2005 Surveys*	None
Survey Report; #19930	Hazen 2003	*Cultural Resource Inventory Report* *Timber Sale—Lookout Mountain Thinning TRACT # - 05-502*	None
Survey Report; #19661	Stutte 2005	*Additional Survey and Testing for Young's Bay Habitat Restoration Project, Clatsop County, Oregon*	None
Survey Report; #19423	Vanderhoof 2004	*School Marm/Green Mtn. Sec. 27, T.9s, R.8w, Road Decommissioning, Cultural Resource Inventory Report, Post-Project Survey, Mary's Peak Resource Area, Salem BLM District*	None
Survey Report; #19268	Brennan 2003	*Kerby Peak Trail Reconstruction*	None
Survey Report; #18938	Solimano 2004	*Results of an Archaeological Survey of the Bonneville Power Administration's Youngs Bay/Walluski River Habitat Restoration Project, Clatsop County, Oregon*	None
Survey Report; #18696	Caruso 2003a	*Cultural Resource Inventory Report, Scoggins Creek Timber Sale (Unit 9-2) Post-Project Survey*	None
Survey Report; #18695	Caruso 2003b	*Cultural Resource Inventory Report, Scoggins Creek Timber Sale (Units 3-2 & 3-3) Post-Project Survey*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #18613	Aucutt and Roulette 2003	*Results of supplemental fieldwork at Feature 5 at Camp Reehers, Washington County, Oregon*	Yes, 35WN00053
Survey Report; #18049	Scheleen 2001	*T-Bone Hunter Timber Sale*	None
Survey Report; #17411	Scheleen 1999	*Hi Yo Silver Timber Sale*	None
Survey Report; #17185	Stepp 1999	*Cultural Resource Inventory Report For The Picket Snake Project Area, Josephine County, Oregon*	None
Survey Report; #17184	Budy 2000	*Esterly Lakes Cultural Resource Survey: Human Landscapes In The Historic Waldo, Takilma, And Blue Creek Mining Districts*	None
Survey Report; #16733	Caruso and Holmen 1998	*Cultural Resource Inventory Report T. 1S., R. 8W., Sec. 25 Land Exchange Pre-Project Survey*	None
Survey Report; #15813	Sherer et al. 1992	*Cultural Resource Reconnaissance Report for the Shasta Costa Timber Sales*	None
Survey Report; #15540	Cosby 1996	*Cultural Resource Reconnaissance Report for the Sha-Kett Salvage Timber Sale*	None
Survey Report; #15513	Winthrop 1996	*McLawson Timber Sale*	None
Survey Report; #15470	Minor 1996a	*Cultural Resources Survey For The Riparian Rehabilitation Project, Kilchis River And North Fork Of Kilchis River, Tillamook County, Or*	None
Survey Report; #15469	Minor 1996b	*Cultural Resources Survey of a Culvert Replacement Area, Little North Fork of Wilson River, Tillamook County, Oregon*	None
Survey Report; #15344	Hazen 1995a	*Cultural Resource Inventory Report for the Scott Hamilton Thinning*	None
Survey Report; #15212	Hazen 1995b	*Cultural Resource Survey Report, Roland-Minto Timber Sale-Revised Sale Plan, Pre-Harvest Survey*	None
Survey Report; #15153	Martinek 1995	*Cultural Resource Reconnaissance Report for the Fall Creek Meadows Prescribed Burn*	None
Survey Report; #15004	Stepp 1995	*High Five And Low Five Timber Sale*	None
Survey Report; #14982	Caruso 1995	*Cultural Resource Inventory Report, Bear Creek Density Management Timber Sale Pre-project Survey*	None
Survey Report; #14881	Ellis 1995	*Documentation Of Cultural Resources For The Proposed Barney Reservoir Expansion Project, Washington And Yamhill Counties, Oregon*	Yes, Brick Scatter
Survey Report; #14875	Piazza 1995	*Thomason Salvage Cultural Resource Inventory Report*	None
Survey Report; #13706	De Ford 1993	*Cultural Resource Inventory Report Precommercial Thinning 12 -1-1 Pre-Project Survey*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #13541	Winthrop 1993	*Lost Fortune Timber Sale*	None
Survey Report; #13487	Kelly and Nicholas 1992	*Cultural Resource Inventory Report for the Detroit Tributaries Integrated Resource Planning Area*	None
Survey Report; #13412	Southard 1992a	*Thin One Timber Sale*	None
Survey Report; #13379	Mumblo 1992	*Puma Timber Sale*	None
Survey Report; #13309	Murphy and Philipek 1992	*Cultural Resource Inventory Report, Kirks Bluff Timber Sale, Pre-Project Survey*	None
Survey Report; #13271	Oetting 1992	*Cultural Resource Surveys Of Selected BLM Land Exchange Parcels in Lane, Linn and Polk Counties, Oregon*	None
Survey Report; #13221	Straub and Wagner 1992	*Cultural Resource Inventory Report for the Saddle Salvage Timber Sale Post-project Survey*	None
Survey Report; #12999	Murphy 1992	*Cultural Resource Inventory Report, Daily News Timber Sale Pre-Project Survey*	None
Survey Report; #12837	Connolly 1992	*Archaeological Survey Of The John Day River Bridge-Youngs Bay Bridge (Astoria Bypass) Section, Lower Columbia River Highway (US 30)*	None
Survey Report; #12729	Southard 1992b	*Cultural Resource Report, Bulmer Creek Timber Sale*	None
Survey Report; #12543	Stepp 1991	*Cultural Resource Reconnaissance Report for the Finley Overlook Timber Sale*	None
Survey Report; #12226	Barner 1991	*Bits and Pieces Timber Sale*	None
Survey Report; #12132	Yeiter 1991	*Cultural Resource Survey Report, Two Crooked Digits Sale Units 1 & 2 Pre-Harvest Survey*	None
Survey Report; #12083	Southard 1991	*Cultural Resource Survey Report, Lookout Thinning Timber Sale*	None
Survey Report; #11929	Philipek and Peterson 1991	*Cultural Resource Survey Report, Crooked Finger Rd. T.S. Unit 1 Post-Harvest and Looney's Creek R-O-W Pre-Project Survey*	None
Survey Report; #11928	Hazen 1990a	*Cultural Resource Survey Report Shellburg Cr. Timber Sale Pre-Harvest Survey*	None
Survey Report; #11778	Badger 1990	*Lost Fortune Timber Sale*	None
Survey Report; #11440	Exeter 1990	*Camp Cooper Combo Blowdown Sale Pre-Harvest Survey*	None
Survey Report; #11432	Hazen 1990b	*Cultural Resource Survey Report for the Saddle Salvage Timber Sale*	None
Survey Report; #11333	Deich 1990	*Cultural Resource Survey Report for the Buckhorn South Timber Sale*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #11236	Vanderhoof 1990	*Something Special Timber Sale Unit-1 Pre-Harvest Survey*	None
Survey Report; #11191	Vanderhoof 1989	*Cultural Resource Survey Report, Fallen Angle Timber Sale-Unit 1* *Pre-Harvest Survey*	None
Survey Report; #10630	Exeter 1989a	*Pylon Timber Sale*	None
Survey Report; #10626	Exeter 1989b	*Cultural Resource Survey Report Old Testament Timber Sale Pre-Harvest Survey*	None
Survey Report; #10625	Vanderhoof 1988	*Cultural Resource Survey Report, Little Duece Timber Sale, Pre-harvest Survey*	None
Survey Report; #10611	Nash 1989	*Cultural Resource Survey Report, Silver Creek Falls Land Exchange Tract 1 Pre-Exchange Survey*	None
Survey Report; #9722	Edwards 1988a	*Cultural Resource Survey Report, Y8814 Valsetz Exchange-Mercury Thinning Parcel Pre-Exchange Survey*	None
Survey Report; #9718	Edwards 1988b	*Cultural Resource Survey Report, Y8816 Valsetz Exchange-Cougar Ridge Parcel* *Pre-Exchange Survey*	None
Survey Report; #8985	Philipek 1987a	*Cultural Resource Survey Report, Murphy Coop Timber Sale, Pre-harvest Survey*	None
Survey Report; #8977	Wilen 1987	*Cultural Resource Inventory for the Tum Fly Timber Sale*	None
Survey Report; #8443	Rodriguez and Sanders 1987	*Cultural Resource Survey Report Blue Collar Timber Sale Post-Harvest Survey*	None
Survey Report; #8419	Brownfield and Sanders 1987	*Cultural Resource Survey Report* *Devil's Well Neg. R/W*	None
Survey Report; #8074	Philipek 1987b	*Meadowsaw Salvage Timber Sale Yamhill Resource Area Salem BLM District*	None
Survey Report; #8043	Philipek 1987c	*Gold Creek Timber Sale, Tillamook Resource Area, Salem BLM District*	None
Survey Report; #8035	Philipek 1986	*Schoolmarm II Timber Sale*	None
Survey Report; #8028	Philipek 1986	*Cultural Resource Report for the Packsaddle Timber Sale*	
Survey Report; #8003	Philipek 1986	*Devil’s Creek Timber Sale*	None
Survey Report; #7962	Southard 1987	*FY88 Timber Sale*	None
Survey Report; #7633	Deich 1986	*Fortune Branch Timber Sale*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #7005	Byram 2006b	*Map of Curry County, Oregon Showing Location and Holdings of Early Indian Tribes with early History of the County as Recounted*	None
Survey Report; #6977	Philipek 1985	*Tillamook Resource Area FY87 Timber Sale Program: Cultural Resource Inventory Report*	None
Survey Report; #6488	Cox 1985	*Cultural Resource Inventory Report for the Little North Santiam Mining District*	None
Survey Report; #6456	Deich 1985	*Grants Pass Timber Sale*	None
Survey Report; #6420	Martin 1985	*Youngs River #22 and Tucker / Battle Creek Dikes*	None
Survey Report; #5877	Martin 1984	*Letter Report - John Day River Road Location Bank Protection*	None
Survey Report; #5493	West et al. 1983	*Cultural Resources Sample Survey Design for the Siskiyou National Forest*	None
Survey Report; #5025	Pettigrew 1983	*Letter Report: on the Archaeological Survey of the Proposed Improvements of the North Fork Trask River Bridge, Trask River Road, Tillamook County, Oregon*	None
Survey Report; #3736	Mitchell 1981	*State of Oregon Slickrock Right-of-Way*	None
Survey Report; #2489	McFadden 1981	*Cultural Resource Survey Report Shan Creek Ridge Indian Site*	None
Survey Report; #2321	Baley and Russo-Card 1980	*Cultural Resource Survey Report for the French Basin Timber Sale*	None
Survey Report; #1764	Davis 1980	*Intensive Cultural Resource Reconnaissance of New or Improved Access Roads for the Proposed Slatt-Marion 500KV Transmission Line*	None
Survey Report; #1547	Snyder et al. 1980a	*Cultural Resource Survey of the Proposed Bonneville Power Administration Slatt-Marion 500 KV Transmission Line in the Region of Wasco, Marion and Clackamas Counties, Oregon*	None
Survey Report; #1536	Snyder et al. 1980b	*Cultural Resource Survey of the Proposed Bonneville Power Administration Slatt-Marion 500 KV Transmission Line in the Region of Wasco, Marion and Clackamas Counties, Oregon*	None
Survey Report; #734	Cox and Wenger 1979	*A Survey for Archaeological Resources along the Columbia River in Columbia County*	None
Survey Report; #602	Baley 1978	*Cultural Resource Report Margie Salvage Timber Sale*	None
Survey Report; #327	Swanson 1976	*Archaeological Reconnaissance of the North Fork Nehalem, Nehalem, Miami, Kilchis, Wilson, Trask, Nestucca & Little Nestucca Rivers Stream Protection Project*	None

Investigation Type/NADB #	Author/Date	Title	Cultural Resources in APE
Survey Report; #324	Cole and Pettigrew 1976	*Archaeological Survey of the Proposed Milepost 6.8 Slide Section, Wilson River Highway Tillamook County, Oregon*	None

NADB=National Archaeological Database; APE=area of potential effects; SHPO=State Historic Preservation Officer

Table 2. Previously Documented Cultural Resources

Trinomial/ Forest Service Site Number	Site Type	Description	OARRA Recorded NRHP Status
35CLT00091	Historic Mine and Logging Camp	Includes historic-age logging camp and mine features, including equipment and a road.	Unevaluated
35CLT00087	Historic Homestead	Homestead Orchard, domestic debris scatter	Unevaluated
35CLT00084	Precontact site	Lithic scatter with debitage	Unevaluated
35CLT00075	Precontact site	Lithic scatter with tools and debitage	Unevaluated
35CLT00074	Precontact site	Lithic scatter with tools and debitage	Unevaluated
35CLT00073	Precontact site	Lithic scatter with tools and debitage	Unevaluated
35CLT00070	Precontact site	Lithic scatter with tools and debitage	Unevaluated
35CLT00043	Historic Cemetery	16–26 historic-age burials	Unevaluated
35CLT00038	Open Midden	An exposed midden, with precontact and historic materials observed	Unevaluated
35DO01513	Historic Homestead	The Leach Homestead/Site #10	Unevaluated
35DO01047	Refuse scatter	Historic-age refuse scatters	Unevaluated
35JA00697	Historic Railroad	Railroad grade associated with the Fruit Grower's Supply Company Railroad	Unevaluated
35LIN00244	Lithic scatter	Precontact lithic scatter	Unevaluated
35MA00419	Historic Railroad	Historic-age railroad grade with trestle	Unevaluated
35MA00328	Historic Railroad	Historic-age railroad grade with trestle	Unevaluated
35MA00306	Refuse Scatter	Scatter of historic-age artifacts	Unevaluated
35TI00117	Historic Undetermined	Features include a rock alignment and ditch.	Unevaluated
35TI00093	Historic Structure	Historic powder house	Unevaluated
35TI00092	Historic Logging Camp	Blue, White, and Red Logging Camp	Unevaluated
35TI00081	Historic Homestead	Walter J. Smith Homestead, with historic-age artifacts.	Unevaluated
35WN00092	Historic Lumber Camp	Stimson Lumber Camp 17	Unevaluated
35WN00053	Historical CCC Camp	Historic camp with structures and trash scatters	Unevaluated
35WN00052	Historic Railroad	Tuttle Creek Railroad Ties and Rail	Unevaluated

Trinomial/ Forest Service Site Number	Site Type	Description	OARRA Recorded NRHP Status
35CLT- *Missing from database	Precontact Isolate	CCS flake identified in Roedel 2010, isolate form missing from SHPO database	Unknown
35CLT- *Missing from database	Historic isolate	Steam Donkey from logging site—now housed at Tillamook Forest Center (ODF)	Removed
35WN-No # Assigned	Historic Scatter	Brick Scatter	Unevaluated

OARRA=Oregon Archaeological Records Remote Access; NRHP=National Register of Historic Places

Table 3. Previously Documented Built Environment Resources

OHSD Resource ID	Name	Resource Type	Address/Location	Year Built	OHSD Recorded NRHP Status
34204	Yunker & Wicks Logging Camp	Site	Lower Nehalem River Road, Clatsop County	1937	Eligible/ Contributing
38173	Camp Nehalem	Site	Foss Road, Tillamook County	1935	Eligible/ Contributing
38176	Hembre Lookout	Dismantled Structure	Hembre Ridge Road, Tillamook State Forest, Tillamook County	1953	Eligible/ Contributing
651907	West Creek Skid Road Tunnel	Site	Highway 30, Clatsop County	c.1890	Eligible/ Contributing
673779	Port of Tillamook Bay Railroad	District	Washington and Tillamook Counties	c. 1911	Eligible/ Contributing

OHSD = Oregon Historic Sites Database; NRHP = National Register of Historic Places

Correspondence

Correspondence related to compliance with the National Historic Preservation Act is included in Attachment 1 of this appendix:

- Letter from NMFS to Oregon State Historic Preservation Officer to initiate Section 106 review for the Undertaking, notifying them that the National Environmental Policy Act (NEPA) process would be used in lieu of the standard Section 106 review process, and designating a delegee for consultation.
- Letter from NMFS to the Advisory Council on Historic Preservation to initiate Section 106 review for the Undertaking, notifying them that the NEPA process would be used in lieu of the standard Section 106 review process, and designating a delegee for consultation.
- Letters from NMFS to 14 tribes to initiate Section 106 consultation for the Undertaking.

References

AECOM. 2010. *Cultural Resources Inventory and Evaluation Report Westport Water Supply Project.* Survey Report; NADB #23311. February. Seattle, WA. Prepared for Westport Water Association, Westport, OR and U.S. Department of Homeland Security, FEMA Region X, Bothell, WA.

Anderson, F. 2010. *Results of an archaeological reconnaissance of the Wilson River communication tower site, Tillamook, Oregon.* Survey Report; NADB #23240. March 15. Portland, OR. Prepared for Adapt Engineering, Portland, OR.

Aucutt, C. and B. Roulette. 2003**.** *Results of supplemental fieldwork at Feature 5 at Camp Reehers, Washington County, Oregon.* Survey Report; NADB #18613. October 13. Portland, OR. Prepared for Oregon Department of Forestry, Salem, OR.

Badger, J. 1990. *Lost Fortune Timber Sale.* Survey Report; NADB #11778. October 30. Portland, OR: U.S. Department of Interior, Bureau of Land Management.

Baker, R.T. 2014. *Green Peter Cell Tower Cultural Resources Survey.* Survey Report; NADB #26684. September 4. Portland, OR. Prepared for AT&T Mobility, LLC, Lake Oswego, OR.

Baley, A.W. 1978. *Cultural Resource Report Margie Salvage Timber Sale.* Survey Report; NADB #602. December 12. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger District.

Baley, A.W., and S. Russo-Card. 1980. *Cultural Resource Survey Report for the French Basin Timber Sale.* Survey Report; NADB #2321. August 18. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger District.

Bard, J.C., and R.D. McClintock. 2008. *Oregon LNG Terminal and Oregon Pipeline Project Cultural Resources Survey and Evaluation Report.* Survey Report; NADB #24125. October. Portland, OR. Prepared for Oregon LNG, Portland, OR.

Barner, I.N. 1991. *Bits and Pieces Timber Sale.* Survey Report; NADB #12226. August 23. Portland, OR: U.S. Department of Interior, Bureau of Land Management.

Baxter, P., and B. O'Neill. 2008. *Report of the Pedestrian Survey and Subsurface Reconnaissance of the Bundle 507 Bridges Project- McKay Creek (02365), Devil's Lake Fork (02472), Mills (01868) Bridges in Northwest Oregon.* Survey Report; NADB #22147. September 29. Eugene, OR. Prepared for Oregon Department of Transportation, Salem, OR.

Beckham, S.D. 2003. *Stump Farming on the Upper Wilson River: A Brief History of Life at Jones Creek, 1886-1920, Tillamook County, Oregon.* Survey Report; NADB #28589. January 6. Eugene, OR. Prepared for Oregon Department of Forestry, Salem, OR.

Bennett-Rogers, A. 2012. *A Restoration on the Upper Clatskanie River, Columbia County, Oregon.* Survey Report; NADB #25058. April 6. Portland, OR: U.S. Department of Agriculture, Natural Resources Conservation Service.

Brannan, N.F., and S.R. Clark Schmidt. 2010. *A Cultural Resources Survey for the Driscoll Substation Expansion and Allston-Astoria No. 1 Transmission Line Rebuild.* Survey Report; NADB #23030. January 7. Portland, OR: Bonneville Power Administration.

Brennan, L. 2003. *Kerby Peak Trail Reconstruction.* Survey Report; NADB #19268. October 30. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Brownfield, S., and A. Sanders. 1987. *Cultural Resource Survey Report Devil's Well Neg. R/W.* Survey Report; NADB #8419. June 6. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Budy, E.E. 2000. *Esterly Lakes Cultural Resource Survey: Human Landscapes In The Historic Waldo, Takilma, And Blue Creek Mining Districts.* Survey Report; NADB #17184. April 28. Prepared for U.S. Department of Interior, Bureau of Land Management, Medford District. Klamath Falls, OR.

Butler, S., et al. 2009. *Addendum to the Cultural Resource Inventory for the Palomar Gas Transmission Project, Wasco, Clackamas, Marion, Yamhill, Washington, Columbia, and Clatsop Counties, Oregon.* Survey Report; NADB #22721. July. Portland, OR. Prepared for Palomar Gas Transmission, LLC, Portland, OR.

Byram, S.R. 2006a. *Cultural Resources Survey for the Jordan Cove Energy Project at Coos Bay, Oregon*. Prepared by R. Scott Byram. Submitted to SHN Consulting Engineers. June.

Byram, S. 2006b. *Map of Curry County, Oregon Showing Location and Holdings of Early Indian Tribes with early History of the County as Recounted.* Survey Report; NADB #7005. October 2.

Cabebe, T., et al. 2006. *Archaeological Survey of Forty-Nine (49) Culverts and Seven (7) Staging Areas in Region 2 for the Oregon Department of Transportation.* Survey Report; NADB #20418. March 1. Eugene, OR: Museum of Natural and Cultural History.

Carlisle, K., and R. Musil. 2008. *Archaeological Survey and Discovery Probing of the Sweet Home Creek Dispersed Camping Site (35CLT70) in Clatsop County, Oregon.* Survey Report; NADB #21881. April 20. Eugene, OR. Prepared for Oregon Department of Forestry, Salem, OR.

Carloni, K.R. 2006. *The Ecological Legacy of Indian Burning Practices in Southwestern Oregon*. PhD dissertation submitted to Oregon State University. Available: https://www.proquest.com/openview/86de6f51d8ac7ee5e8ac8c283f994cf4/1?pq-origsite=gscholar&cbl=18750&diss=y. Accessed: September 3, 2021.

Caruso, J. 1995. *Cultural Resource Inventory Report, Bear Creek Density Management Timber Sale Pre-project Survey.* Survey Report; NADB #14982. February 21. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Caruso, J. 2003a. *Cultural Resource Inventory Report, Scoggins Creek Timber Sale (Unit 9-2) Post-Project Survey.* Survey Report; NADB #18696. November 10. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Caruso, J. 2003b. *Cultural Resource Inventory Report, Scoggins Creek Timber Sale (Units 3-2 & 3-3) Post-Project Survey.* Survey Report; NADB #18695. October 21. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Caruso, J., and C. Holmen. 1998. *Cultural Resource Inventory Report T. 1S., R. 8W., Sec. 25 Land Exchange Pre-Project Survey.* Survey Report; NADB #16733. November 24. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Cole, D.L., and R.M. Pettigrew. 1976. *Archaeological Survey of the Proposed Milepost 6.8 Slide Section, Wilson River Highway Tillamook County, Oregon.* Survey Report; NADB #324. December 8.

Eugene, OR. Prepared for Oregon State Highway Division, Oregon Department of Transportation, Salem, OR.

Connolly, T.J. 1992. *Archaeological Survey Of The John Day River Bridge-Youngs Bay Bridge (Astoria Bypass) Section, Lower Columbia River Highway (US 30).* Survey Report; NADB #12837. May 1. Eugene, OR. Prepared for Oregon State Highway Division, Oregon Department of Transportation, Salem, OR.

Connolly, T.J. 1994. Paleo Point Occurrences in the Willamette Valley, Oregon in *Contributions to the Archaeology of Oregon 1989-1994.* Edited P.W. Baxter. Association of Oregon Archaeologists. Available: https://www.researchgate.net/profile/Thomas_Connolly/publication/281582527_Paleo_point_occurrences_in_the_willamette_valley_oregon/links/5656087508ae4988a7b3531e/Paleo-point-occurrences-in-the-willamette-valley-oregon.pdf. Accessed: September 3, 2021.

Cook-Slette, C. 2008. *Archaeological Reconnaissance Report for the Mt. Ashland LSR Project.* Survey Report; NADB #21701. March. Happy Camp, CA: U.S. Forest Service, Klamath National Forest, Oak Knoll Ranger District.

Cosby, L. 1996. *Cultural Resource Reconnaissance Report for the Sha-Kett Salvage Timber Sale.* Survey Report; NADB #15540. January 23. Jacksonville, OR: U.S. Forest Service, Siskiyou National Forest, Galice Ranger District.

Cox, J.B. Jr. 1985. *Cultural Resource Inventory Report for the Little North Santiam Mining District.* Survey Report; NADB #6488. March. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger District.

Cox, T.G. 2016. *The Role of Fire in Montane Forest Environments in the Willamette National Forest, Oregon*. Master's thesis submitted to Central Washington University. Available: https://digitalcommons.cwu.edu/etd/450/. Accessed: September 4, 2021.

Cox, A., and R. Wenger. 1979. *A Survey for Archaeological Resources along the Columbia River in Columbia County.* Survey Report; NADB #734. June. Eugene, Oregon: Department of Anthropology, University of Oregon.

Curtis, G.A., et al. 2016. *A Cultural Resource Inventory of the Elliott State Forest.* Survey Report; NABD #28417. June. Salem, OR: Oregon Department of State Lands.

Darby, M. 2010. *Phase One Archaeological Survey: Foss Rd. @ MP 13.85 (Salmonberry Bridge) Repair Project.* Survey Report; NADB #24197. September 14. Vancouver, WA. Prepared for WH Pacific and Tillamook County, Tillamook, OR.

Davis, L.G., A.J. Nyers, and S. Willis. 2011. Technology, Mobility, and Adaptation Among Early Foragers of the Southern Northwest Coast: The View from Indian Sands. *American Antiquity*. 79(4), 2014, pp. 596–615. DOI: 10.7183/0002-7316.79.4.596

Davis, R.D. 1980. *Intensive Cultural Resource Reconnaissance of New or Improved Access Roads for the Proposed Slatt-Marion 500KV Transmission Line*. Survey Report; NADB #1764. Pullman, WA. Prepared for Bonneville Power Administration, Portland, OR.

De Ford, S. 1993. *Cultural Resource Inventory Report Precommercial Thinning 12 -1-1 Pre-Project Survey.* Survey Report; NADB #13706. May 13. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Deich, L. 1985. *Grants Pass Timber Sale.* Survey Report; NADB #6456. May 3. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Deich, L. 1986. *Fortune Branch Timber Sale.* Survey Report; NADB #7633. October 2. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Deich, L. 1990. *Cultural Resource Survey Report for the Buckhorn South Timber Sale.* Survey Report; NADB #11333. June 21. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Diters, L. 2008. *Nehalem CCC Camp Debris Stating Area.* Survey Report; NADB #21772. May 3. Bothell, WA. Prepared for Port of Tillamook Bay Railroad.

Edwards, P.J. 1988a. *Cultural Resource Survey Report, Y8814 Valsetz Exchange-Mercury Thinning Parcel Pre-Exchange Survey.* Survey Report; NADB #9722. September 15. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Edwards P.J. 1988b. *Cultural Resource Survey Report, Y8816 Valsetz Exchange-Cougar Ridge Parcel Pre-Exchange Survey.* Survey Report; NADB #9718. September 15. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Ellis, D.V. 1995. *Documentation Of Cultural Resources For The Proposed Barney Reservoir Expansion Project, Washington And Yamhill Counties, Oregon.* Survey Report; NADB #14881. January 5. Portland, OR. Prepared for CH2M Hill, Inc., Portland, OR.

Ellis, D.V., et al. 2010. *Cultural Resources Studies for the Palomar Gas Transmission Project: Phase I Investigations for Selected Portions of the Palomar Mainline and the Maupin and Warm Springs Alternatives; and Phase II Investigations for the Palomar Mainline.* Survey Report; NADB #23376. December 16. Prepared for Palomar Gas Transmission, LLC, Portland, OR.

Ellis, D.V., et al. 2013. *Archaeological Survey Report for the Western Component of Portland General Electric's Cascade Crossing Transmission Project, Oregon*. Survey Report; NADB #26784. July 17. Portland, OR: Prepared for Portland General Electric, Portland, OR; Tetra Tech, Inc., Portland, OR; and URS Corporation, Portland, OR.

Ellis, D.V., and B. Taylor. 2017. *Cultural Resources Survey for Clean Water Service's Upper Sunday Pit Location for the Downstream Dam Option Project, Washington County, Oregon*. Survey Report; NADB #29293. August 22. Prepared for Clean Water Services, Hillsboro, OR.

Exeter, R. 1989a. *Pylon Timber Sale.* Survey Report; NDB #10630. August 29. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Exeter, R. 1989b. *Cultural Resource Survey Report Old Testament Timber Sale Pre-Harvest Survey.* Survey Report; NADB #10626. August 29. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Exeter, R. 1990. *Camp Cooper Combo Blowdown Sale Pre-Harvest Survey.* Survey Report; NADB #11440. May 13. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Finley, A.A. 2015. *Results of a Cultural Resources Study of the OR1 Reservoir Cell Site (Trileaf #615104), Astoria, Clatsop County, Oregon.* Survey Report; NADB #27139. January 27. Portland, OR. Prepared for Trileaf Environmental and Property Consultants, Chandler, AZ.

Finley, A., and C.K. Heidrich. 2009. *Results of a Cultural Resources Study of the Bonneville Power Administration's Keeler-Tillamook No. 1 Transmission Line Access Road Project, Washington and Tillamook Counties, Oregon*. Survey Report; NADB #22378. March 13. Portland, OR. Prepared for Bonneville Power Administration, Portland, OR.

Fortin, L.W., and J.L. Fagan. 2016. *Eugene to Grants Pass Line Mile Post 101.39 Pipe Replacement Project Cultural Resource Survey Summary and Recommendations, Canyonville, Douglas County, Oregon*. Survey Report; NADB #29163. July 10. Portland, OR. Prepared for Williams Northwest Pipeline, Houston Texas.

Gaston, J. 2008. *EWP2008, Clatsop and Columbia Counties*. Survey Report; NADB #22023. August 21. Portland, OR: U.S. Department of Agriculture, Natural Resources Conservation Service, NRCS State Office.

Goodwin, M. 2018. *Archaeological Survey for Proposed WCCCA South Saddle Mountain Telecommunications Facility, Wash. County, Oregon*. Survey Report; NADB #29892. October 24. Portland, OR: Black Mountain Consulting, LLC, Portland, Oregon.

Greenberg, G. 2013. *Phase 1 Archaeological Investigation for Abn Engineering, LLC Project, F73407 Round Top, Timber, Washington County, Oregon.* Survey Report; NADB #26184. December 2. Scottsdale, AZ. Prepared for Abn Engineering, LLC, Phoenix AZ.

Hale, A.J. 2008. *Cultural Resource Survey Related to the Bonneville Power Administration's Tumble Creek-Hall Ridge Project, Marion County, Oregon.* Survey Report; NADB #22019. August 29. Portland, OR. Prepared for Bonneville Power Administration, Portland, OR.

Hale, A., and A.A. Finley. 2010. *Archaeological resources Study of Six 2009 ITS Rural and Urban Improvement Work Areas, Clackamas, Clatsop, Multnomah and Washington Counties, Oregon.* Survey Report; NADB #24021. January 14. Portland, OR. Prepared for Oregon Department of Transportation, Salem, OR.

Hazen, P.W. 1990a. *Cultural Resource Survey Report Shellburg Cr. Timber Sale Pre-Harvest Survey*. Survey Report; NADB #11928. October 25. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Hazen, P.W. 1990b. *Cultural Resource Survey Report for the Saddle Salvage Timber Sale.* Survey Report; NADB #11432. May 1. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Hazen, P.W. 1995a. *Cultural Resource Inventory Report for the Scott Hamilton Thinning.* Survey Report; NADB #15344. November 20. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Hazen, P.W. 1995b. *Cultural Resource Survey Report, Roland-Minto Timber Sale-Revised Sale Plan, Pre-Harvest Survey.* Survey Report; NADB #15212. July 25. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Hazen, P.W. 2003. *Cultural Resource Inventory Report Timber Sale—Lookout Mountain Thinning TRACT # - 05-502*. Survey Report; NADB #19930. November 3. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Hennessey, J., and K. Perkins. 2017. *Cultural Resources Survey for the FY17 Chemawa District Priority Poles in Linn, Polk, Tillamook, Washington, and Yamhill Counties, Oregon*. Survey Report; NADB #29038. April 13. Portland, OR: Bonneville Power Administration.

Holschuh, D., and A.W. Gall. 2011. *Cultural Resource Survey of the Wilson River Telecommunications Facility, Tillamook County, Oregon*. Survey Report; NADB #24804. November 18. Vancouver, WA. Prepared for Adapt Engineering, Portland, OR.

Hylton, L., et al. 2007. *Cultural Resources Survey Report for the French Bug Project Planning Area, Willamette National Forest, Marion County, Oregon.* Survey Report; NADB #23291. November 19. Warm Springs, OR. Prepared for U.S. Forest Service, Willamette National Forest, Marion County, OR.

Jenkins, D.L., L.G. Davis, T.W. Stafford Jr., P.F. Campos, B. Hockett, G.T. Jones, L.S. Cummings, C. Yost, T.J. Connolly, R.M. Yohe II, S.C. Gibbons, M. Ragahavan, M. Rasmussen, J. Paijmans, M. Hofreiter, B.M. Kemp, J.L. Barta, C. Monroe, M. Gilbert, and E. Willerslev. 2012. Clovis Age Western Stemmed Projectile Points and Human Coprolites at the Paisley Caves. *Science* 13 July 2012. Retrieved: 13 July 2012.

Jones, J.W., and E.E. Budy. 2001. *Cultural Resource Survey and Historic Overview of the Kelsey/Whiskey Project Area.* Survey Report; NADB #23362. February 2. Klamath, OR. Prepared for U.S. Department of the Interior, Bureau of Land Management, Medford District, Medford, OR.

Kachadoorian, L.A. 2003. *A Preliminary Archaeological Predictive Model for the US 30 Transportation Corridor, Portland, Oregon to Astoria, Oregon*. Thesis for Master of the Arts; NABD #30271. February 4. Oregon State University, Corvallis, OR.

Kelly, C.M. 2001. *Prehistoric Land-Use Patterns in the North Santiam Subbasin, On the Western Slopes of the Oregon Cascade Range.* Thesis for Master of Arts; NABD #30272. June 11. Oregon State University, Corvallis, OR.

Kelly, C. 2009. *Cultural Resource Inventory Report for the Sardine Timber Project.* Survey Report; NADB #23288. June 30. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger Station.

Kelly, C., and S. Dunn. 2011. *Cultural Resource Inventory Report for the Margie Timber Sale.* Survey Report; NADB #24405. February 22. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger Station.

Kelly, C.M., and D. Nicholas. 1992. *Cultural Resource Inventory Report for the Detroit Tributaries Integrated Resource Planning Area.* Survey Report; NADB #13487. September 30. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger Station.

Knutson, D. 2004. *Heritage Resource Reconnaissance Report for the Biscuit Fire Recovery Project.* Survey Report; NADB #21636. July. Jacksonville, OR: U.S. Forest Service, Rogue River-Siskiyou National Forest, Chetco, Galice, Gold Beach, and Illinois Valley Ranger Districts

Kolar, K.C. 2013a. *Cultural Resource Investigations for Bonneville Power Administration's Keeler-Forest Grove, Forest-Tillamook No. 1 Transmission Line Rebuild/ Reconductor Project (OR 2012 029) In Washington and Tillamook Counties, Oregon.* Survey Report; NADB #26040. June. Eugene, OR. Prepared for Bonneville Power Administration, Portland, OR.

Kolar, K.C. 2013b. *Archaeological Survey for Geotech Testing along the Forest Grove-Tillamook No. 1 115-kv Transmission Line Rebuild Project (OR 2012 029), Tillamook, Oregon*. Survey Report; NADB #25820. June 24. Eugene, OR. Prepared for Bonneville Power Administration, Portland, OR.

Lehman, M.L., et al. 2011. *Cultural Resources Survey of BPA's Lane-Wendson No. 1 Transmission Line Rebuild Project Area, Lane County, Oregon.* Survey Report; NADB #24632. July 14. Portland Oregon. Prepared for Bonneville Power Administration, Portland, OR.

Lloyd-Jones, J., et al. 2008a. *Archaeological Survey of the Proposed West Oregon Electric Cooperative's Elsie to Timber Power Line Undergrounding Project, Clatsop, Columbia, Tillamook and Washington Counties, Oregon.* Survey Report; NADB #21902. Revised. June 17. Portland, OR. Prepared for David Evans and Associates, Inc., Portland, OR.

Lloyd-Jones, J., et al. 2008b. *Archaeological Survey of the Proposed West Oregon Electric Cooperative's Elsie to Timber Power Line Undergrounding Project, Clatsop and Tillamook Counties, Oregon*. Survey Report; NADB #21901. Revised. June 17. Portland, OR. Prepared for David Evans and Associates, Inc., Portland, OR.

Lloyd-Jones, J., et al. 2009. *Archaeological Resources Technical Report for the Proposed Realignment of US 26: Salmonberry Road- Viewpoint (SEC.), Sunset Highway (US 26), MP 32.2 to MP 32.8, Tillamook County, Oregon.* Survey Report; NADB #22722. June 8. Portland, OR. Prepared for Murray, Smith, & Associates, Inc. Portland, OR and Oregon Department of Transportation, Portland, OR.

Lloyd-Jones, J., and J.L. Fagan. 2009. *Technical Memo: Archaeological Monitoring of Electrical Transmission Line undergrounding between Timber and Elsie, Oregon.* Survey Report; NADB #22959. June 8. Portland, OR. Prepared for West Oregon Electric Cooperative, Inc., Vernonia, OR.

Loy, W.G., S. Allan, A. Buckley, and J.E. Meacham. 2001. American Indian Languages of Western Oregon. LCC Library. Available: https://libraryguides.lanecc.edu/americanindianlanguages. Accessed: September 4, 2021.

Marcotte, J., et al. 2012. *Bonneville Power Administration Submerged Cultural Resources Project, Lower Columbia River, Oregon and Washington: Literature Review.* Survey Report; NADB #25436. September. Portland, OR. Prepared for Bonneville Power Administration, Portland, OR.

Martin, M. 1984. *Letter Report - John Day River Road Location Bank Protection.* Survey Report; NADB #5877. September 7.

Martin, M. 1985. *Youngs River #22 and Tucker / Battle Creek Dikes.* Survey Report; NADB #6420. March 7.

Martinek, G.W. 1995. *Cultural Resource Reconnaissance Report for the Fall Creek Meadows Prescribed Burn.* Survey Report; NADB #15153. September. Gold Beach, OR: U.S. Forest Service, Siskiyou National Forest, Gold Beach Ranger District.

McCurdy, R.M., and A.A. Finley. 2010. *Results of an Archaeological Reconnaissance of the Nicolai Mountain Communication Tower Site, Clatsop County, Oregon.* Survey Report; NADB #23484. June 21. Portland, OR. Prepared for Adapt Engineering, Inc. Portland, OR.

McCurdy, R.M., and A.A. Finley. 2010. *Results of an Archaeological Reconnaissance of the Rector Ridge Communications Tower Site, Tillamook County, Oregon*. Survey Report; NADB #23486. June 25. Portland, OR. Prepared for Adapt Engineering, Inc. Portland, OR.

McCurdy, R.M., and B.R. Roulette. 2010. *Results of an Archaeological Reconnaissance of the South Saddle Communication Tower Site, Washington County, Oregon.* Survey Report; NADB #23515. July 8. Portland, OR. Prepared for Adapt Engineering, Inc. Portland, OR.

McFadden, T. 1981. *Cultural Resource Survey Report Shan Creek Ridge Indian Site.* Survey Report; NADB #2489. February 20. Jacksonville, OR. U.S. Forest Service, Siskiyou National Forest, Galice Ranger District.

McLaren, D., D. Fedje, Q. Mackie, L.G. Davis, J. Erlandson, A. Gauvreau, and C. Vogelaar. 2019. Late Pleistocene Archaeological Discovery Models on the Pacific Coast of North America, PaleoAmerica. DOI: 10.1080/20555563.2019.1670512

Minor, R. 1996a. *Cultural Resources Survey For The Riparian Rehabilitation Project, Kilchis River And North Fork Of Kilchis River, Tillamook County, Or.* Survey Report; NADB #15470. April 23. Eugene, OR. Prepared for U.S. Fish and Wildlife Service, Portland, OR.

Minor, R. 1996b. *Cultural Resources Survey of a Culvert Replacement Area, Little North Fork of Wilson River, Tillamook County, Oregon.* Survey Report; NADB #15469. April 15. Eugene, OR. Prepared for U.S. Fish and Wildlife Service, Portland, OR.

Minor, R. 2002. *Preliminary Archaeological Investigations at the Walter J. Smith Homestead Site, Tillamook County, Oregon*. Survey Report; NADB #28588. November 30. Eugene, OR. Prepared for Walker Macey, Portland, OR and Oregon Department of Forestry, Forest Grove.

Minor, R. 2018. *Cultural Resource Survey for the South Fork Trask River Bridge Project, Tillamook County, Oregon*. Survey Report; NADB #29935. June 12. Eugene, OR. Prepared for OBEC Consulting Engineers, Eugene, OR.

Minor, R., and R. Wenger. 2007. *Archaeological Survey, Discovery Probing, and Construction Monitoring at Nehalem Falls Campground, Tillamook County, Oregon.* Survey Report; NADB #21521. August 15. Eugene, OR. Prepared for Oregon Department of Forestry, Salem, OR.

Mitchell, R.A. 1981. *State of Oregon Slickrock Right-of-Way.* Survey Report; NADB #3736. June 5. Jacksonville, OR: U.S. Forest Service, Rogue River National Forest, Star Ranger District.

Mumblo, B. 1992. *Puma Timber Sale.* Survey Report; NADB #13379. November. Grants Pass, OR: U.S. Forest Service, Rogue River National Forest, Applegate Ranger District.

Murphy, K. 1992. *Cultural Resource Inventory Report, Daily News Timber Sale Pre-Project Survey.* Survey Report; NADB #12999. April 7. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Murphy, K., and F.M. Philipek. 1992. *Cultural Resource Inventory Report, Kirks Bluff Timber Sale, Pre-Project Survey.* Survey Report; NADB #13309. November 30. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Nash, Christine. 1989. *Cultural Resource Survey Report, Silver Creek Falls Land Exchange Tract 1 Pre-Exchange Survey.* Survey Report; NADB #10611. July 12. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Neuzil, A.A., and A. Heppner. 2016a. *Cultural Resources Inventory of the Colm-5 Project Area, Columbia County, Oregon*. Survey Report; NADB #28598. October 7. Portland, OR. Prepared for U.S. Department of Agriculture Natural Resources Conservation Service, St. Helens Service Center, St. Helens, OR.

Neuzil, A.A., and A. Heppner. 2016b. *Cultural Resources Inventory of the COLM-4 Project Area, Columbia County, Oregon*. Survey Report; NADB #28552. October 7. Portland, OR. Prepared for U.S. Department of Agriculture Natural Resources Conservation Service, St. Helens Service Center, St. Helens, OR.

Newsome, D. 2016. *Cultural Resource Survey for the Santiam-Toledo No. 1 Transmission Line Access Road Project, Structures 51/4 to 67/5, Lincoln County, Oregon.* Survey Report; NADB #28365. July 28. Bend, OR: U.S. Forest Service, Bend-Fort Rock.

ODF (Oregon Department of Forestry). 2010. *Northwest Oregon State Forests Management Plan*. Revised Plan. April. Available: https://www.oregon.gov/odf/documents/aboutodf/2010fmpnorthwestoregon.pdf. Accessed: Sept 3, 2021.

Oetting, A.C. 1992. *Cultural Resource Surveys Of Selected BLM Land Exchange Parcels in Lane, Linn and Polk Counties, Oregon.* Survey Report; NADB #13271. September 8. Eugene, OR: U.S. Department of Interior, Bureau of Land Management, Eugene District.

Ogle, T.B., et al. 2006. *Cultural Resource Survey of Northwest Pipeline Corporation's 2006 Eugene District Winchester to Grants Pass Pigging Project, Douglas and Josephine Counties, Oregon.* Survey Report; NADB #20489. May 26, 2006. Portland, OR. Prepared for Northwest Pipeline Corporation, Salt Lake City, UT.

Oregon Forest Resources Institute. 2021. "Facts About Oregon's Forests." Available: https://oregonforests.org/forest-facts-figures. Accessed: Sept 3, 2021.

O'Rourke, L.M. 2008. *Cultural Resources Survey for the Proposed Miles Crossing Vacuum Sewer System Project, Miles Crossing Sanitary Sewer District, Clatsop County, Oregon.* Survey Report; NADB #22053. September 26. West Linn. Prepared for Miles Crossing Sanitary Sewer District, Astoria, OR.

Perrin, N.K., and J.L. Henderson. 2020. *North Fork and Gates Hill Road Chip Seal Cultural Resources Report, Marion County, Oregon*. NADB #31000. February. Portland Oregon. Prepared for David Evans and Associates, Inc., Portland, OR.

Pettigrew, R.M. 1983. *Letter Report: on the Archaeological Survey of the Proposed Improvements of the North Fork Trask River Bridge, Trask River Road, Tillamook County, Oregon.* Survey Report; NADB #5025. May 5. Eugene, OR. Prepared for Highway Division, Oregon Department of Transportation, Salem, OR.

Philipek, F.M. 1985. *Tillamook Resource Area FY87 Timber Sale Program: Cultural Resource Inventory Report.* Survey Report; NADB #6977. August. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1986. *Cultural Resource Report for the Packsaddle Timber Sale.* Survey Report; NADB #8028. November. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1986. *Devil's Creek Timber Sale.* Survey Report; NADB #8003. October. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1986. *Schoolmarm II Timber Sale.* Survey Report; NADB #8035. December. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1987a. *Cultural Resource Survey Report, Murphy Coop Timber Sale, Pre-harvest Survey.* Survey Report; NADB #8985. December 30. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1987b. *Meadowsaw Salvage Timber Sale Yamhill Resource Area Salem BLM District.* Survey Report; NADB #8074. January. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M. 1987c. *Gold Creek Timber Sale, Tillamook Resource Area, Salem BLM District.* Survey Report; NADB #8043. January. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Philipek, F.M., and J.M. Peterson. 1991. *Cultural Resource Survey Report, Crooked Finger Rd. T.S. Unit 1 Post-Harvest and Looney's Creek R-O-W Pre-Project Survey.* Survey Report; NADB #11929. Survey Report; #11928. January 24. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Piazza, M. 1995. *Thomason Salvage Cultural Resource Inventory Report.* Survey Report; NADB #14875. January. Baker City: U.S. Forest Service, Wallowa-Whitman National Forest, Wallowa Valley Ranger District.

Pullen, R.J. 1996. *Overview of the environment of native inhabitants of Southwestern Oregon, late prehistoric era*. U.S. Bureau of Land Management. Medford, Oregon.

Punke, M.L., et al. 2006. *Archaeological Survey and Shovel Testing for Northwest Pipeline' Corporation's 2006 Eugene District Sutherlin and Windy Creek Restoration Projects, Douglas County, Oregon.* Survey Report; NADB #20803. August 31. Portland, OR. Prepared for Northwest Pipeline Corporation, Salt Lake City, UT.

Punke, M.L., and J.L. Fagan. 2006. *Archaeological Shovel Testing for Northwest Pipeline Corporation's 2006 Eugene District Winchester to Grants Pass Pigging Project, Douglas and Josephine Counties, Oregon.* Survey Report; NADB #20491. June 8. Portland, OR. Prepared for Northwest Pipeline Corporation, Salt Lake City, UT.

Rader, B. 2009. *Rebuild of the Minto Fish Egg Collection Facility.* Survey Report; NADB #25545. August 20. Prepared for USACE-Portland District Cultural Resources Team. Portland, OR.

Rennaker, P.W., and A. Raymond. 2021. *Green Creek, Samson Creek, and Illingsworth Creek Fish Passage Restoration Project, Tillamook County, Oregon.* NADB #31506. March 8. Sherwood, OR: U.S. Fish and Wildlife Service, Interior Region 9 Branch of Cultural Resources.

Ricks, J.A., and A.C. Oetting. 2009. *Cultural Resource Survey And Historic Overview of the Kelsey/ Whiskey Project Area.* Survey Report; NADB #22362. February 26. Eugene, OR. Prepared for OBEC Consulting Engineers, Eugene, OR.

Robbins, William G. 2021. "Timber Industry." Oregon Encyclopedia. Oregon Historical Society. Available: https://www.oregonencyclopedia.org/articles/timber_industry/#.YTJ_JY5KhPY. Accessed: September 3, 2021.

Rodriguez, M.T. and A. Sanders. 1987. *Cultural Resource Survey Report Blue Collar Timber Sale Post-Harvest Survey.* Survey Report; NADB #8443. August 4. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Roedel, K. 2010. *Programmatic Agreement SHPO Tracking Beneke Creek Scour Project Clatsop County, Oregon.* Survey Report; NADB #24476. July 28. Salem, OR: Oregon Department of Transportation.

Roulette, B.R., and A. Finley. 2017. *Results of a Cultural Resources Study of the Nedonna Beach to Tillamook Fiber Optic Cable Installation Route, Tillamook County, Oregon.* Survey Report; NADB #29569. March 13. Portland, OR. Prepared for Reeve Sherwood Consulting, LLC, Albany, OR.

Roulette, B.R., et al. 2015. *Results of Cultural Resources Studies Related to BPA's Lane-Wendson No. 1 Transmission Line Rebuilding*. Survey Report; NADB #28241. December 29. Portland, OR. Prepared for Bonneville Power Administration, Portland, OR.

Roulette, B.R., and M.R. Lynch. 2020*. Results of an Archaeological Reconnaissance of the Shellburg Falls Campground, Marion County, Oregon Applied Archaeological Research, Inc.* NADB #31633. April 30. Portland, OR. Prepared for Oregon Department of Forestry, Salem, OR.

Scheleen, D. 1999. *Hi Yo Silver Timber Sale*. Survey Report; NADB #17411. March 11. Roseburg, OR: U.S. Department of Interior, Bureau of Land Management, Roseburg District.

Scheleen, D. 2001. *T-Bone Hunter Timber Sale.* Survey Report; NADB #18049. March 27. Roseburg, OR: U.S. Department of Interior, Bureau of Land Management, Roseburg District.

Scheleen, D. 2005. *South River Watershed Restoration—Culvert Replacements.* Survey Report; NADB #23239. April 5. Roseburg, OR: U.S. Department of Interior, Bureau of Land Management, Roseburg District.

Shannon, D., and D. Ellis. 2013. *Ethnographic Report for Portland General Electric's Cascade Crossing Transmission Project, Morrow, Gilliam, Sherman, Wasco, Clackamas, and Marion Counties, Oregon.* Survey Report; NADB #26786. Revised. July. Portland, OR. Prepared for Portland General Electric Company, Portland, OR.

Sherer, K., et al. 1992. *Cultural Resource Reconnaissance Report for the Shasta Costa Timber Sales.* Survey Report; NADB #15813. February 10. Gold Beach, OR: U.S. Forest Service, Siskiyou National Forest, Gold Beach Ranger District.

Simpson, S. 2015. *A Cultural Resources Assessment for T-Mobile West, LLC Candidate PO02058A (Hwy 26W Music Rd) - Proposed Installation, Clatsop County, Oregon.* Survey Report; NADB #27755. September 8. Ventura, CA. Prepared for T-Mobile West, LLC, Portland, OR.

Smith, C. and M. Casperson. 2017. *Shively Clark Harvest Plan Roseburg District Bureau of Land Management Cultural Resources NADB.* Survey Report; NADB #29292. September 6. Roseburg, OR: Bureau of Land Management.

Smith, G.M., D. Duke, D.L. Jenkins, T. Goebel, L.G. Davis, P. O'Grady, D. Stueber, J. Pratt, and H.L. Smith. 2019. The Western Stemmed Tradition: Problems and Prospects in Paleoindian Archaeology in the Intermountain West. *PaleoAmerica* 6:1–20. 10.1080/20555563.2019.1653153.

Smith, M., and A.W. Gall. 2010. *Archaeological Survey of the Dunbar Ridge Telecommunications Facility, Tillamook County, Oregon*. Survey Report; NADB #23719. September 16. Vancouver, WA. Prepared for Adapt Engineering, Inc., Portland, OR.

Smith, M., and A.W. Gall. 2013. *Archaeological Survey of the Green Peter Project Area, Linn County, Oregon.* Survey Report; NADB #26024. August 22. Vancouver, WA. Prepared for Adapt Engineering, Inc., Portland, OR.

Snyder, D.J. 2017. *Cultural Resources Survey of the Steven Berg CSP17 Project, Clatsop County, Oregon*. Survey Report; NADB #28918. March 23. Portland, OR: U.S. Department of Agriculture Natural Resources Conservation Service.

Snyder, S.L., et al. 1980a. *Cultural Resource Survey of the Proposed Bonneville Power Administration Slatt-Marion 500 KV Transmission Line in the Region of Wasco, Marion and Clackamas Counties, Oregon.* Survey Report; NADB #1536. January 9. Corvallis, OR: Department of Anthropology, Oregon State University.

Snyder, S.L., et al. 1980b. *Cultural Resource Survey of the Proposed Bonneville Power Administration Slatt-Marion 500 KV Transmission Line in the Region of Wasco, Marion and Clackamas Counties, Oregon.* Survey Report; NADB #1547. Pullman, WA: Washington Archaeological Research Center, Washington State University.

Solimano, P. 2004. *Results of an Archaeological Survey of the Bonneville Power Administration's Youngs Bay/Walluski River Habitat Restoration Project, Clatsop County, Oregon.* Survey Report; NADB #18938. June 10. Portland, OR. Prepared for Bonneville Power Administration, Portland, OR.

Southard, M.D. 1987. *FY88 Timber Sale.* Survey Report; NADB #7962. January 12. Eugene, OR: U.S. Department of Interior, Bureau of Land Management, Eugene District.

Southard, M.D. 1991. *Cultural Resource Survey Report, Lookout Thinning Timber Sale.* Survey Report; NADB #12083. March 28. Eugene, OR: U.S. Department of Interior, Bureau of Land Management, Eugene District.

Southard, M.D. 1992a. *Thin One Timber Sale.* Survey Report; NADB #13412. December 11. Eugene, OR: U.S. Department of Interior, Bureau of Land Management, Eugene District.

Southard, M.D. 1992b. *Cultural Resource Report, Bulmer Creek Timber Sale.* Survey Report; NADB #12729. February 6. Eugene, OR: U.S. Department of Interior, Bureau of Land Management, Eugene District.

Stepp, D. 1991. *Cultural Resource Reconnaissance Report for the Finley Overlook Timber Sale.* Survey Report; NADB #12543. June 28. Jacksonville, OR: Siskiyou U.S. Forest Service, National Forest, Galice Ranger District.

Stepp, D. 1995. *High Five And Low Five Timber Sale.* Survey Report; NADB #15004. May 5. Corvallis, OR. Prepared for U.S. Department of Interior, Bureau of Land Management, Medford District, Medford, OR.

Stepp, D. 1999. *Cultural Resource Inventory Report For The Picket Snake Project Area, Josephine County, Oregon.* Survey Report; NADB #17185. December 15. Corvallis, OR. Prepared for U.S. Department of Interior, Bureau of Land Management, Medford District, Medford, OR.

Straub, R., and S. Wagner. 1992. *Cultural Resource Inventory Report for the Saddle Salvage Timber Sale Post-project Survey*. Survey Report; NADB #13221. July 13. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Stutte, N. 2005. *Additional Survey and Testing for Young's Bay Habitat Restoration Project, Clatsop County, Oregon.* Survey Report; NADB #19661. June 2. Portland, OR: Bonneville Power Administration.

Swanson, C.R. 1976. *Archaeological Reconnaissance of the North Fork Nehalem, Nehalem, Miami, Kilchis, Wilson, Trask, Nestucca & Little Nestucca Rivers Stream Protection Project.* Survey Report; NADB #327. Bellingham, WA: Western Washington State College.

Tasa, G.L., et al. 2005. *Archaeological Resource Evaluation of Area 4 and Area 2, Oregon State Parks, 2004/2005 Surveys.* Survey Report; NADB #20359. Eugene, OR: Museum of Natural and Cultural History, State Museum of Anthropology, University of Oregon.

Tipton, K.L., and S. Schmidt. 2019. *Allston-Driscoll No 2 Access Road Maintenance Phase I and II Clatsop and Columbia Counties, Oregon.* NADB #30532 July 5. Portland, OR: Bonneville Power Administration.

Vanderhoof, T.M. 1988. *Cultural Resource Survey Report, Little Duece Timber Sale, Pre-harvest Survey.* Survey Report; NADB #10625. November 3. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Vanderhoof, T.M. 1989. *Cultural Resource Survey Report, Fallen Angle Timber Sale-Unit 1 Pre-Harvest Survey.* Survey Report; NADB #11191. December 27. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Vanderhoof, T.M. 1990. *Something Special Timber Sale Unit-1 Pre-Harvest Survey.* Survey Report; NADB #11236. January 4. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Vanderhoof, T.M. 2004. *School Marm/Green Mtn. Sec. 27, T.9s, R.8w, Road Decommissioning, Cultural Resource Inventory Report, Post-Project Survey, Mary's Peak Resource Area, Salem BLM District.* Survey Report; NADB #19423. September 30. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Van Roggen, J., et al. 2020. *Cultural Resource Inventory for the Fishhawk Lake Reserve and Community Fishhawk Lake Dam Spillway and Fish Passage Improvements, Clatsop County, Oregon.* NADB #31486. November 5. La Grande, OR. Prepared for U.S. Army Corps of Engineers, Portland, OR.

West, T.L., et al. 1983. *Cultural Resources Sample Survey Design for the Siskiyou National Forest.* Survey Report; NADB #5493. July. [Author Publishing Information]: U.S. Forest Service, Siskiyou National Forest, Region Six Pacific Northwest.

Wilen, R. 1987. *Cultural Resource Inventory for the Tum Fly Timber Sale.* Survey Report; NADB #8977. November 3. Detroit, OR: U.S. Forest Service, Willamette National Forest, Detroit Ranger District.

Winterhoff, E.H. 2004. *Archaeological Survey of Bridge 01868 (OR 6 over Wilson River at MP 5.78), Tillamook County.* Survey Report; NADB #20865. February 16. Eugene: OR. Prepared for Oregon Department of Transportation, Salem OR.

Winterhoff, E.H., and T.E. Cabebe. 2006. *Archaeological Survey of Bridge 01869A (Oregon Highway 6 over the Wilson River at Milepoint 11.8-Mills), Tillamook County, Oregon.* Survey Report; NADB #20867. August 15. Eugene: OR. Prepared for Oregon Department of Transportation, Salem OR.

Winterhoff, E.H., and M.M. Long. 2006. *Archaeological Survey of Bridge 00921 (Oregon Highway 30 over Gnat Creek at Mile Point 77.25) Clatsop County, Oregon.* Survey Report; NADB #20857. February 16. Eugene: OR. Prepared for Oregon Department of Transportation, Salem OR.

Winthrop, K. 1993. *Lost Fortune Timber Sale.* Survey Report; NADB #13541. February 22. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Winthrop, K. 1996. *McLawson Timber Sale.* Survey Report; NADB #15513. May 21. Medford, OR: U.S. Department of Interior, Bureau of Land Management, Medford District.

Worrel, D. 2007. *Cultural Resource Inventory Report Re-Bear Timber Sale Post-Project Survey.* Survey Report; NADB #23256. October 9. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Yeiter, M. 1991. *Cultural Resource Survey Report, Two Crooked Digits Sale Units 1 & 2 Pre-Harvest Survey.* Survey Report; NADB #12132. January 16. Salem, OR: U.S. Department of Interior, Bureau of Land Management, Salem District.

Attachment 1: National Historic Preservation Act Correspondence

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

August 6, 2021

Christine Curran
Deputy State Historic Preservation Officer
Oregon Heritage
Oregon Parks & Recreation Department
725 Summer St NE, Suite C
Salem, Oregon 97301

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Proposed Area of Potential Effects, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Christine Curran:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 covered species: Oregon Coast coho salmon, Oregon Coast spring Chinook salmon, Southern Oregon/Northern California Coast spring Chinook salmon, Lower Columbia River coho salmon, Upper Willamette River spring Chinook salmon, Upper Willamette River winter steelhead, Columbia River chum salmon, Southern Oregon/Northern California Coast coho salmon, Lower Columbia River Chinook salmon, eulachon, northern spotted owl, marbled murrelet, Oregon slender salamander, Columbia torrent salamander, Cascade torrent salamander, coastal marten, and red tree vole.

The plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) 800.4(a)(1) includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF currently controls and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

The regulations at 36 CFR 800.8(c) of the NHPA provide for use of the NEPA process to fulfill a lead federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. NMFS intends to use the NEPA process for the Project and is notifying the Advisory Council on Historic Preservation (ACHP) and Oregon State Historic Preservation Officer (SHPO), as required under 36 CFR 800.8(c). As a part of this process, consultation with SHPOs, tribes, other consulting parties, and the ACHP will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR 800.8(c)(1) during NEPA scoping, the environmental analysis, and the preparation of NEPA documents.

ICF will assist NMFS with NHPA Section 106 review of the Project. With this letter, NMFS hereby authorizes ICF to initiate and conduct consultation with the ACHP, Oregon SHPO, and other consulting parties regarding Section 106 review for the Project on NMFS's behalf. NMFS has assigned ICF as the third-party contractor to execute various administrative and logistical tasks, including but not limited to, coordinating communication with the consulting parties; distributing NMFS-approved documents; providing technical assistance; and hosting and facilitating meetings, webinars, and calls with consulting parties.

NMFS fully recognizes that consulting with the appropriate federally recognized tribes is the responsibility of NMFS and this responsibility cannot be delegated, per 36 CFR 800.2(c)(4). NMFS will remain legally responsible for all findings and determinations throughout the entirety of the Project. NMFS initiated contact with Tribes through outreach letters sent on January 29, 2021, prior to the initiation of the Notice of Intent to initiate an EIS. NMFS will remain involved throughout the consultation.

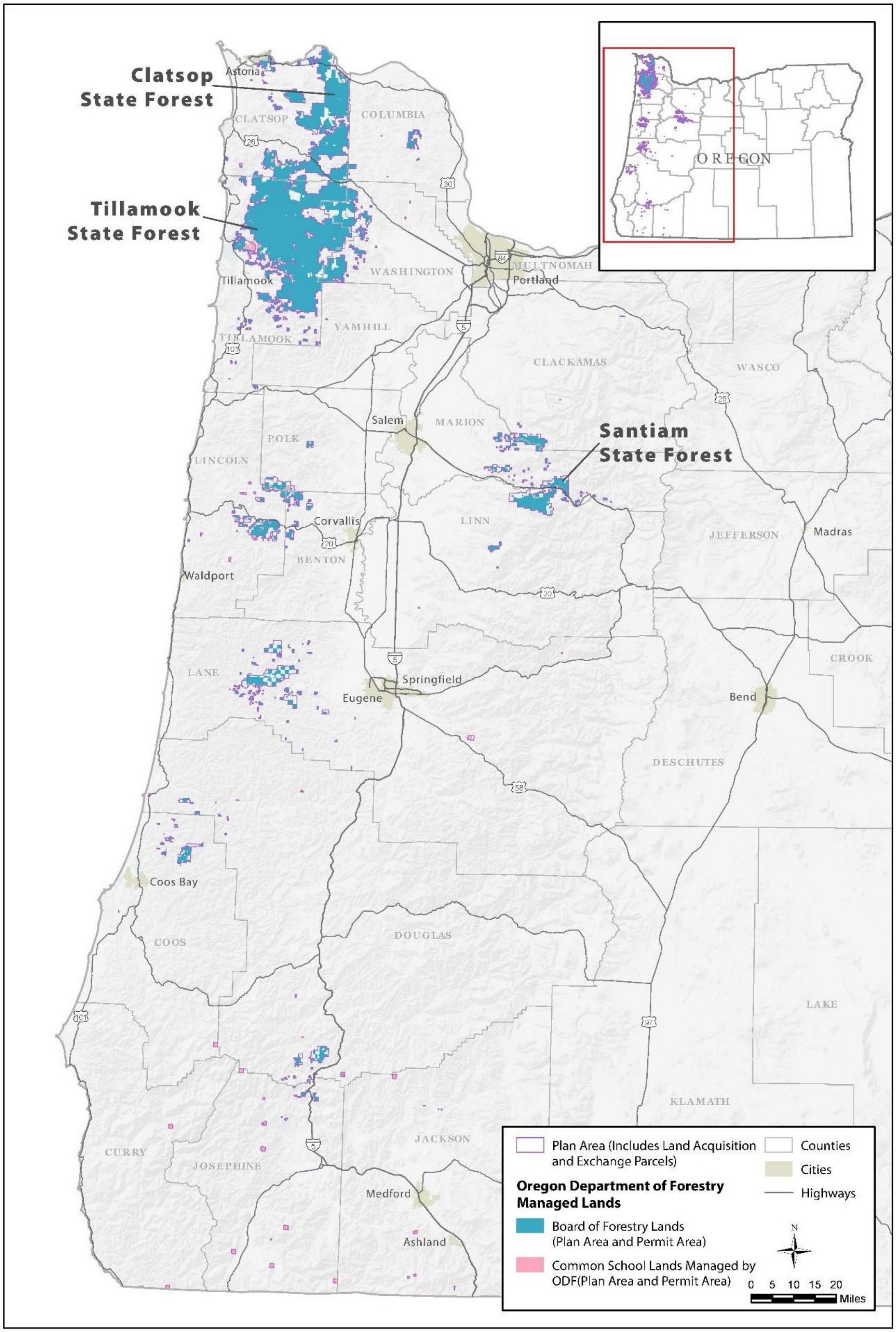
NMFS asks that you share your comments regarding the Project and the proposed APE by September 5, 2021. Please send your written comments or questions electronically to Tait Elder, the Section 106 contact for the project, at tait.elder@icf.com or (360) 920-8959. Should you have any questions or concerns regarding this delegation please contact Michelle McMullin at michelle.mcmullin@noaa.gov or (541) 957-3378. We look forward to consulting with you.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Manager
Oregon Washington Coastal Office

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area

Enclosure 1 – Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Dale Miller
Chairman
Elk Valley Tribe

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairman Miller:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Elk Valley Tribe will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

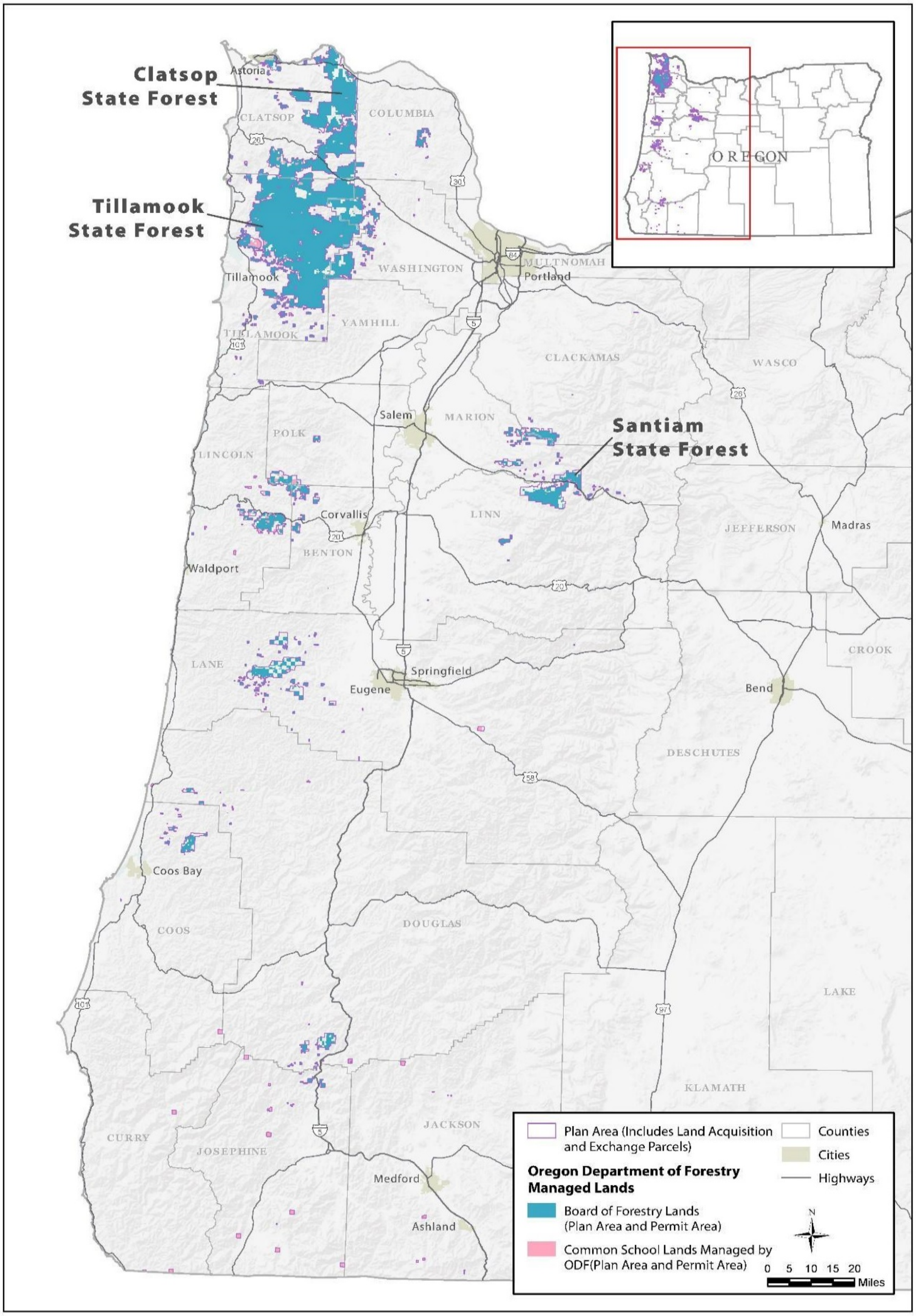
Sincerely,

Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Jody Richards
Chairperson
General Council, Burns Paiute Tribe

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Richards:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

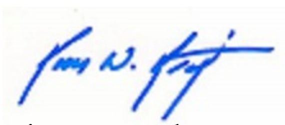
NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Burns Paiute Tribe will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,



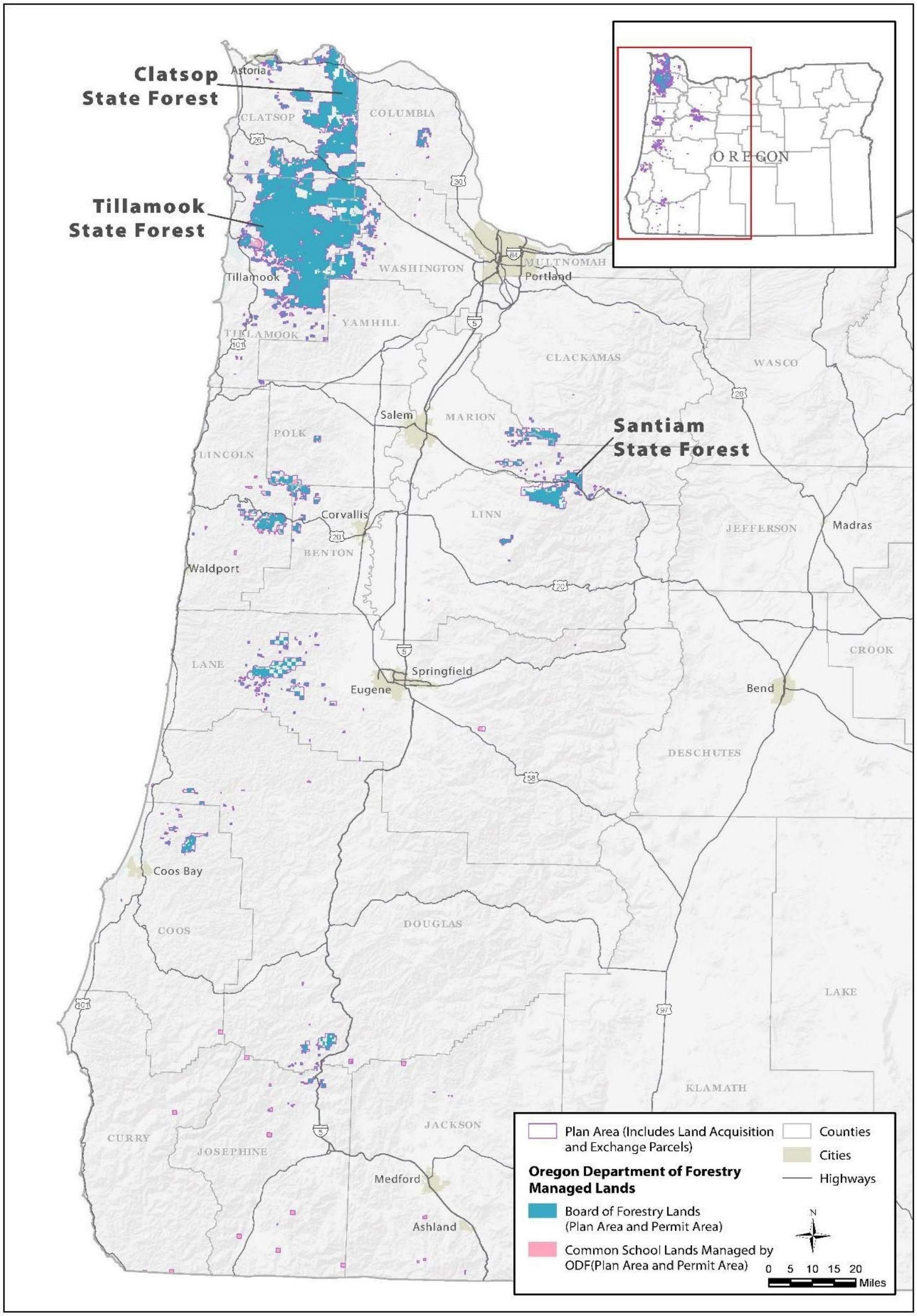
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Ms. Calla Hagle, Director of Department of Natural Resources
Ms. Erica Maltz, Manager of Fisheries Program

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Brenda Meade
Chairwoman
Coquille Indian Tribe

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairwoman Meade:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Coquille Indian Tribe will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

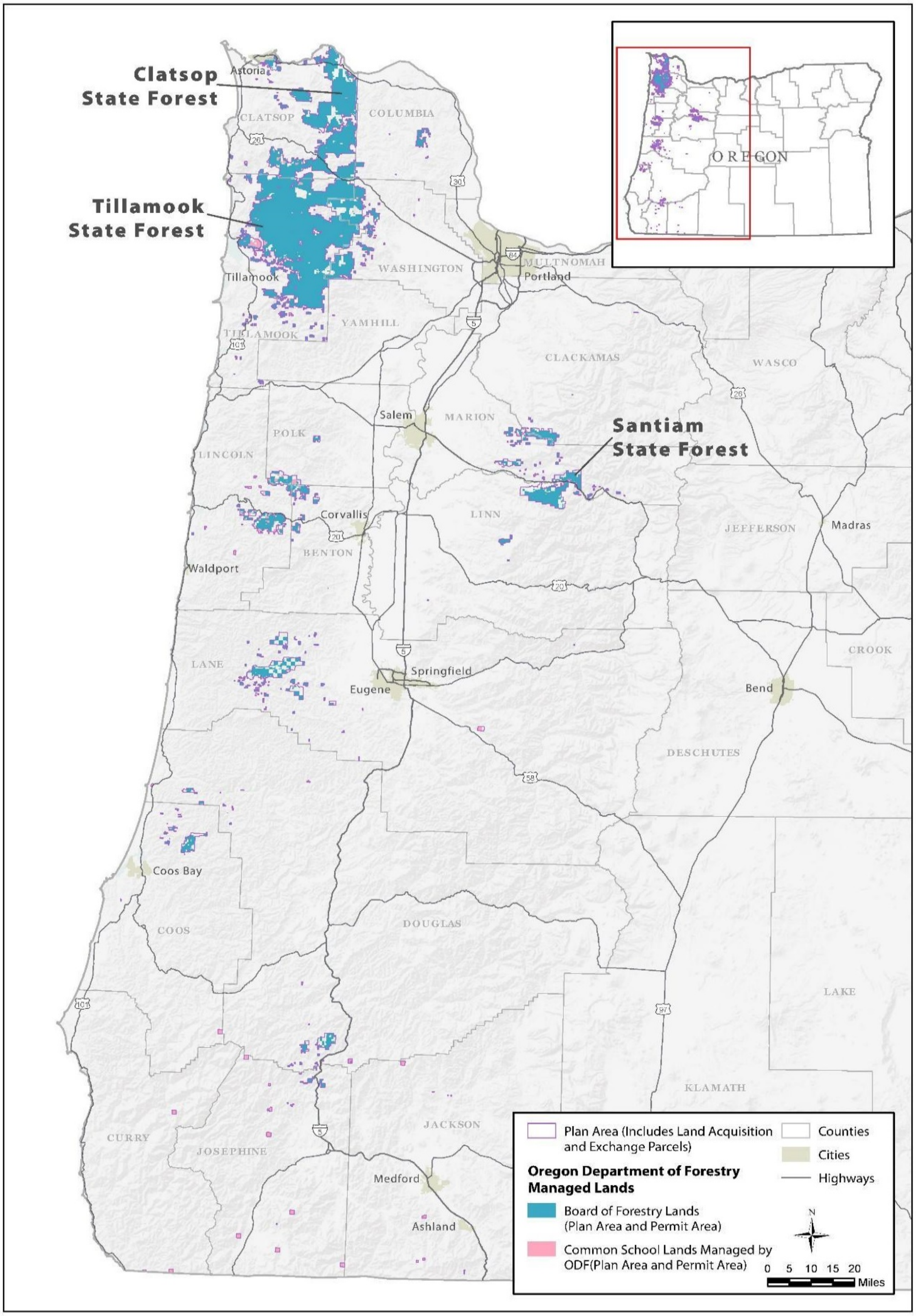
Sincerely,

Kim Kratz, PhD	Paul Henson, PhD
Assistant Regional Administrator	State Supervisor
Oregon Washington Coastal Office	Oregon Fish and Wildlife Office
National Marine Fisheries Service	United States Fish and Wildlife Service

cc: Mr. Darin Jarnaghan Sr., Natural Resource Director
Ms. Helena Linnell, Biological Planning & Operations Manager

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Daniel Courtney
Chairperson
Board of Directors
Cow Creek Band of Umpqua Tribe of Indians

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Courtney:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

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NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Cow Creek Band of Umpqua Tribe of Indians will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

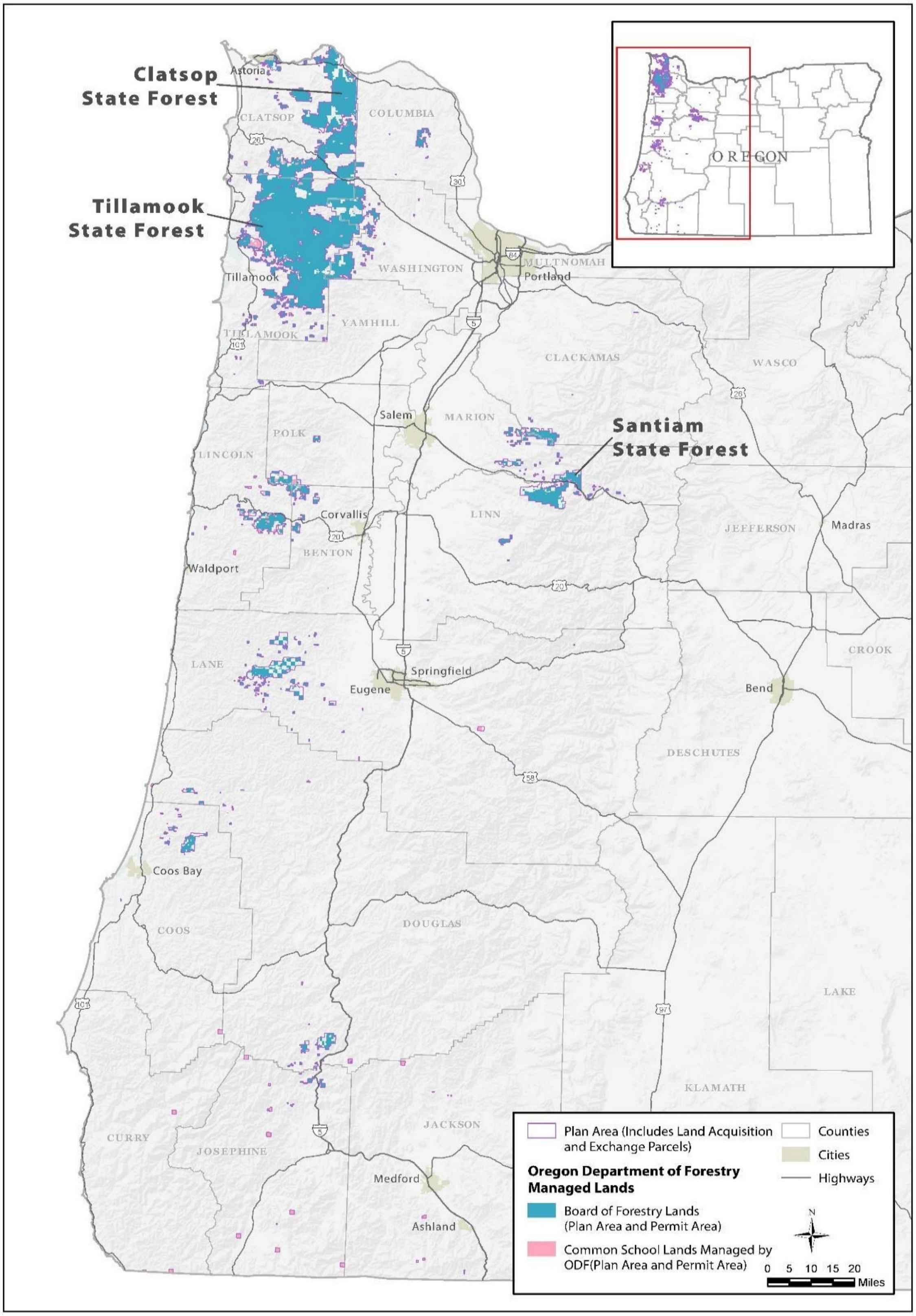
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Tim Vredenburg, Forest Manager, Natural Resources
Mr. Jason Robison, Director, Natural Resources

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable David Barnett
Chairman
Cowlitz Indian Tribe

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairman Barnett:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

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The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Cowlitz Indian Tribe will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

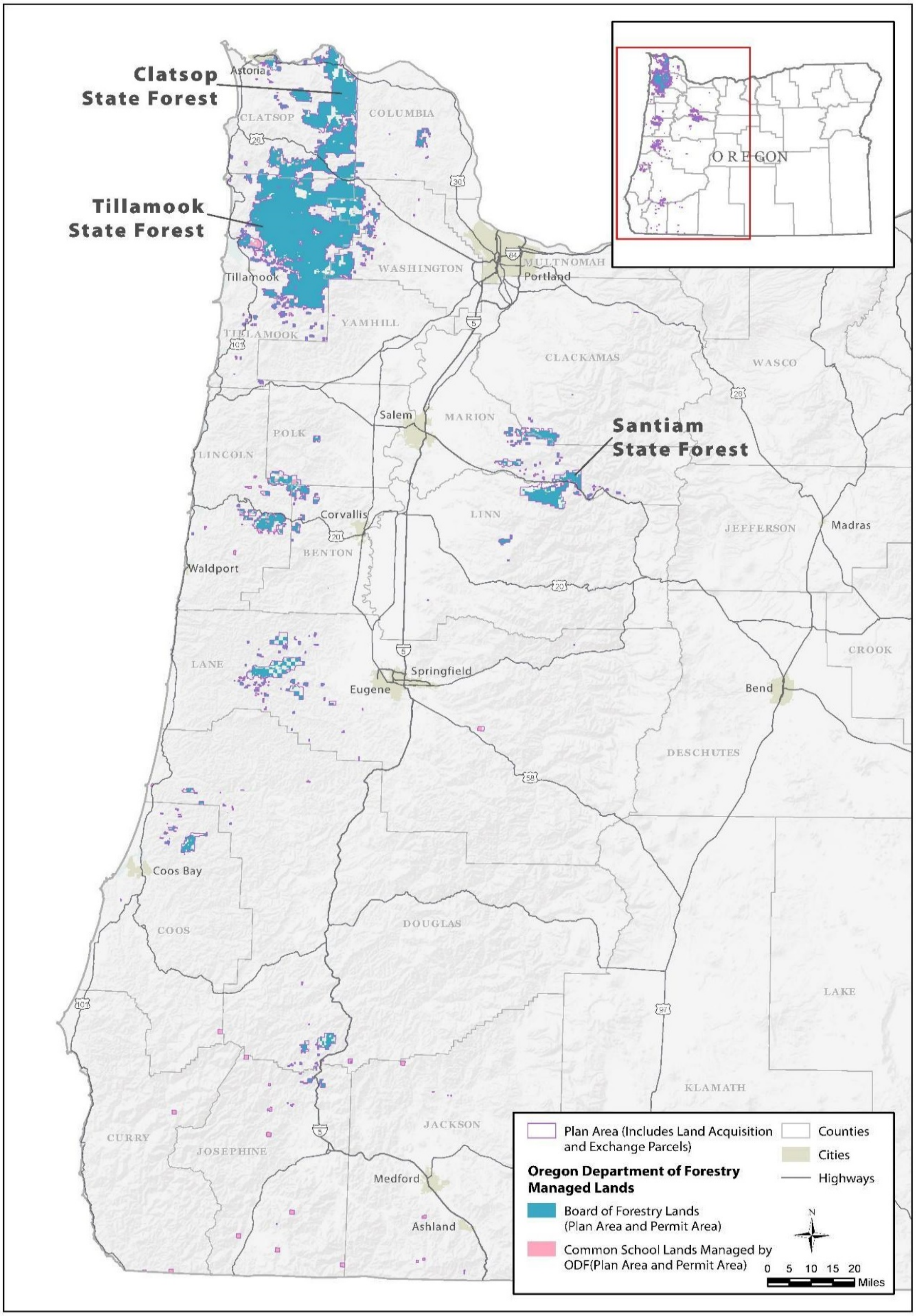
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Taylor Aalvik, Natural Resource Director, Department of Natural Resources
Mr. John Marsh, Policy Analyst, Department of Natural Resources

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Debbie Bossley
Chairperson
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Bossley:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

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NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

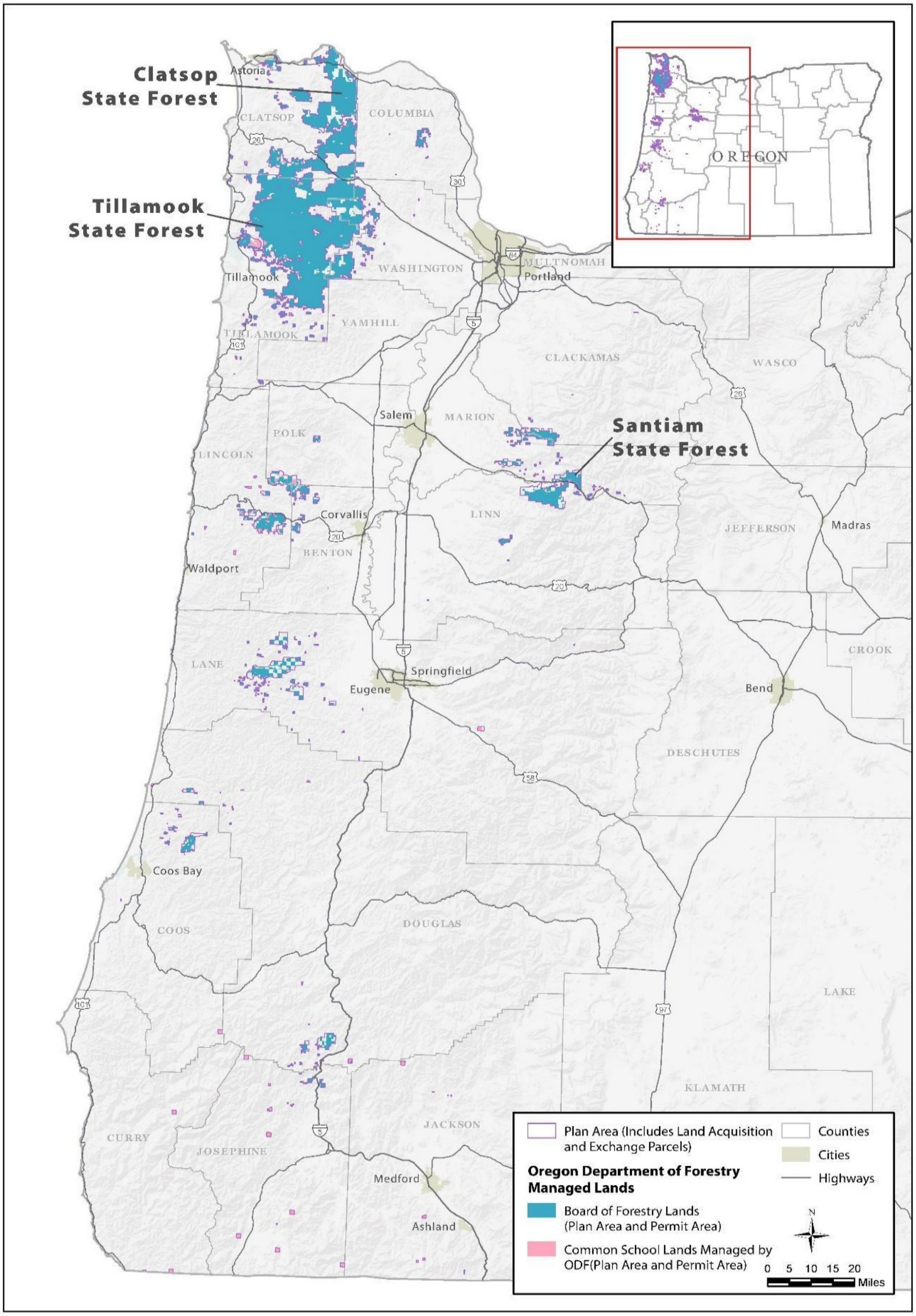
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. John Schaefer, Natural Resources

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Cheryle Kennedy
Chairwoman
Confederated Tribes of the Grand Ronde Community of Oregon

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairwoman Kennedy:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

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NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes of the Grand Ronde Community of Oregon will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

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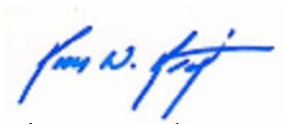


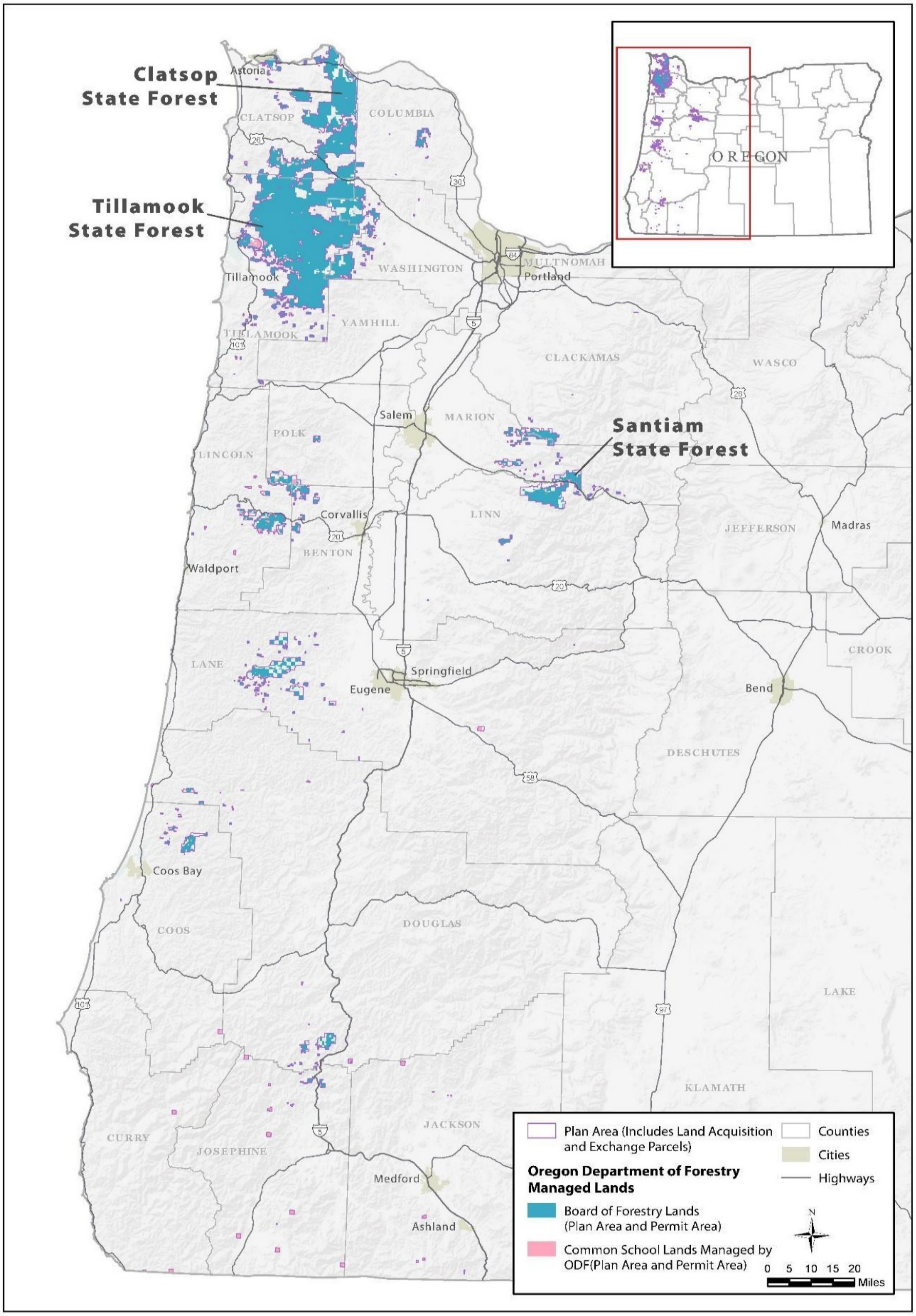
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Kelly Dirksen, Fish and Wildlife Coordinator
Mr. Colby Drake, Interim Natural Resources Division Manager
Mr. Torey Wakeland, Ceded Lands Coordinator
Mr. Michael Karnosh, Timber Resource Program Manager

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Don Gentry
Chairman
Klamath Tribal Council
Klamath Tribes

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairman Gentry:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

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Information exchange and informal consultation with the Klamath Tribes will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

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Sincerely,

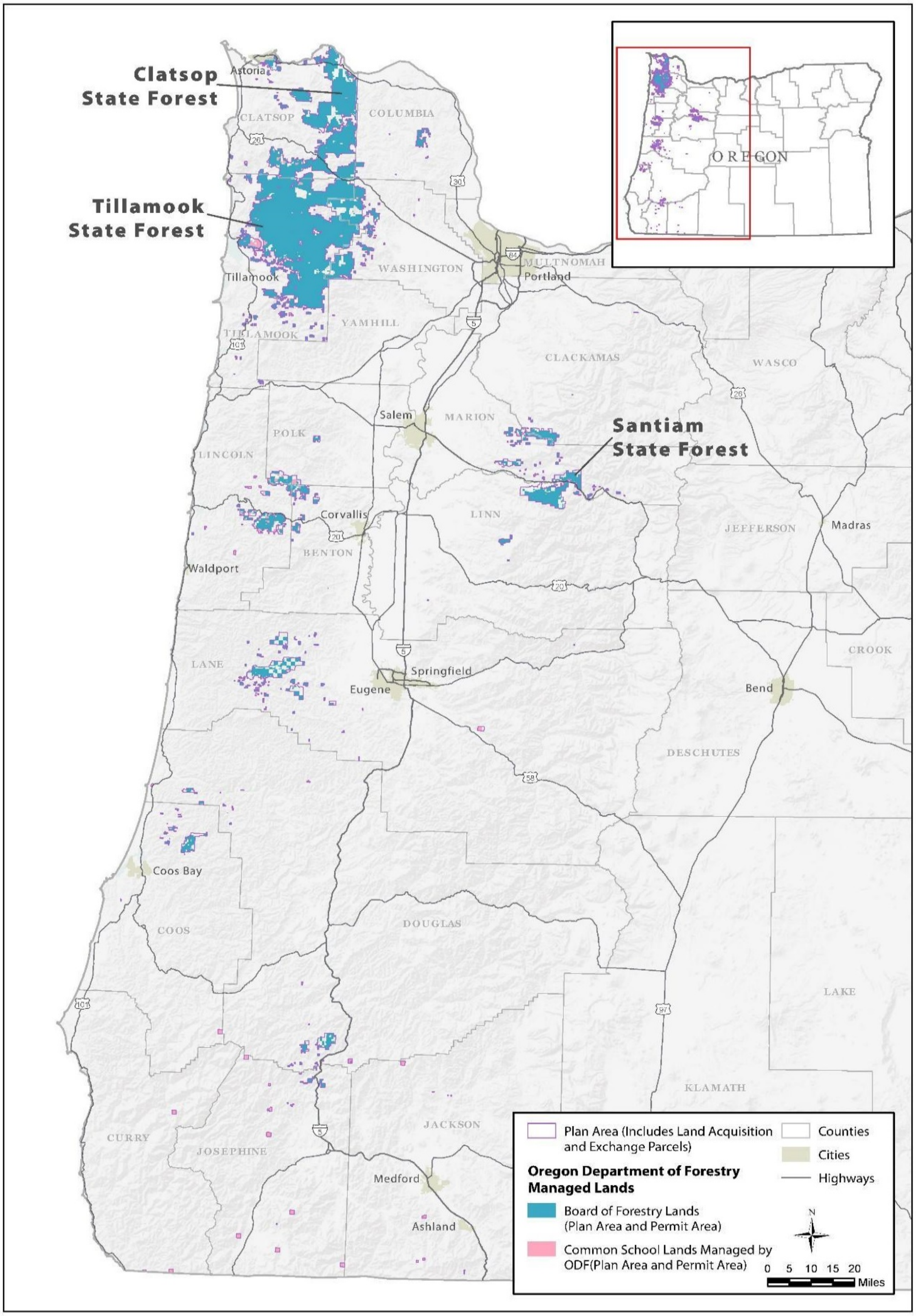
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Will Hatcher, Director, Department of Natural Resources

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Charlene Nelson
Chairwoman
Shoalwater Bay Tribal Council
Shoalwater Bay Tribe

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairwoman Nelson:

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Information exchange and informal consultation with the Shoalwater Bay Tribe will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

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Sincerely,

Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Ms. Larissa Pfleeger-Ritzman, Natural Resource Director

Enclosure

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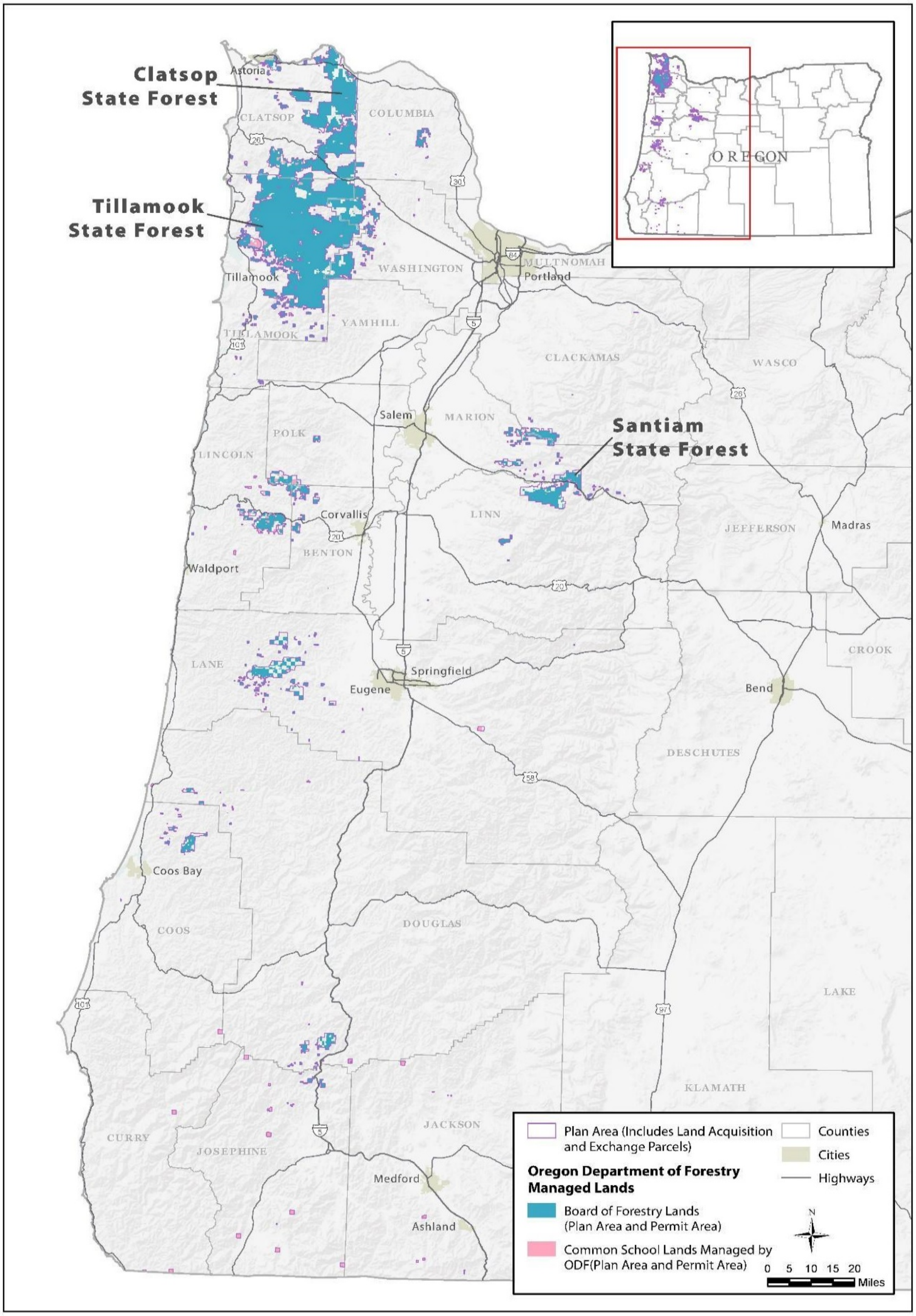


UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Delores Pigsley
Chairperson
Siletz Tribal Council
Confederated Tribes of Siletz Indians of Oregon

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Pigsley:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes of Siletz Indians of Oregon will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

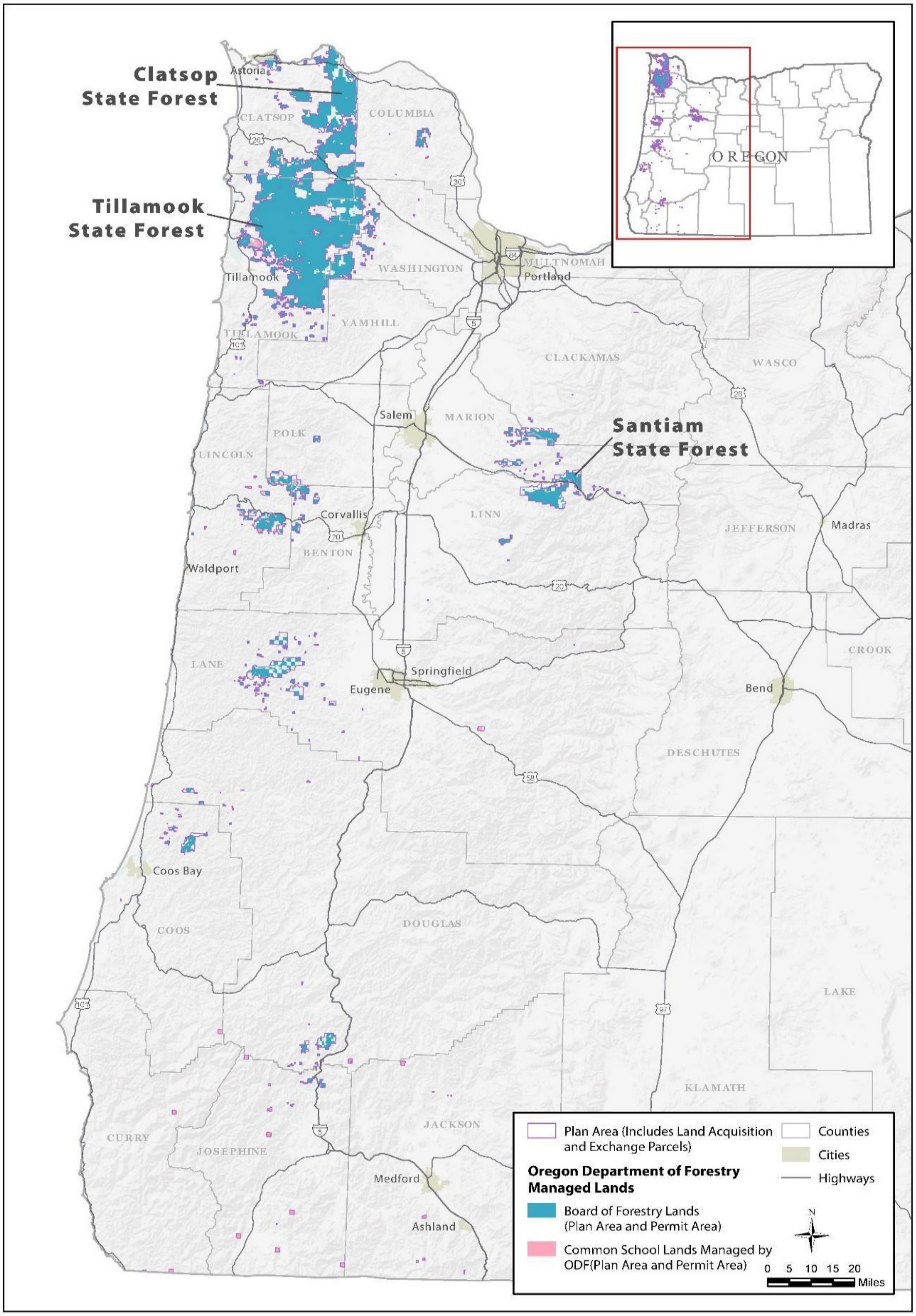
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Mike Kennedy, Natural Resources Manager
Mr. Stan van de Wetering, Director of Biological Programs

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Jeri Lynn Thompson
Chairperson
Smith River Rancheria

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Thompson:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Smith River Rancheria will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

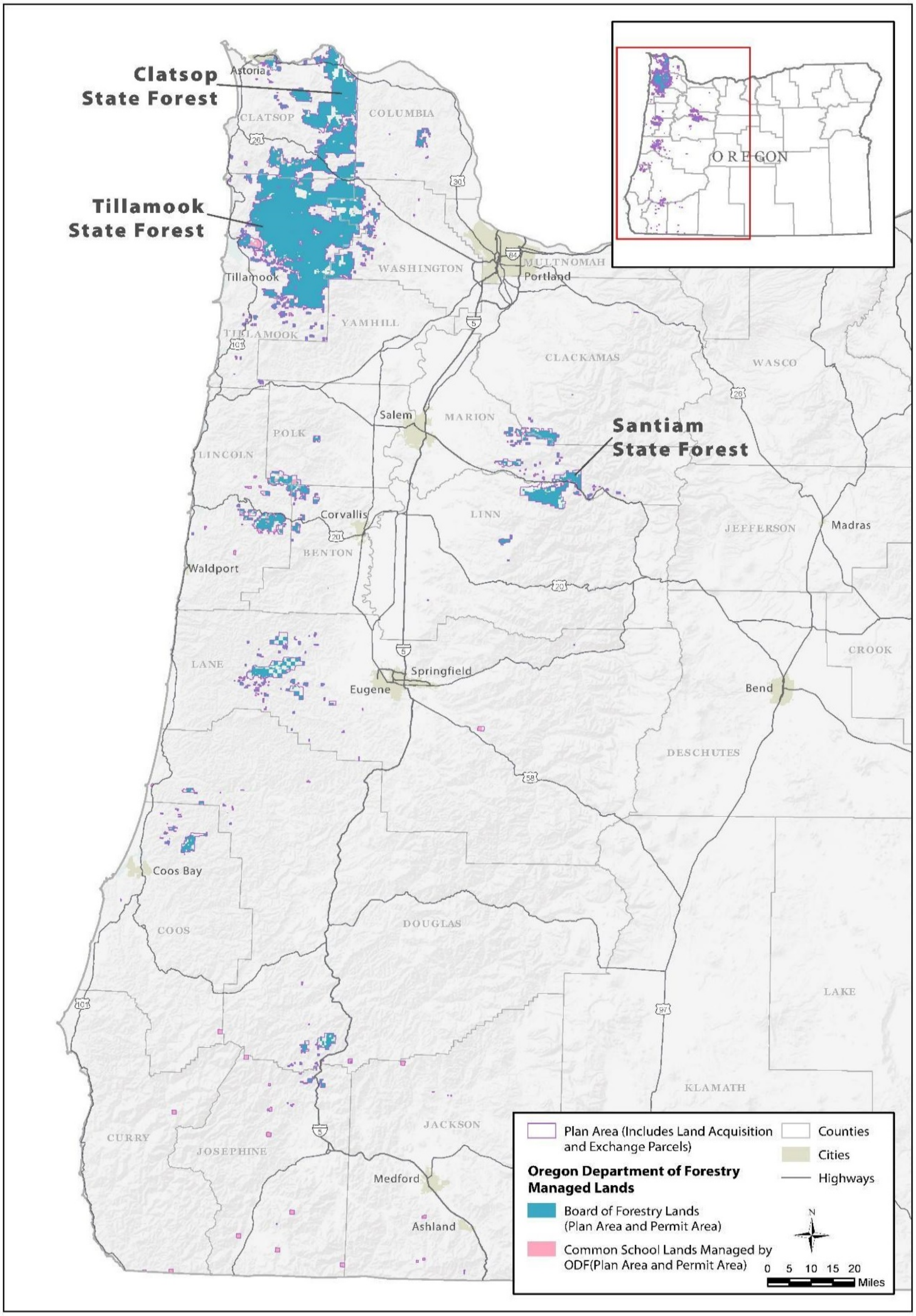
NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

Kim Kratz, PhD	Paul Henson, PhD
Assistant Regional Administrator	State Supervisor
Oregon Washington Coastal Office	Oregon Fish and Wildlife Office
National Marine Fisheries Service	United States Fish and Wildlife Service

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable M. Kathryn Brigham
BOT Chair
Board of Trustees
Confederated Tribes of the Umatilla Reservation

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairperson Brigham:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes of the Umatilla Reservation will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

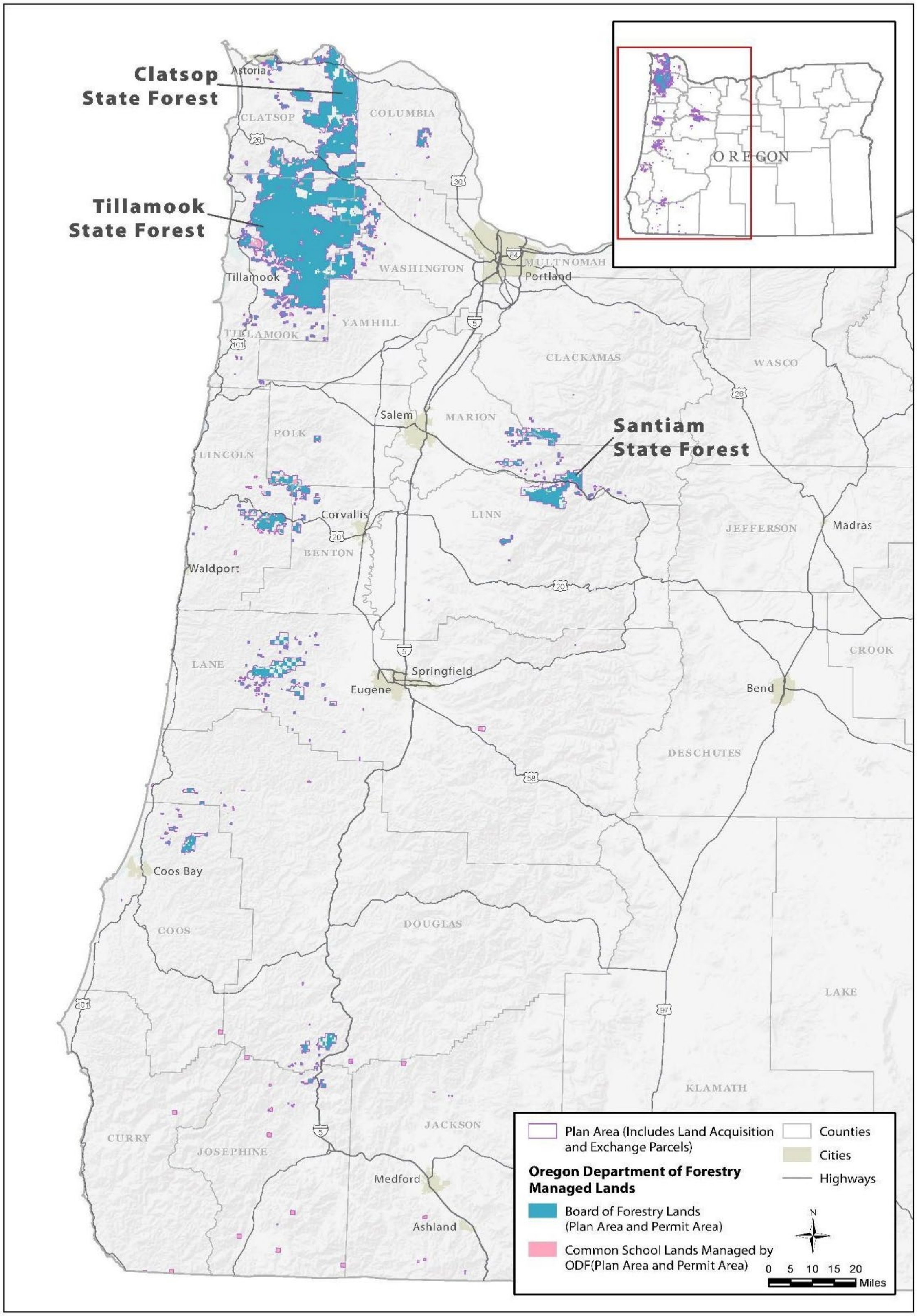
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Gordy Schumacher, Program Manager, Range, Agriculture and Forestry

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Raymond Tsumpti
Chairman
Tribal Council, Confederated Tribes of the Warm Springs Reservation

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairman Tsumpti:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes of the Warm Springs Reservation will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

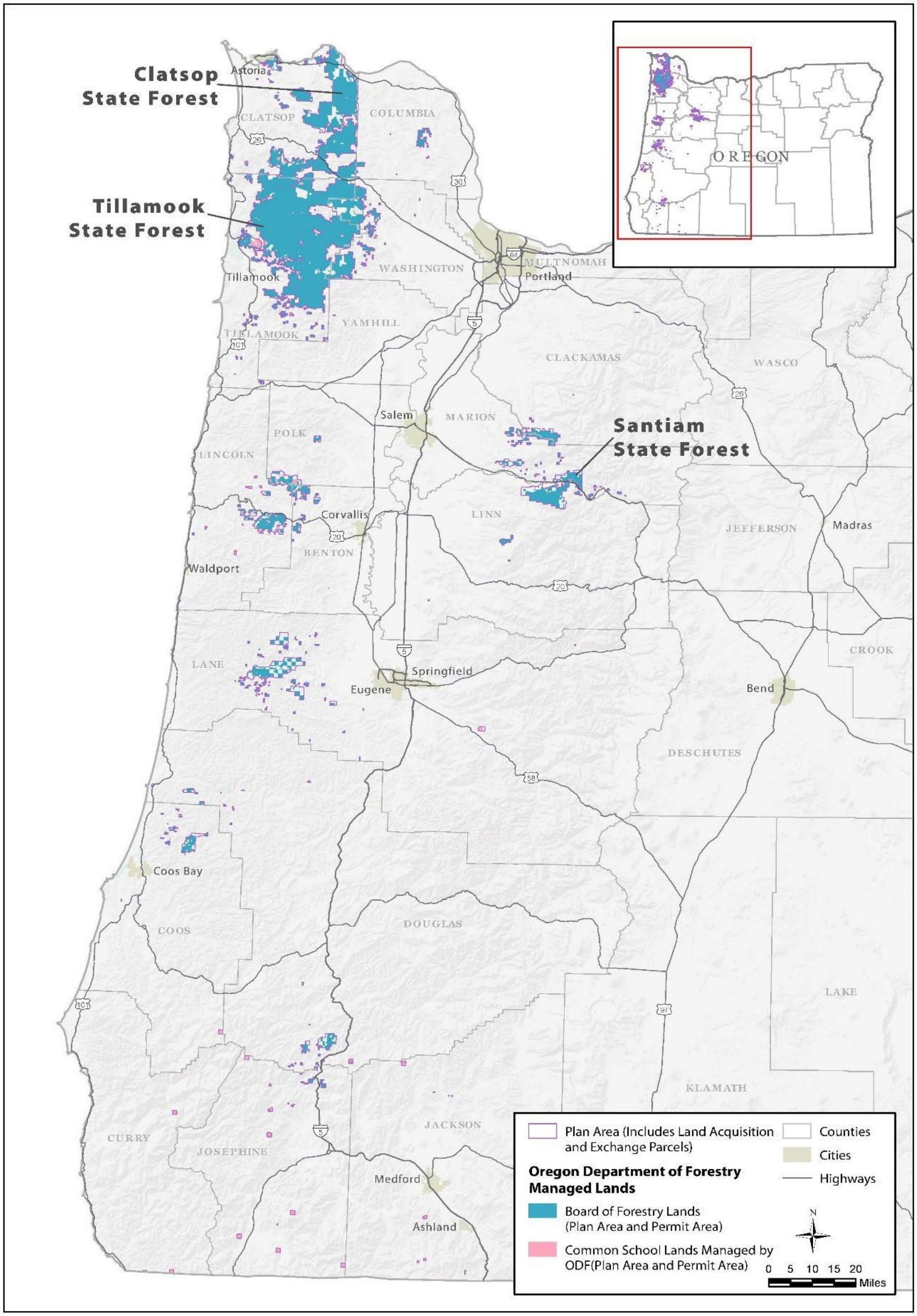
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Robert Brunoe, Natural Resources General Manager

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

September 23, 2021

The Honorable Delano Saluskin
Chairman
Yakama Tribal Council
Confederated Tribes and Bands of the Yakama Nation

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Consulting Party Invitation, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Honorable Chairman Saluskin:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Western Oregon State Forests Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 species: Oregon Coast coho (*Oncorhynchus kisutch*), Oregon Coast spring Chinook (*O. tshawytscha*), Southern Oregon/Northern California Coast spring Chinook (*O. tshawytscha*), Lower Columbia River coho (*O. kisutch*), Upper Willamette River spring Chinook (*O. tshawytscha*), Upper Willamette River winter steelhead (*O. mykiss*), Columbia River chum (*O. keta*), Southern Oregon/Northern California Coast coho (*O. kisutch*), Lower Columbia River Chinook (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*), Oregon slender salamander (*Batrachoseps wrighti*), Columbia torrent salamander (*Rhyacotriton kezeri*), Cascade torrent salamander (*R. cascadae*), coastal marten (*Martes caurina*), and red tree vole (*Arborimus longicaudus*). The fish species are under the jurisdiction of NMFS, while the birds, salamanders, and mammals are under the jurisdiction of FWS.

The Western Oregon State Forests HCP plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) Section 800.4(a)(1) includes all state forestlands west of the Cascade Range, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF owns or manages and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

NMFS sent a letter to Tribal governments on January 29, 2021, introducing the NEPA process and the Project EIS. NMFS also held an informational meeting with Tribes regarding the Project via virtual presentation on February 24, 2021. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. NMFS initiated NHPA Section 106 consultation with the Oregon State Historic Preservation Office regarding the Project and potential impacts on cultural resources.

NMFS invites you to be a consulting party to this Project regarding potential impacts on historic properties. Consulting parties have certain rights and obligations under the NHPA and its implementing regulations at 36 CFR Part 800 and NEPA and its implementing regulations at 40 CFR Parts 1500–1508. These regulations provide for a review process, under NHPA Section 106 review. The regulations at 36 CFR Section 800.8(c) provide for use of the NEPA process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR Sections 800.3 through 800.6 and NMFS intends to do so for this Project.

Information exchange and informal consultation with the Confederated Tribes and Bands of the Yakama Nation will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR Section 800.8(c)(1) during NEPA scoping, environmental analysis, and the preparation of NEPA documents. Please contact us if a formal consultation is desired at any point in the process.

If you would like to participate as a NHPA Section 106 consulting party on the Project, please designate a representative and an alternate from your tribal government to receive future correspondence and attend meetings. Please respond to michelle.mcmullin@noaa.gov or (541) 957-3378 ***no later than 30 days upon receipt of this letter***. While you may request to be a consulting party at a later date, the NEPA process will continue and the opportunity to fully comment on each step of the process may be affected.

NMFS or our consultant (ICF) will follow up with additional information regarding the Project as new details become available. Please contact Michelle McMullin at the email address or phone number provided above if you require additional information. We look forward to working with you.

Sincerely,

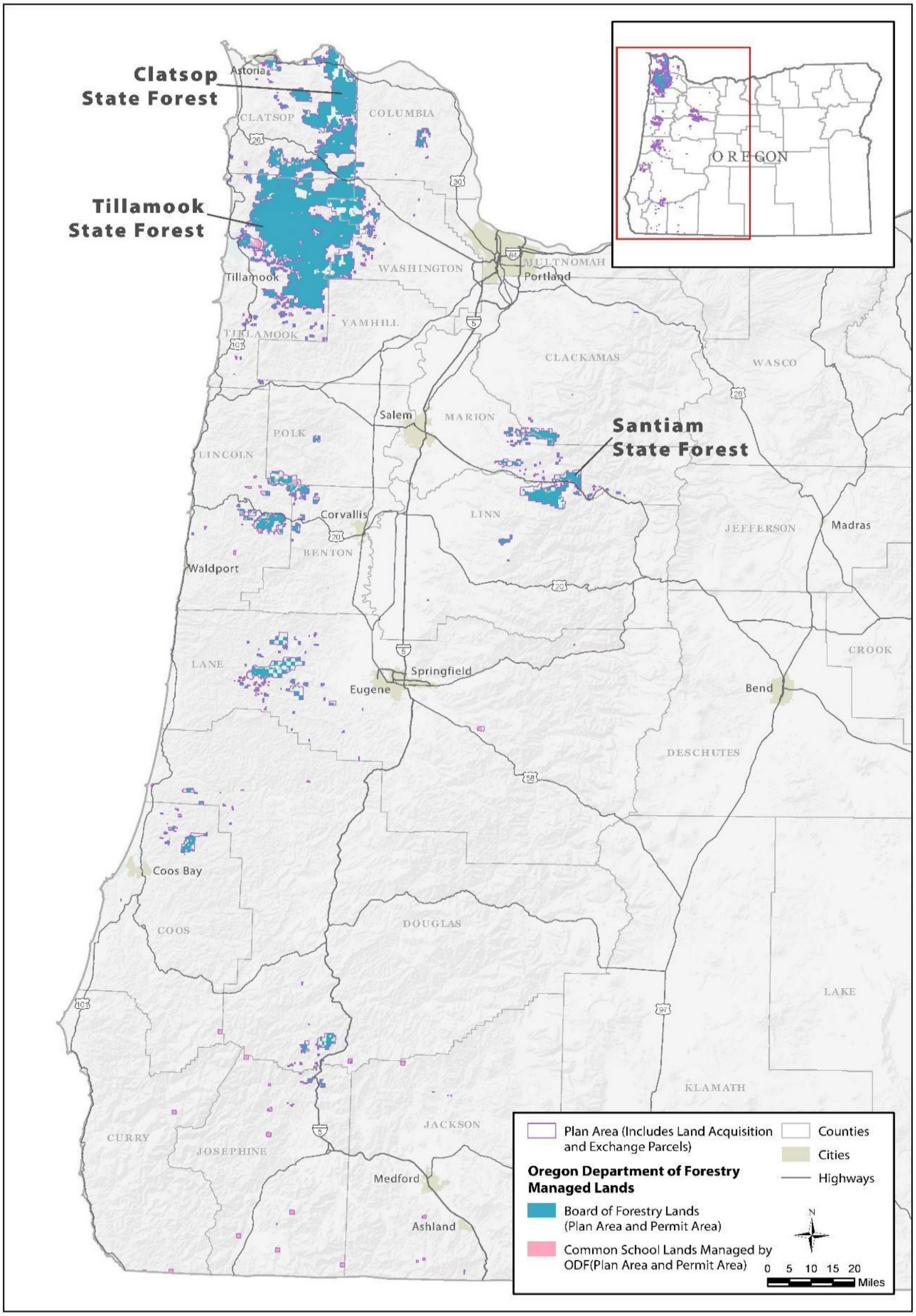
Kim Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office
National Marine Fisheries Service

Paul Henson, PhD
State Supervisor
Oregon Fish and Wildlife Office
United States Fish and Wildlife Service

cc: Mr. Phil Rigdon, Director, Department of Natural Resources
Mr. Gerald Lewis, Chairman of Fish & Wildlife Committee

Enclosure

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

October 15, 2021

Alexis Clark
Historic Preservation Specialist
Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, D.C. 20001

Re: Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Proposed Area of Potential Effects, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations

Dear Ms. Clark:

The National Marine Fisheries Service (NMFS), serving as the lead federal agency under the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA), is preparing an Environmental Impact Statement (EIS) analyzing the implementation of the Habitat Conservation Plan (HCP) associated with the issuance of incidental take permits with 70-year permit terms to the Oregon Department of Forestry (ODF) for incidental take of covered species from covered activities in the plan area (the Project). The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the NEPA process. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. NMFS has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA. More information about the Project can be found on the Project's website at https://www.fisheries.noaa.gov/action/notice-intent-prepare-environmental-impact-statement-western-oregon-state-forests-habitat.

The covered activities are the projects and activities for which ODF is requesting take authorization. The covered activities include ODF's forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy. These include harvest activities, stand management, road system management, minor forest-product harvest, development and operation of quarries, fire management, recreation infrastructure construction and maintenance, and conservation strategy implementation activities. Incidental take coverage would be provided for 17 covered species: Oregon Coast coho salmon, Oregon Coast spring Chinook salmon, Southern Oregon/Northern California Coast spring Chinook salmon, Lower Columbia River coho salmon, Upper Willamette River spring Chinook salmon, Upper Willamette River winter steelhead, Columbia River chum salmon, Southern Oregon/Northern California Coast coho salmon, Lower Columbia River Chinook salmon, eulachon, northern spotted owl, marbled murrelet, Oregon slender salamander, Columbia torrent salamander, Cascade torrent salamander, coastal marten, and red tree vole.

The plan area and proposed Area of Potential Effects (APE) in accordance with 36 Code of Federal Regulations (CFR) 800.4(a)(1) includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres. The permit area is defined as the portion of the plan area that ODF currently controls and where all covered activities would occur and conservation actions would apply. The plan area and proposed APE is depicted on Enclosure 1.

The regulations at 36 CFR 800.8(c) of the NHPA provide for use of the NEPA process to fulfill a lead federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. NMFS intends to use the NEPA process for the Project and is notifying the Advisory Council on Historic Preservation (ACHP) and Oregon State Historic Preservation Officer (SHPO), as required under 36 CFR 800.8(c). As a part of this process, consultation with SHPOs, tribes, other consulting parties, and the ACHP will occur during preparation of the EIS in accordance with NEPA regulations and 36 CFR 800.8(c)(1) during NEPA scoping, the environmental analysis, and the preparation of NEPA documents.

ICF will assist NMFS with NHPA Section 106 review of the Project. With this letter, NMFS hereby authorizes ICF to initiate and conduct consultation with the ACHP, Oregon SHPO, and other consulting parties regarding Section 106 review for the Project on NMFS's behalf. NMFS has assigned ICF as the third-party contractor to execute various administrative and logistical tasks, including but not limited to, coordinating communication with the consulting parties; distributing NMFS-approved documents; providing technical assistance; and hosting and facilitating meetings, webinars, and calls with consulting parties.

NMFS fully recognizes that consulting with the appropriate federally recognized tribes is the responsibility of NMFS and this responsibility cannot be delegated, per 36 CFR 800.2(c)(4). NMFS will remain legally responsible for all findings and determinations throughout the entirety of the Project. NMFS initiated contact with Tribes through outreach letters sent on January 29, 2021, prior to the initiation of the Notice of Intent to initiate an EIS. Since then NMFS also held an informational meeting with Tribes in February and on September 29, 2021, sent out an invitation to Tribes to be a NHPA Section 106 consulting party on the Project. NMFS will remain involved throughout the consultation.

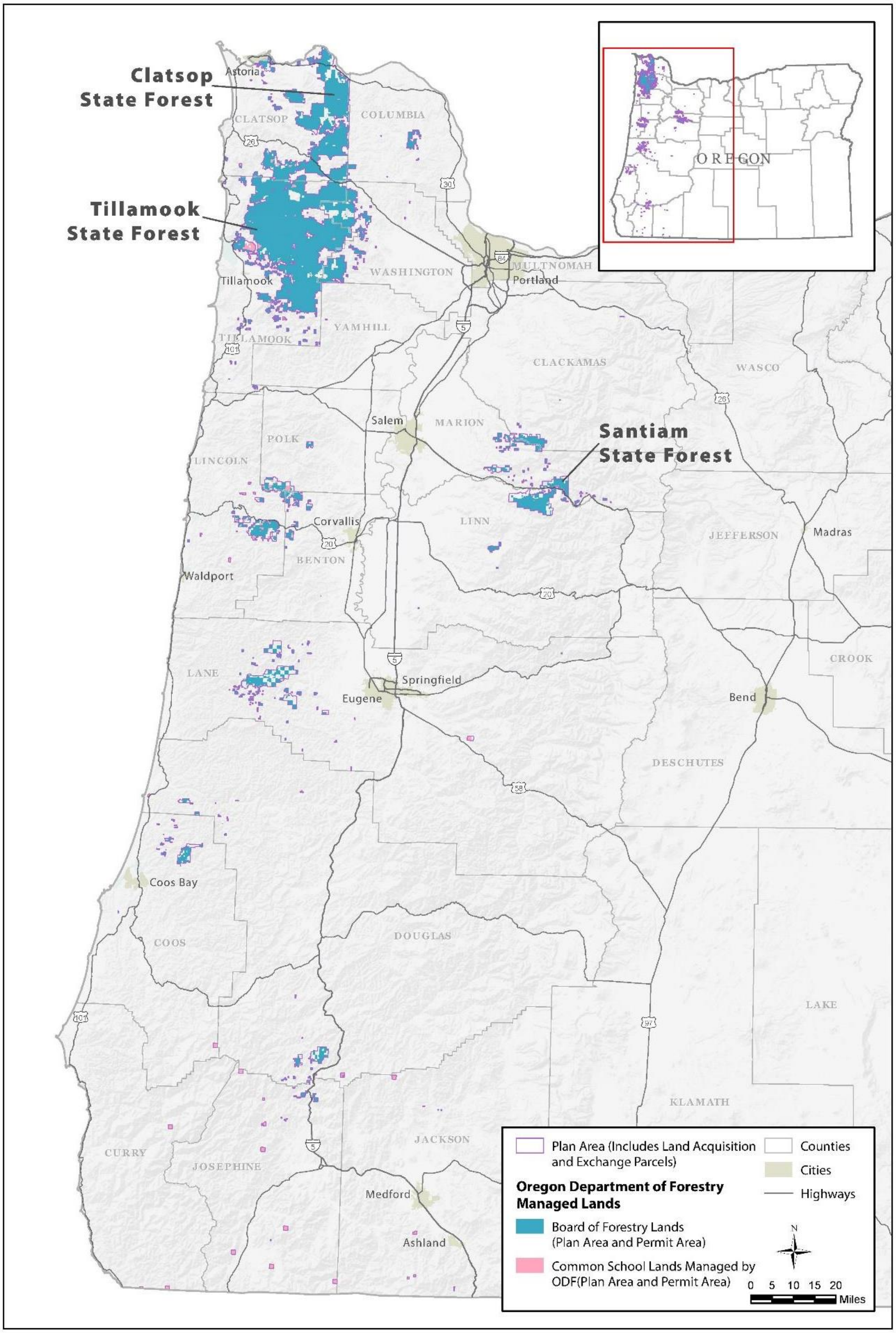
NMFS asks that you share your comments regarding the Project and the proposed APE by November 15, 2021. Please send your written comments or questions electronically to Tait Elder, the Section 106 contact for the project, at tait.elder@icf.com or (360) 920-8959. Should you have any questions or concerns regarding this delegation please contact Michelle McMullin at michelle.mcmullin@noaa.gov or (541) 957-3378. We look forward to consulting with you.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

Enclosure 1: Western Oregon State Forests HCP Plan and Permit Area

Enclosure 1 – Western Oregon State Forests HCP Plan and Permit Area



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

November 26, 2021

Christine Curran
Deputy State Historic Preservation Officer
Oregon Heritage
Oregon Parks and Recreation Department
725 Summer Street NE, Suite C
Salem, Oregon 97301

Re: Section 106 Finding of Effects Determination related to issuance of incidental take permits and approval of the Western Oregon State Forests Habitat Conservation Plan

Dear Ms. Curran:

The National Marine Fisheries Service (NMFS) is notifying your office regarding a Section 106 Finding of Effects determination related to issuance of incidental take permits (ITPs) by NMFS and the U.S. Fish and Wildlife Service (FWS) to the Oregon Department of Forestry (ODF) and approval of the Western Oregon State Forests Habitat Conservation Plan (HCP), the federal undertaking. NMFS previously provided consultation correspondence to your office on August 6, 2021, regarding the Initiation of Section 106 Review of the Western Oregon State Forests HCP EIS, Proposed Area of Potential Effects, and Notification of Using the NEPA Process to Fulfill Section 106 Obligations.

As you know from our previous consultation correspondence, NMFS is serving as the lead federal agency under the National Environmental Policy Act (NEPA), and FWS is acting as a cooperating agency in the NEPA process. Under the National Historic Preservation Act (NHPA), NMFS is leading Section 106 consultation for both NMFS and FWS. Under NEPA, NMFS is preparing an environmental impact statement (EIS) to analyze the effects of the undertaking. The ITPs would permit incidental take of covered species from covered activities in the permit area. NMFS and FWS will review ODF's permit applications to determine if the applications meet permit issuance criteria. Notably, the covered activities—ODF's ongoing forest and recreation management activities—will continue to occur whether they are covered under the ITPs or not. NMFS initiated outreach with Native American tribes through letters sent on January 29, 2021, prior to issuance of the Notice of Intent to prepare an EIS. On September 29, 2021, NMFS submitted letters to tribes to initiate Section 106 consultation for the undertaking. NMFS continues to solicit feedback from consulting parties, including tribes, the Advisory Council on Historic Preservation, and your office. Title 36 Code of Federal Regulations (CFR) § 800.8 provides for use of the NEPA process to fulfill a federal agency's Section 106 review obligations in lieu of the procedures set forth in 36 CFR § 800.3 through 800.6. As such, opportunities for consultation occurred during the NEPA scoping period and will occur during the public comment period after publication of the Draft EIS. However, consulting party comments will be accepted at any point during preparation of the EIS. As of the writing of this document, NMFS has received no comments regarding historic properties from consulting parties.

Based on the limited nature of the undertaking—issuance of the ITPs and implementation of the HCP—NMFS has determined that the undertaking has “no potential to cause effects” pursuant to 36 CFR § 800.3(a)(1) on properties either included in or eligible for inclusion in the National Register of Historic Places. Notably, the ODF forest and recreation management activities that the ITPs would cover do not require federal authorization; they would occur regardless of whether the ITPs are issued or not. Since these activities do not require federal authorization, they are not considered part of the federal undertaking outlined in this documentation.

For future individual forest management actions, ODF would perform cultural resources review in compliance with applicable state and federal regulations and consistently follow ODF policies and procedures. ODF policy is to preserve and protect archaeological and cultural resources and sites during forest and recreation management activities according to state law and the Memorandum of Agreement between ODF and the State Historic Preservation Office (Oregon Department of Forestry 2002). The ODF procedures relating to cultural resources are outlined in the ODF Procedure Document Cultural Resources – Review and Protection, which requires—prior to any ground-disturbing activity on State Forest lands—coordination with a qualified archaeologist to ensure known cultural or archaeological resources are not disturbed or damaged (Oregon Department of Forestry 2016). This procedure document describes the responsibilities of ODF staff for cultural resources review and protection as part of annual operations planning, as well as projects outside of annual operations planning. ODF complies with the following agency guidance documents related to inadvertent discovery of a cultural resource: Inadvertent Discovery of Archaeological Resources and Human Remains During Emergency Operations (Oregon Department of Forestry n.d.[a]) and Inadvertent Discovery of Archaeological Resources and Human Remains During Non-Emergency Operations (Oregon Department of Forestry n.d.[b]). ODF also complies with the Cultural Resources Handbook for Operations Planning on Oregon’s State Forests (Barnes 2008).

NMFS has assigned ICF as the third-party contractor to facilitate the Section 106 consultation process. All federal oversight and decisions will remain with NMFS. ICF’s role in this Section 106 review is to coordinate communication with the consulting parties, facilitate distribution of NMFS-approved documents, provide technical assistance, and arrange and lead the facilitation of meetings, webinars, or calls with consulting parties. Please send your written comments or questions electronically to Tait Elder, the Section 106 contact for the project, at tait.elder@icf.com or (360) 920-8959.

Sincerely,

Kim W. Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office

References

Barnes, John. 2008. Cultural Resources Handbook for Operations Planning on Oregon's State Forests. January. Prepared for Oregon Department of Forestry. Salem, Oregon.

Oregon Department of Forestry. 2002. Memorandum of Agreement Between the Oregon Department of Forestry and Oregon State Historic Preservation Office Policy Document, Cultural Resources. On file with Oregon Department of Forestry, State Forests Division.

Oregon Department of Forestry. 2016. Oregon Department of Forestry Procedure Document, Cultural Resources – Review and Protection. March. On file with Oregon Department of Forestry, State Forests Division.

Oregon Department of Forestry. n.d.(a). Inadvertent Discovery of Archaeological Resources and Human Remains During Emergency Operations. On file with Oregon Department of Forestry, State Forests Division.

Oregon Department of Forestry. n.d.(b). Inadvertent Discovery of Archaeological Resources and Human Remains During Non-Emergency Operations. On file with Oregon Department of Forestry, State Forests Division.

Appendix 3.11
Tribal Resources Technical Supplement

Terms and Definitions

The following provides terms and definitions related to the tribes and federal trust responsibilities.

Ceded lands: Treaty tribal-ceded lands are lands formerly occupied by tribes and later ceded to the United States by treaty, whether or not ratified by the United States Senate. Some claims of sovereignty and loss of ceded lands made by tribes remain unawarded, requiring their recognition as a federally recognized Indian tribe to address these claims.

***Federal recognition*:** The U.S. Department of the Interior Office of Federal Acknowledgement sets up a process and review for unrecognized Indian tribes and communities to gain federal recognition. It is important for a tribe to be recognized as eligible for the special programs and services provided by the United States to Indians because of the former agreements the tribes made with the federal government under treaties and established case law. Tribes can achieve federal recognition status through treaties, acts of Congress, presidential executive orders or other federal administrative actions, or federal court decisions. This status is automatically conferred on members of treaty tribes but does not automatically designate Indian communities whose treaties were not ratified by Congress, that were not treaty signers, or who lost their lands and social-cultural identity because they were struggling for their own survival and tribal social-cultural integrity over the past 150 years. Those tribal communities each must apply for and be granted this status to be listed as federally recognized tribes. There are 10 tribes in the study area that were federally recognized through legal means other than treaties: (1) the Confederated Tribes of Grand Ronde Community of Oregon, (2) the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians, (3) the Confederated Tribes of Siletz Indians, (4) the Coquille Indian Tribe, (5) the Cow Creek Band of Umpqua Tribe of Indians, (6) the Burns Paiute Tribe, (7) the Shoalwater Bay Tribe, (8) the Cowlitz Indian Tribe, (9) the Tolowa Dee-ne' Nation (Smith River Rancheria), and (10) the Elk Valley Rancheria.

***Reserved treaty rights*:** Preexisting rights of indigenous peoples that were reserved by a tribe in a treaty to continue their traditional access and harvest of natural resources on Indian reservations and off-reservation open and unclaimed lands in common with other citizens. Today, *open and unclaimed lands* refers to most state and federal public lands but not private lands or lands unsuited for hunting, gathering, or fishing activities. Treaties reserved the right of tribal members to "take fish, erect houses, hunt game, gather roots and berries, and pasture animals upon unclaimed lands" at usual and accustomed stations within the ceded lands, outside of reservation lands.

In 1968, individual Native Americans and the United States brought separate actions in the Oregon federal district court, in which the Lower Columbia Treaty tribes. Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian, Confederated Tribes of Warm Springs Reservation and the Nez Perce Tribe intervened, concerning the treaty right of taking fish at all usual and accustomed places on the Columbia River and its tributaries (*U.S. v. Washington*). The court issued an order in 1969, confirming the validity of the respective tribes' rights under the treaties (*Sohappy v. Smith*, 302 F. Supp. 899 [D. Or. 1969]).

Treaty: Ratified federal treaties refer to formal agreements between the federal government and Native American tribes under Article II, Section 2 of the United States Constitution, approved by the president and subsequently ratified by the United States Senate. A treaty is a constitutionally recognized agreement between sovereign nations. These legally binding agreements are protected under the United States Constitution, which states that, like the United States Constitution, they are the "supreme law of the land." Under these treaties, tribes ceded millions of acres of land while reserving certain rights, such as fishing, hunting, and gathering, as well as rights to determine use of reserved land and its resources. The treaties reserved the rights to usual and accustomed grounds and stations. These are locations on and off reservations where treaty tribes hold certain treaty-granted usage rights, based on ancestral use.

Treaty tribe: A Native American tribe that formally negotiated a treaty with the United States government between 1855 and 1868 that was subsequently ratified by Congress in the United States Senate. There are four treaty tribes in the study area: (1) Confederated Tribes and Bands of the Yakama Nation (Treaty with the Yakama, 1855), (2) Confederated Tribes of the Umatilla Indian Reservation (Treaty with the Walla Walla, Cayuse, etc., 1855), (3) Confederated Tribes of Warm Springs Reservation (Treaty with the Tribes of Middle Oregon, 1855), and (4) the Klamath Tribes (Klamath Tribes Treaty of 1864). The Yakama, Umatilla, and Warm Springs, have treaty-reserved fishing rights on the Columbia River. These four treaty tribes have comanagement responsibilities with the states (primarily Oregon, Washington, and Idaho) for the management of fish. The Columbia River Inter-Tribal Fish Commission is a tribal organization that provides coordination and technical assistance to these tribes in regional, national, and international efforts.

Tribe: As defined in Section 1(b) of Executive Order (EO) 13175, a tribe is an Indian or Alaska Native federally recognized tribe, band, Nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian tribal entity pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 United States Code 479a and annual update to the Department of the Interior list of Indian Entities Recognized by and Eligible to Receive Services from the United States Bureau of Indian Affairs, published in the *Federal Register* (FR) (84 FR 1200). Several of the nine federally recognized tribes in Oregon are confederations of multiple tribes.

Trust doctrine: The trust doctrine is a source of federal responsibility to Native Americans requiring the federal government to support tribal self-government and economic prosperity, duties that stem from the government's promise to protect Native American tribes and respect their sovereignty.

Unratified federal treaties: Unratified federal treaties are treaties negotiated but not ratified by the United States Senate. Unratified treaties were negotiated with the Lower Chinook, Clatsop, Clackamas, Tillamook, Umpqua, Siletz, and Rogue River Tribes of the Oregon–Washington coast and other groups who established claims against the government for wrongful taking of their lands. Reservations established on the Oregon coast were all terminated by United States Congress, House Resolution No. 108 in 1954, which took effect in 1956. Executive Orders have since restored reservations at Grand Ronde and Siletz in Oregon.

Users: People who are within the boundaries of an affected area and have views *from* the affected area. Users primarily include recreational viewers, workers harvesting forest resources, and roadway travelers.

Supporting Information on Affected Tribes

This section describes the history and context for each of the study area tribes including, but not limited to, the tribe's organization, its federal recognition, ratified and unratified treaties, ceded lands, treaty reserved rights, case law, federal trust doctrine, and noted use of resources in the study area such as fishing and hunting agreements with the State of Oregon and United States of America.

Confederated Tribes of the Grand Ronde Community of Oregon

The Confederated Tribes of the Grand Ronde Community of Oregon is a federally recognized Indian Tribe consisting of 30 tribes and bands with ancestral ties to western Oregon and southwestern Washington (Confederated Tribes of Grand Ronde 2021). The original Grand Ronde Reservation was 61,000 acres established by executive order on June 30, 1857, in the headwaters of the Yamhill River watershed. The General Allotment Act of 1887 removed the original reservation lands from federal trust status to private ownership and transferred reservation lands to tribal members and subsequently sold to private ownership. In 1901, the federal government declared 25,791 acres of the reservation lands "surplus" and sold them.

Federal recognition of the Tribe ended on August 13, 1954, when Congress passed the Western Oregon Termination Act. Passage of the Grand Ronde Restoration Act (Public Law 98-165) reestablished federal recognition in 1983. The Grand Ronde Reservation Act (25 United States Code [USC] 713f note; 102 stat. 1594), signed on September 9, 1988, established 9,811 acres of the original reservation. The Tribe has acquired additional trust lands since gaining federal recognition and the total community land base is currently 10,773 acres in Yamhill and Polk Counties (BIA 2019). The number of enrolled members is approximately 5,567 (Oregon Blue Book 2021).

A Consent Decree among the State of Oregon, the United States of America, and the Confederated Tribes of the Grand Ronde Community of Oregon permanently defines tribal hunting, fishing, trapping, and animal gathering rights. The Confederated Tribes of the Grand Ronde Community of Oregon Fish and Wildlife Ordinance (Chapter 801) regulates subsistence and ceremonial hunting and fishing by tribal members defined in the Consent Decree. Hunting and fishing pursuant to the Consent Decree occur in the Trask Management Unit. The Trask Unit includes portions of the Tualatin and Yamhill watersheds flowing into the Willamette River and portions of the Nestucca, Wilson, Trask, and Salmon watersheds flowing westward into the Pacific Ocean.

The Tribe's Natural Resources Department manages reservation lands for timber, recreation, and fish and wildlife. Pursuant to the Consent Decree, the Tribe receives an allocation of hunting tags for the Trask Unit and the Tribe issues fishing licenses for tribal members to fish within the Trask Unit. The Tribe may establish its own tribal hunting and fishing programs on tribal lands.

Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians

The Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians is a federally recognized confederated tribe made up of three tribes: Coos Tribes, Lower Umpqua Tribe, and Siuslaw Tribe (Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians 2021). Their ancestral lands include the south-central coast of Oregon.

A treaty was drafted in 1855 with the Coos, Lower Umpqua and Siuslaw Indians and the United States of America providing compensation to the Tribes in terms of food, clothing, employment, education, and health benefits in exchange for ceded lands. As with many other western Oregon tribes, the United States Senate never ratified the treaty. A small privately held 6-acre parcel in Coos Bay was donated to the Tribe to establish a reservation to be held in trust by the BIA.

Federal recognition of the Tribe ended on August 13, 1954, when Congress passed the Western Oregon Termination Act. The Tribe never sold the small parcel in Coos Bay and instead maintained it to provide services to tribal members. Passage of the Coos, Lower Umpqua, and Siuslaw Restoration Act (Public Law 98-481) reestablished federal recognition on October 17, 1984. The tribal community and tribal government services encompass Coos, Curry, Lincoln, Douglas, and Lane Counties.

Title II of the Western Oregon Tribal Fairness Act (Public Law 115-103, January 2018) transferred 14,472 acres of federally owned lands to the Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians to be held in trust by the BIA. The parcels are in Lane, Douglas, and Coos Counties (Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians Forestry Department 2021). The number of enrolled members is approximately 1,297 (Oregon Blue Book 2021).

Confederated Tribes of Siletz Indians

The Confederated Tribes of Siletz Indians is a federally recognized confederated tribe made up of many different tribes: Clatsop, Chinook, Klickitat, Molala, Kalapuya, Tillamook, Alsea, Siuslaw/Lower Umpqua, Coos, Coquelle, Upper Umpqua, Tututni (including all the lower Rogue River Bands and those extending up the coast to Floras Creek and down to Whales Head), Chetco (including all of the villages from Whales Head to the Winchuck River), Tolowa, Takelma (including the Illinois Valley/mid-Rogue River and Cow Creek peoples), Galice/Applegate, and Shasta). Their ancestral lands include much of western Oregon (Confederated Tribes of Siletz Indians 2021).

Federal recognition of the Tribe ended on August 13, 1954, when Congress passed the Western Oregon Termination Act. Passage of the Siletz Indian Tribe Restoration Act (Public Law 95-195) reestablished federal recognition in 1977.

The Tribe has acquired additional trust lands since gaining federal recognition and the total community land base is currently 3,745 acres in Lincoln County (BIA 2019). Trust lands include a few contiguous parcels and scattered parcels east of Siletz, Oregon in the Siletz River watershed. The number of enrolled members is approximately 5,080 (Oregon Blue Book 2021).

A Consent Decree among the State of Oregon, the United States of America, and the Confederated Tribes of Siletz Indians permanently defines tribal hunting, fishing, trapping, and animal gathering rights. The Confederated Tribes of Siletz Indians Hunting, Fishing and Gathering Ordinance regulates subsistence and ceremonial hunting and fishing by tribal members defined in the Consent Decree (Siletz Tribal Code 7.001). Hunting and fishing pursuant to the Consent Decree occur in the Stott Mountain Management Unit and the north portion of the Alsea Management Unit. This includes portions of the Alsea, Siletz-Yaquina, and Yamhill watersheds. The Consent Decree identifies three cultural fishing sites on tributaries of the Siletz River.

Coquille Indian Tribe

The Coquille Indian Tribe is a federally recognized tribe in southwestern Oregon (Coquille Indian Tribe 2021).

Federal recognition of the Coquille Indian Tribe ended on August 13, 1954, when Congress passed the Western Oregon Termination Act. Passage of the Coquille Restoration Act restored federal recognition on June 28, 1989.

The Tribe does not have an agreement with the State of Oregon and the United States of America establishing hunting and fishing rights for tribal members. However, the Tribe is seeking recognition of rights to hunt, fish, gather, and practice cultural traditions and ceremonies at their usual and accustom places (Coquille Indian Tribe 2019).

The Tribe has acquired additional trust lands since gaining federal recognition. The Coquille Forest was created in 1996 (Public Law (P.L. 104-208), This act restored 5,410 acres to the Coquille Indian Tribe, as the Coquille Forest. The Coquille Forest is located in Coos County. The total community land base is currently 6,132 acres in Coos County (BIA 2019). The number of enrolled members is approximately 1,113 (Oregon Blue Book 2021).

Cow Creek Band of Umpqua Tribe of Indians

The Cow Creek Band of Umpqua Tribe of Indians is a federally recognized tribe in southwestern Oregon (Cow Creek Band of Umpqua Tribe of Indians 2021). Their ancestral lands are between the Coast Range and Cascade Range of Oregon along the South Umpqua River and Cow Creek. The Cow Creek Tribe signed a treaty with the United States of America on September 19, 1853. The United States Senate ratified the treaty on April 12, 1954. However, the treaty did not permanently secure land for a reservation in exchange for ceded lands.

Federal recognition of the Cow Creek Tribe ended on August 13, 1954, when Congress passed the Western Oregon Termination Act. Passage of the Cow Creek Band of Umpqua Tribe of Indians Recognition Act (Section 1 of Public Law 97–391) restored federal recognition on December 29, 1982.

Title I of the Western Oregon Tribal Fairness Act (Public Law 115-103, January 2018) transferred 17,519 acres of federally owned lands to the Cow Creek Tribe to be held in trust by the BIA. This plus other lands held in trust by BIA since gaining federal recognition total 22,308 acres in Douglas County (BIA 2019). Trust lands include a few contiguous parcels and scattered parcels south and east of Roseburg, Oregon, in the South Umpqua watershed. In 2000, the Tribe purchased K-Bar Ranches and has since purchased additional properties throughout the Umpqua River valley (K-Bar Ranch 2021). In 2013, the Tribe expanded the ranch into the Rogue River Valley with the purchase of the Rogue River Ranch near Central Point, Oregon. At present, the Tribe, including the K-Bar Ranches, manages approximately 5,500 acres.

The number of enrolled members is approximately 1,760 (Oregon Blue Book 2021).

Klamath Tribes

The Klamath Tribes is a federally recognized confederation of three tribes in the Klamath Basin in southcentral Oregon: the Klamaths, the Modocs, and the Yahooskin (Klamath Tribes 2021). The Klamath Tribes signed the Klamath Tribes Treaty of 1864. The treaty reserved rights of the Klamath Tribes to harvest game, fish, and gather edible roots and berries are limited to reservation lands set forth in the 1864 Treaty as it existed in 1954 at the time of termination and does not include ceded lands. A Consent Decree among the State of Oregon, the United States of America, and the Klamath

Tribes permanently defines tribal hunting, fishing, trapping, and animal gathering rights on federal lands within the former reservation boundaries.

The former reservation is north of the city of Klamath Falls in Klamath County and includes 689,822 acres of National Forest land. The reservation does not extend to lands in the plan area. However, this analysis assumes members of the Klamath Tribes maintain a cultural connection to portions of western Oregon that are in the plan area.

The Klamath Tribes have acquired trust lands and the total land base is currently 946 acres in Klamath County (BIA 2019). The number of enrolled members is approximately 5,200 (Oregon Blue Book 2021).

Confederated Tribes of Warm Springs

The Confederated Tribes of Warm Springs is a confederation of treaty tribes, consisting of the Warm Springs, Wasco, and Paiute bands and tribes (Confederated Tribes of Warm Springs 2021).

The Wasco bands on the Columbia River were the easternmost group of Chinookan-speaking Indians. Although they were principally fishermen (salmon most notably), their frequent contact with other Indians throughout the region, including western Oregon, provided abundant trade. Unlike the Wasco bands, the Warm Springs bands moved between winter and summer villages, and depended more on game, roots, and berries. Salmon was also an important staple for the Warm Springs bands, and, like the Wasco bands, they built scaffolding over waterfalls, which allowed them to harvest fish with long-handled dip nets. The Paiutes lived in southeastern Oregon and spoke a Shoshonean dialect. The lifestyle of the Paiutes was considerably different from that of the Wasco and Warm Springs bands. Their high-plains existence required that they migrate further and more frequently for game, and fish was not the most important part of their diet.

The Confederated Tribes of Warm Springs signed the Treaty with the Tribes of Middle Oregon, 1855, with the United States on June 9, 1855. The treaty reserved the Tribe's exclusive right to take fish from all streams running through or bordering its reservation and the right to take fish at usual and accustomed stations in common with citizens of the United States. In addition to fishing the mainstem Columbia River, tribal members fish with dipnets and nets set with wooden scaffolding on the Deschutes River, a major tributary of the Columbia River, at the falls near Sherar's Bridge and the lower Columbia River including the northern portion of the study area and the Cascade Range crest on the eastern portion of the study area.

The economy of the confederation is based on natural resources, including hydropower, forest products, and ranching, as well as tourism and recreation (Confederated Tribes of Warm Springs 2021). In addition to the Columbia River, the confederation comanages the Deschutes River, Fifteenmile Creek, John Day River, and Hood River tributaries in Oregon.

The reservation and trust lands of the Confederated Tribes of Warm Springs includes 656,878 acres in Wasco and Jefferson Counties and a portion of Clackamas County along the Cascade Range crest (Bureau of Indian Affairs 2019). The number of enrolled members is approximately 5,363 (Oregon Blue Book 2021).

Confederated Tribes of the Umatilla Indian Reservation

The Confederated Tribes of the Umatilla Indian Reservation is a federally recognized confederation of three treaty tribes in Oregon: Cayuse, Umatilla, and Walla Walla (Confederated Tribes of the

Umatilla Indian Reservation 2021). The Tribes signed the Treaty with the Walla Walla, Cayuse, etc., 1855, with the United States on June 9, 1855. The treaty reserved the rights to fish, hunt, gather foods and medicines such as roots and berries, and pasture livestock on unclaimed lands. Tribal members continue to exercise these rights throughout the area of traditional use, which extends to the lower Columbia River and northern portions of the study area.

The Umatilla Indian Reservation and trust lands comprise 293,101 acres in Umatilla County (Bureau of Indian Affairs 2019). The number of enrolled members is over 3,152 members (Oregon Blue Book 2021).

Burns Paiute Tribe

The Burns Paiute Tribe is a federally recognized tribe in eastern Oregon. Federal recognition was established by Executive Order in 1972. Tribal members are the descendants of the "Wadatika" band of Paiutes of central and southern Oregon. The tribal members gather willow, sagebrush, tule plant and Indian hemp to make baskets. Tribal members continue traditional hunting, gathering of food and do beadwork and drum-making (Burns Paiute Tribe 2021).

The Burns Paiute Tribe trust lands comprise 13,736 acres in Harney County (Oregon Blue Book 2021). The number of enrolled members is over 420 members (Oregon Blue Book 2021).

Confederated Tribes and Bands of the Yakama Nation

The Confederated Tribes and Bands of the Yakama Nation is a federally recognized confederation of tribes in Washington State (Confederated Tribes of Yakama Nation 2021). The Yakama Nation consists of 14 tribes and bands including Kah-milt-pah, Klickitat, Klinquit, Kow-was-say-ee, Li-ay-was, Oche-chotes, Palouse, Pisquose, Se-ap-cat, Shyiks, Skinpah, Wenatshapam, Wishram, and Yakama.

The 14 tribes and bands and the United States signed the Treaty with the Yakama on June 9, 1855. This treaty reserved the Tribe's right to fish, hunt, and gather all of the Tribe's traditional foods on the reservation as well as in the ceded area, including large portions of the Columbia River Basin and the lower Columbia River, including the northerly portions of the study area.

The Yakama Nation reservation is 1.2 million acres located in southwestern Washington State. In 2011 the number of enrolled members was over 10,200 (Columbia River Intertribal Fish Commission 2021).

Shoalwater Bay Tribe

The Shoalwater Bay Indian Reservation was established by Executive Order in 1866 under the Treaty of Olympia (Shoalwater Bay Tribe 2021). The Tribe gained federal recognition in 1971.

The Shoalwater Tribe inhabit the Willapa Bay and Grays Harbor areas of Southwest Washington. The Shoalwater Reservation is about one-square mile in area and consists of 440 acres of uplands and 700 acres of marine salt marsh and tidal flat habitats. The coastal location of the Tribe means members have a strong traditional relationship with natural resources in the Lower Columbia and Washington coast. Tribal members continue to fish and harvest shellfish in the Lower Columbia and Willapa Bay (Shoalwater Bay Tribe 2021).

The number of enrolled members is approximately 237 (Northwest Portland Area Indian Health Board 2021).

Cowlitz Indian Tribe

Federal recognition was acknowledged for the Cowlitz Indian Tribe in 2000 (Cowlitz Indian Tribe 2021). Federal recognition acknowledged that the Tribe exists as an Indian tribe within the meaning of federal law—i.e., a federally recognized Indian tribe (Final Determination, FR Notice, 2000.02.18, 65 FR 8436-8438). Federal recognition did not include reserved treaty rights.

The Cowlitz are a Salish-speaking group who also traditionally resided in the Longview area in southwest Washington State along the Cowlitz River from its mouth to below Mayfield Dam, as well as along segments of the Toutle, Newaukum, and South Fork of the Chehalis Rivers.

The Cowlitz Indian Tribe attended a treaty council at Chehalis in 1855, but it did not sign a treaty because the government-proposed reservation did not include lands in the Tribe's traditional territory.

The Cowlitz Indian Tribe does not have treaty-reserved fishing rights in the Columbia River or Cowlitz River. However, the Tribe has an active interest in protecting and restoring fish and wildlife on its ancestral lands. The Tribe signed a Memorandum of Understanding with the Washington Department of Fish and Wildlife (WDFW) to maintain healthy populations of fish and wildlife in southwest Washington as a common interest for both parties (WDFW and Cowlitz Indian Tribe no date).

In 2014, the Cowlitz Indian Tribe was awarded a grant from the National Oceanic and Atmospheric Administration for a eulachon species recovery program in the Cowlitz River. The Tribe holds smelt, salmon, and river ceremonies on the Cowlitz River and participates with other tribes in canoe journeys on major waterways (Cowlitz Indian Tribe 2021).

The Cowlitz Indian Tribe was officially granted a reservation in Clark County following a court decision in December 2014. The reservation is located approximately 20 miles south of Longview near the Lewis River. The enrolled population is approximately 1,400 tribal members (Northwest Portland Area Indian Health Board 2021).

Tolowa Dee-ni' Nation (Smith River Rancheria)

The Tolowa Dee-ni' Nation (formerly Smith River Rancheria) is a federally recognized tribe near the Oregon border (Tolowa Dee-ni' Nation 2021). Federal trust lands ended with passage of the California Rancheria Termination Act passed in 1958 (PL 85-671). In 1983, 89 acres were restored to tribal trust by U.S. Federal Court.

The Tolowa Dee-ni' Nation land base has grown to over 900 acres since the transfer of 89 acres in 1983. The Tribe is active in data collection and management of fish resources (habitat and hatchery management) in the Smith River watershed and is developing plans for wildlife and plant management on trust lands and advising management on non-tribal lands (Tolowa Dee-ni' Nation 2021).

The enrolled population is approximately 1,400 tribal members (Northwest Portland Area Indian Health Board 2021).

Elk Valley Rancheria

The Elk Valley Rancheria is a federally recognized tribe near the Oregon border (Elk Valley Rancheria 2021). The Rancheria was founded shortly after the Landless California Indians Act of 1906 as a piece of land reserved for "homeless" local Indians. Federal recognition and trust lands ended with the California Rancheria Termination Act passed in 1958 (PL 85-671). Federal recognition was restored in 1983 and 215 acres were restored to tribal trust by U.S. Federal Court.

The Tribe is a combination of Tolowa and Yurok people. It is located Del Norte County, California, just east of Crescent City (Elk Valley Rancheria 2021). The enrolled population is less than 100 tribal members.

Correspondence

Attachment 1 to this appendix includes letters NMFS sent to tribes outside of the Section 106 process.

References

BIA (Bureau of Indian Affairs). 2019. American Indian Alaskan Native (AIAN) Land Area Representation (LAR). Available: https://www.bia.gov/gis. Accessed: August 3, 2021.

Burns Paiute Tribe. 2021. Burns Paiute Tribe - About the Tribe. Available: https://burnspaiute-nsn.gov/about-the-tribe/. Accessed: August 25, 2021

Columbia River Inter-Tribal Fish Commission. 2021. Columbia River Inter-Tribal Fish Commission - Confederated Tribes and Bands of the Yakama Nation. Available: https://critfc.org/member-tribes-overview/the-confederated-tribes-and-bands-of-the-yakama-nation/. Accessed: August 25, 2021.

Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians. 2021. Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians - History. Available: https://ctclusi.org/history/. Accessed: August 25, 2021.

Confederated Tribes of Grand Ronde. 2021. Confederated Tribes of Grand Ronde - History and Culture. Available: https://www.grandronde.org/history-culture/. Accessed: August 25, 2021.

Confederated Tribes of Siletz Indians. 2021. Confederated Tribes of Siletz Indians - https://www.ctsi.nsn.us/heritage/. Accessed: August 25, 2021.

Confederated Tribes of Warm Springs. 2021. Confederated Tribes of the Warm Springs Reservation. Available: https://warmsprings-nsn.gov/. Accessed: August 25, 2021.

Confederated Tribes of the Umatilla Indian Reservation. 2021. Confederated Tribes of the Umatilla Indian Reservation - About. Available: https://ctuir.org/about/. Accessed: August 25, 2021.

Confederated Tribes of Yakama Nation. 2021. Confederated Tribes of Yakama Nation - About. Available: https://www.yakama.com/about/. Accessed: August 25, 2021.

Coquille Indian Tribe. 2019. K'vn-da' Xwvn-de' - Yesteday & Tomorrow - 2040 Comprehensive Plan. September 2019.

Coquille Indian Tribe. 2021. Coquille Indian Tribe- Our Lands. Available: https://www.coquilletribe.org/?page_id=32. Accessed: August 25, 2021.

Cow Creek Band of Umpqua Tribe of Indians. 2021. Cow Creek Band of Umpqua Tribe of Indians – Tribal Story. Available: https://www.cowcreek-nsn.gov/tribal-story/. Accessed: August 25, 2021.

Cowlitz Indian Tribe. 2021. Cowlitz Indian Tribe - Focal Landscapes and Species. Available: https://www.cowlitz.org/focal-landscapes-and-species/. Accessed: August 25, 2021.

Elk Valley Rancheria. 2021. Elk Valley Rancheria – Culture. Available: https://www.members.elk-valley.com/culture/. Accessed: October 10, 2021.

Northwest Portland Area Indian Health Board. 2021. Northwest Portland Area Indian Health Board Member Tribes. Available: https://www.npaihb.org/member-tribes/. Accessed: August 25, 2021.

Oregon Blue Book. 2021. Oregon Blue Book – Indian Tribes. Available: https://sos.oregon.gov/blue-book/Pages/national-tribes.aspx. Accessed: August 25, 2021.

Shoalwater Bay Tribe. 2021. Shoalwater Bay Tribe- Our History. Available: https://www.shoalwaterbay-nsn.gov/home/about-the-tribe/our-history/. Accessed: August 25, 2021.

Tolowa Dee-ni' Nation. 2021. Tolowa Dee-ni' Nation – About Us. Available: https://www.tolowa-nsn.gov/35/About-Us/. Accessed: October 10, 2021.

WDFW and Cowlitz Indian Tribe. no date. Memorandum of Understanding between the Washington Department of Fish and Wildlife and the Cowlitz Indian Tribe. Available: https://wdfw.wa.gov/sites/default/files/2018-12/wdfw_cowlitz_mou.pdf. Accessed: May 16, 2020.

The Klamath Tribes. 2021. The Klamath Tribes- History. Available: https://klamathtribes.org/history/. Accessed: August 25, 2021.

Attachment 1: Tribal Letters

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Jody Richards
Chairman
General Council, Burns Paiute Tribe

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Richards:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

NMFS will be the lead federal agency and the USFWS will be a cooperating agency for the NEPA process. The ODF will be the Applicant for the HCP Incidental Take Permit. We understand the significance of anadromous fish resources in Native American past, present, and future cultural and religious activities and look forward to working with you to hear any feedback or concerns you may have regarding this letter, NMFS' environmental impact statement, or the NEPA process in general. To facilitate this process, we invite you to an informational webinar on February 24, 2021, beginning at 1 pm PST. The webinar link is https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dmb2242d300b2165496f74a2589833634d&sa=D&source=calendar&ust=1612140199589000&usg=AOvVaw3M7W5A28yUxEwODaQzKOWT. The meeting number is 199 679 3625 and the password is 5033437777. We have attached instructions for connecting (Attachment 2). You may also participate by phone at 1-415-527-5035 with access code: 1996793625.

In the near future, NMFS will publish a Notice of Intent (NoI) to prepare an Environmental Impact Statement (EIS) under the National Environmental Protection Act (NEPA) for the Western Oregon State Forest HCP. We anticipate the NoI will be published in the Federal Register in March 2021 which will begin the official scoping period. We anticipate having a public meeting toward the end of March. While the EIS is still in early phases of development, preliminary assessments indicate the plan may affect anadromous fish populations along the Oregon Coast and in the Columbia and Willamette Rivers as well as birds, amphibians, and mammals.

We look forward to your collaboration as the proposed project matures. Please let us know if you are interested in being involved and or informed of this action, how you would like to be involved (informed via letter, email, meeting), who you would like to represent you, and if informal or formal government-to-government consultation is desired or needed. If you have any questions, concerns, or comments please feel free to contact Michelle McMullin at michelle.mcmullin@noaa.gov or Tere O'Rourke at therese.orourke@noaa.gov. We are also available to meet upon request.

Sincerely,

/s/

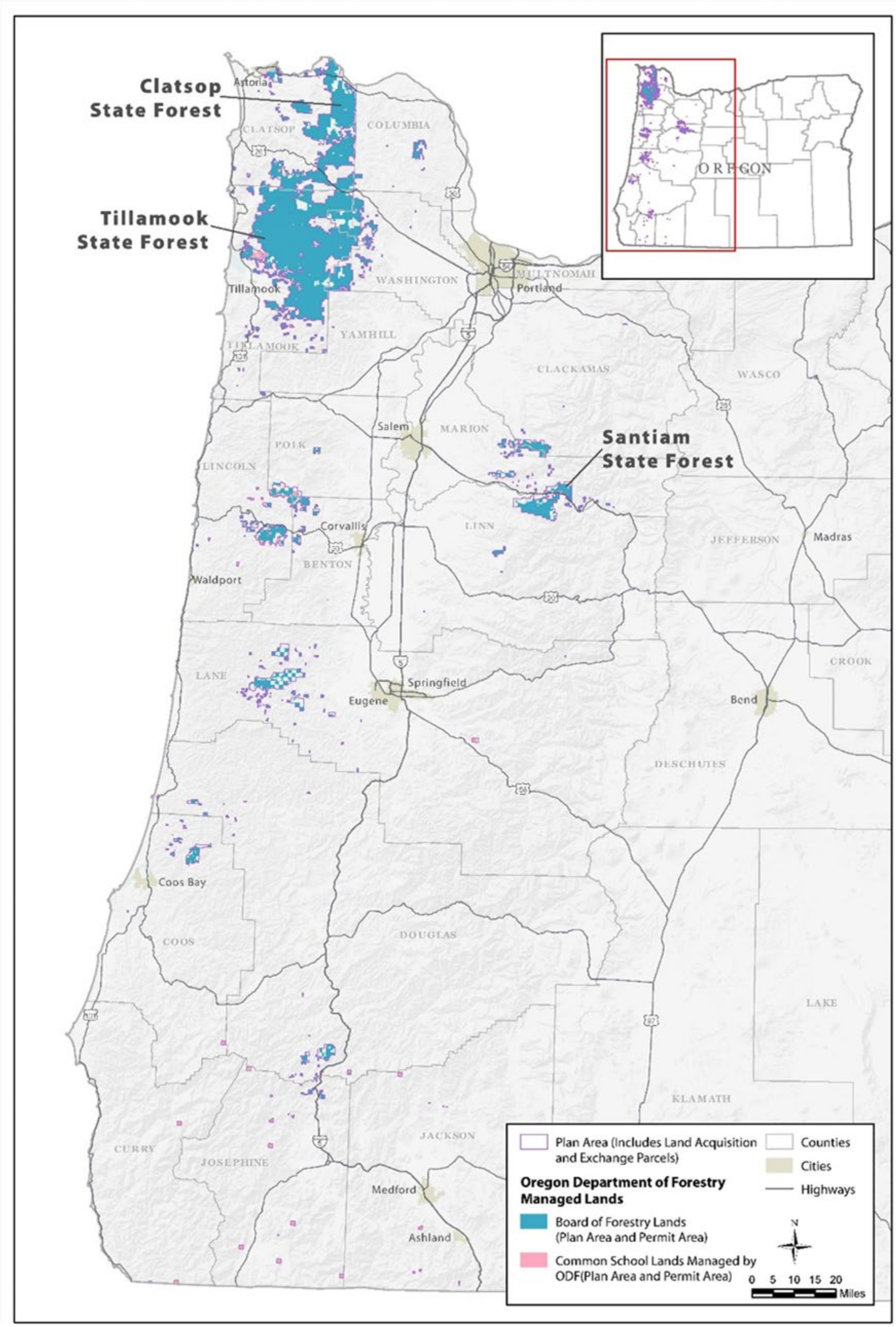
Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Ms. Calla Hagle, Director of Department of Natural Resources
Ms. Erica Maltz, Manager of Fisheries Program

Attachments

Attachment 1.



Western Oregon State Forest Habitat Conservation Plan Area.

Attachment 2.

WCR - WebEx Web-based Conferencing
Participant Guide

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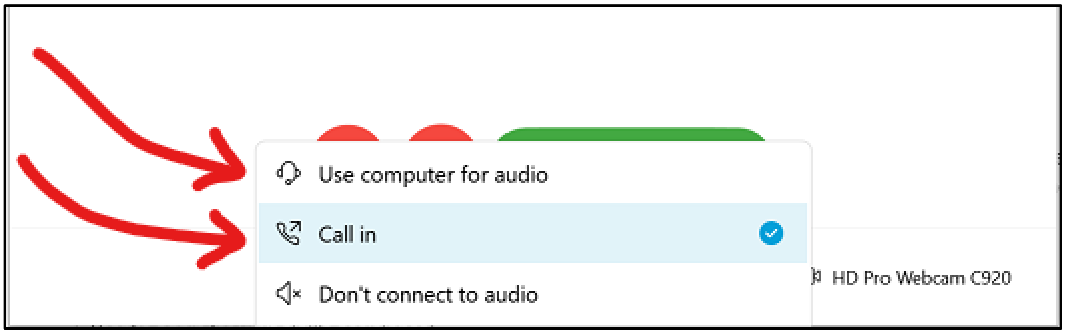

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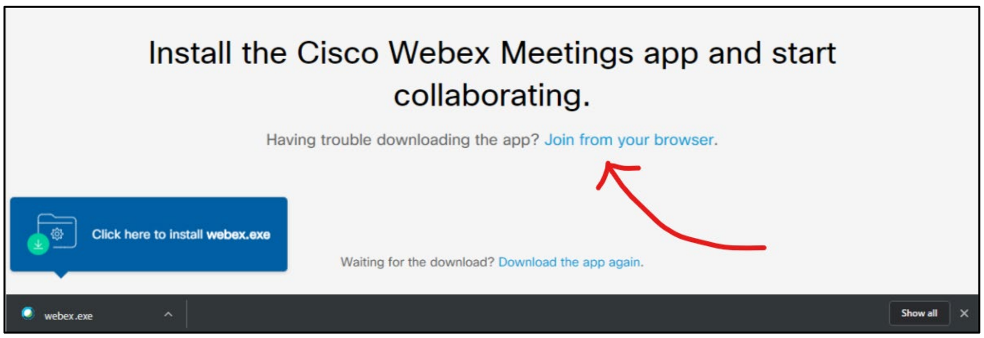

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Debbie Bossley
Chairperson
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Bossley:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

NMFS will be the lead federal agency and the USFWS will be a cooperating agency for the NEPA process. The ODF will be the Applicant for the HCP Incidental Take Permit. We understand the significance of anadromous fish resources in Native American past, present, and future cultural and religious activities and look forward to working with you to hear any feedback or concerns you may have regarding this letter, NMFS' environmental impact statement, or the NEPA process in general. To facilitate this process, we invite you to an informational webinar on February 24, 2021, beginning at 1 pm PST. The webinar link is https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dmb2242d300b2165496f74a2589833634d&sa=D&source=calendar&ust=1612140199589000&usg=AOvVaw3M7W5A28yUxEwODaQzKOWT. The meeting number is 199 679 3625 and the password is 5033437777. We have attached instructions for connecting (Attachment 2). You may also participate by phone at 1-415-527-5035 with access code: 1996793625.

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We look forward to your collaboration as the proposed project matures. Please let us know if you are interested in being involved and or informed of this action, how you would like to be involved (informed via letter, email, meeting), who you would like to represent you, and if informal or formal government-to-government consultation is desired or needed. If you have any questions, concerns, or comments please feel free to contact Michelle McMullin at michelle.mcmullin@noaa.gov or Tere O’Rourke at therese.orourke@noaa.gov. We are also available to meet upon request.

Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. John Schaefer, Natural Resources

Attachments

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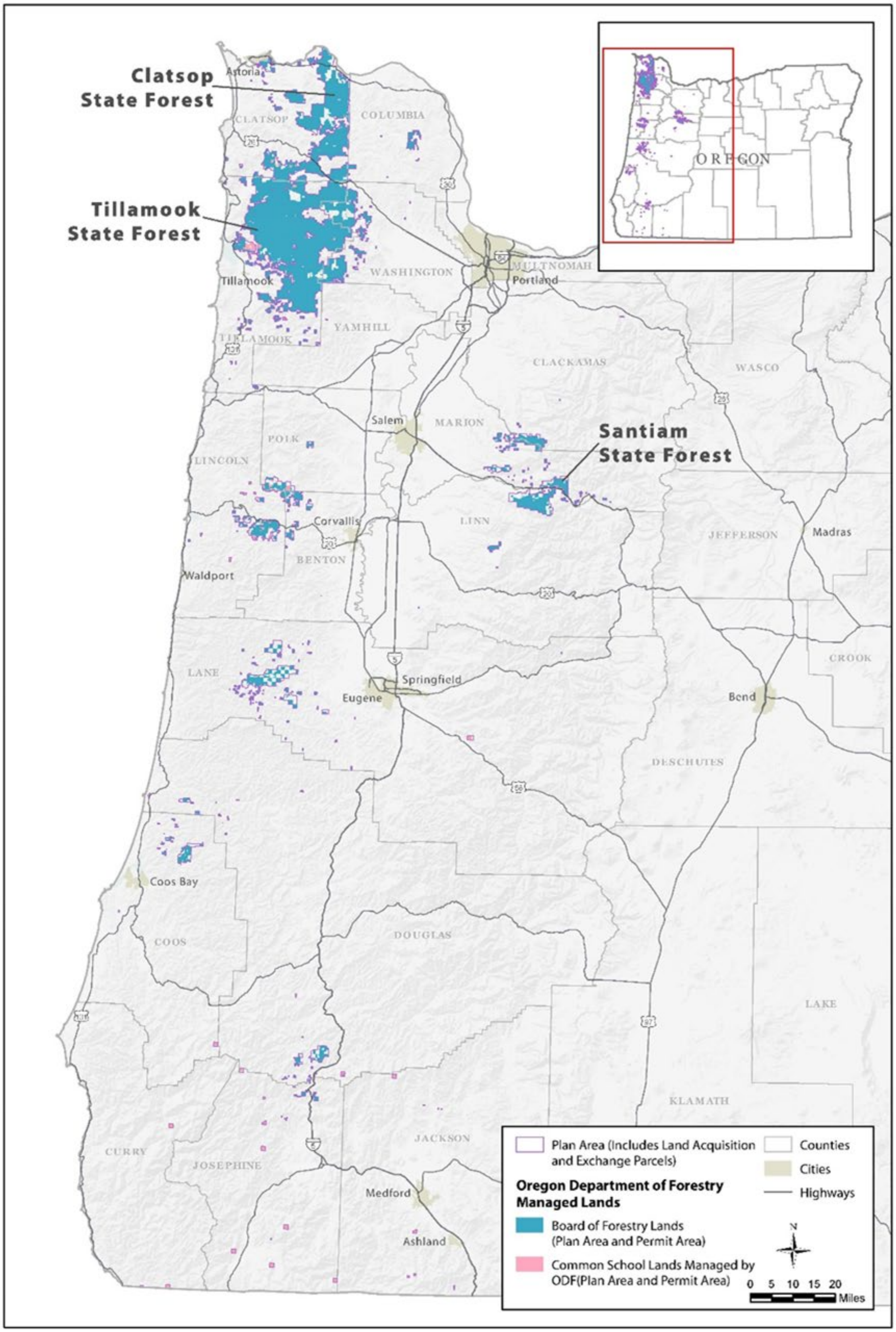

Western Oregon State Forest Habitat Conservation Plan Area.

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Participant Guide

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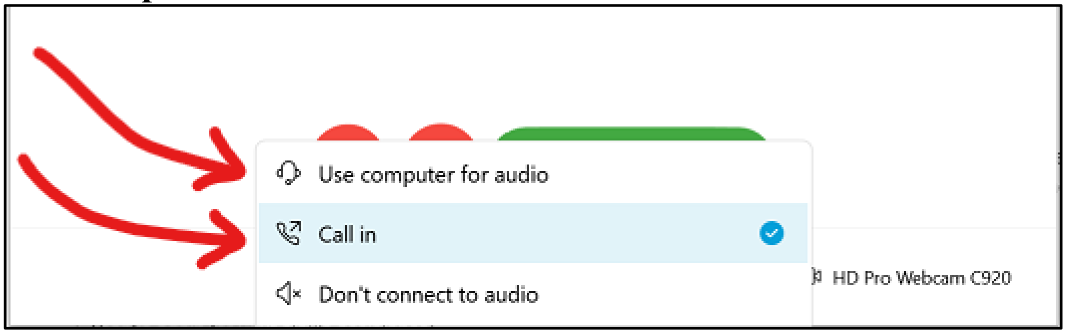

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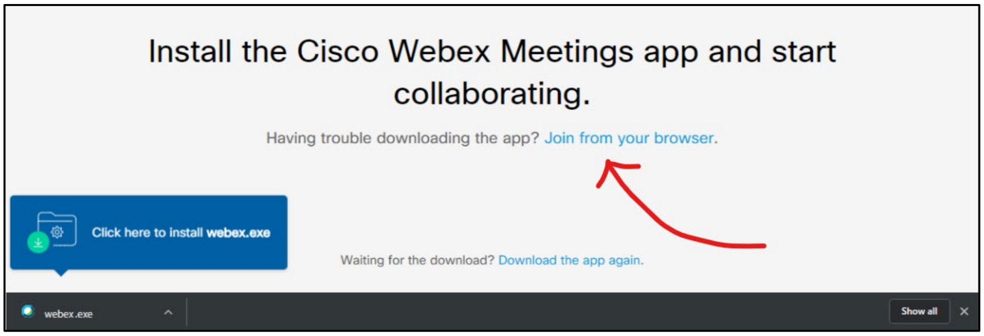

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

Debbie.bossley@ctclusi.org

jschaefer@ctclusi.org

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Brenda Meade
Chairwoman
Coquille Indian Tribe

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Meade:

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Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Darin Jarnagan Sr., Director of Natural Resources
Ms. Helena Linnell, Biological Planning & Operations Manager

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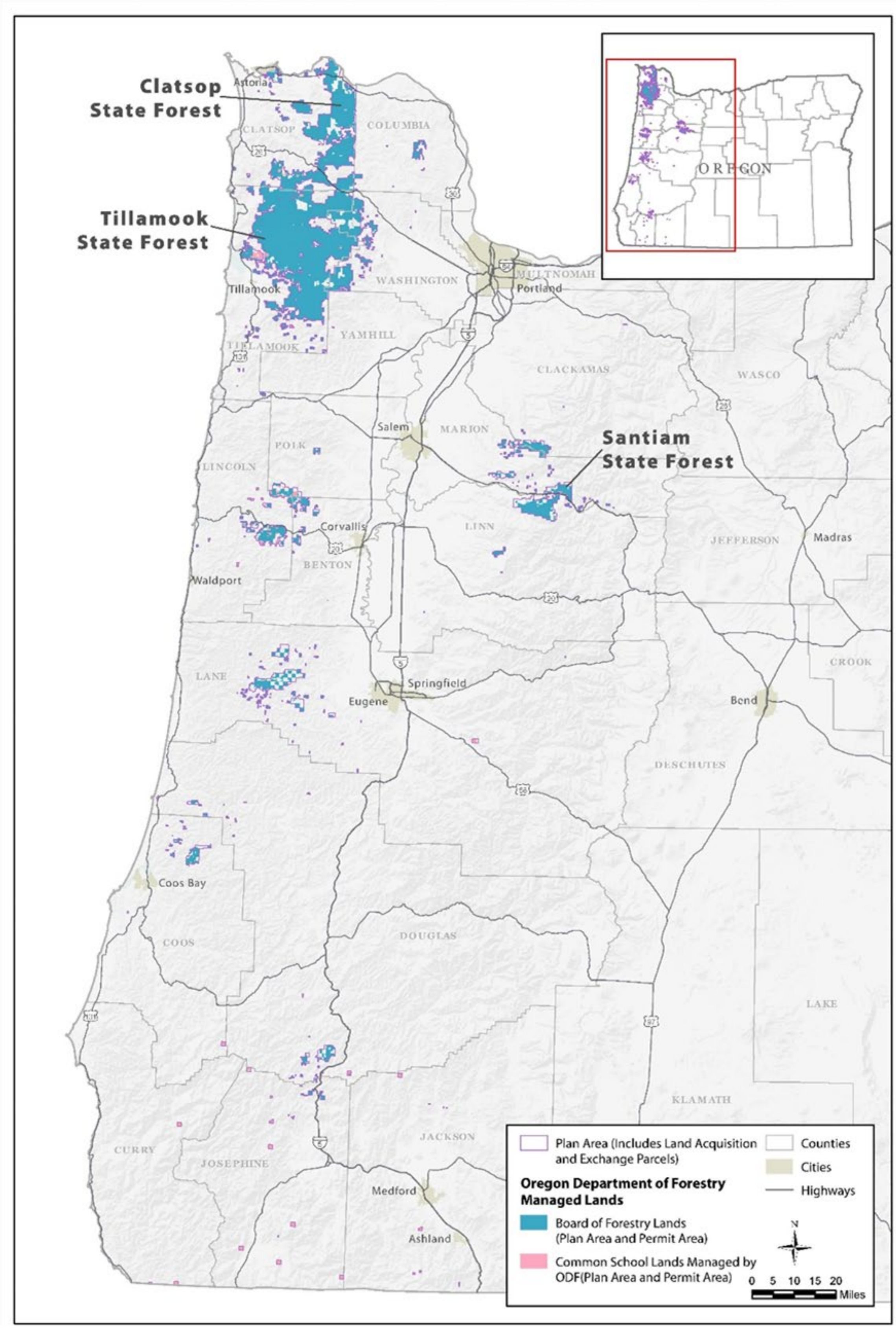

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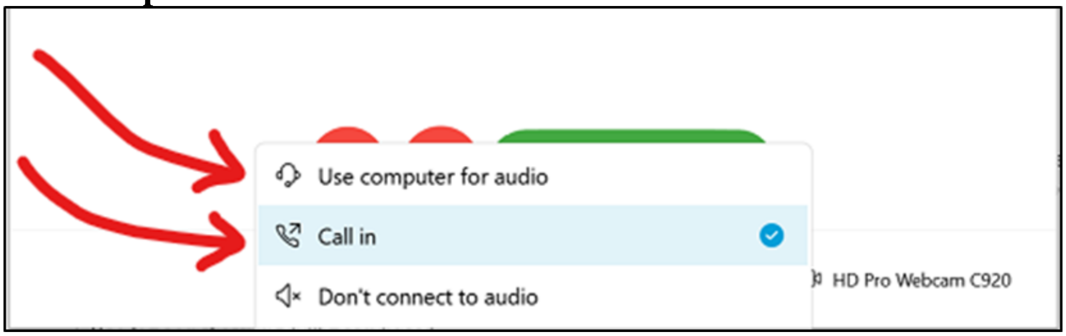

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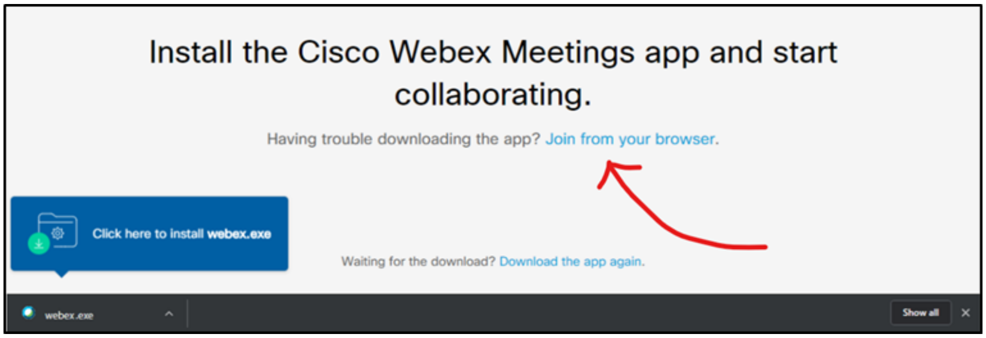

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

tribalcouncil@coquilletribe.org

darinjarnaghan@coquilletribe.org

helena.linnell@coquilletribe.org

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Daniel Courtney
Chairperson
Cow Creek Band of Umpqua Tribe of Indians, Board of Directors

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Courtney:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

NMFS will be the lead federal agency and the USFWS will be a cooperating agency for the NEPA process. The ODF will be the Applicant for the HCP Incidental Take Permit. We understand the significance of anadromous fish resources in Native American past, present, and future cultural and religious activities and look forward to working with you to hear any feedback or concerns you may have regarding this letter, NMFS' environmental impact statement, or the NEPA process in general. To facilitate this process, we invite you to an informational webinar on February 24, 2021, beginning at 1 pm PST. The webinar link is https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dmb2242d300b2165496f74a2589833634d&sa=D&source=calendar&ust=1612140199589000&usg=AOvVaw3M7W5A28yUxEwODaQzKOWT. The meeting number is 199 679 3625 and the password is 5033437777. We have attached instructions for connecting (Attachment 2). You may also participate by phone at 1-415-527-5035 with access code: 1996793625.

In the near future, NMFS will publish a Notice of Intent (NoI) to prepare an Environmental Impact Statement (EIS) under the National Environmental Protection Act (NEPA) for the Western Oregon State Forest HCP. We anticipate the NoI will be published in the Federal Register in March 2021 which will begin the official scoping period. We anticipate having a public meeting toward the end of March. While the EIS is still in early phases of development, preliminary assessments indicate the plan may affect anadromous fish populations along the Oregon Coast and in the Columbia and Willamette Rivers as well as birds, amphibians, and mammals.

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Sincerely,

/s/

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Tim Vredenburg, Forest Manager
Mr. Jason Robison, Director of Natural Resources

Attachments

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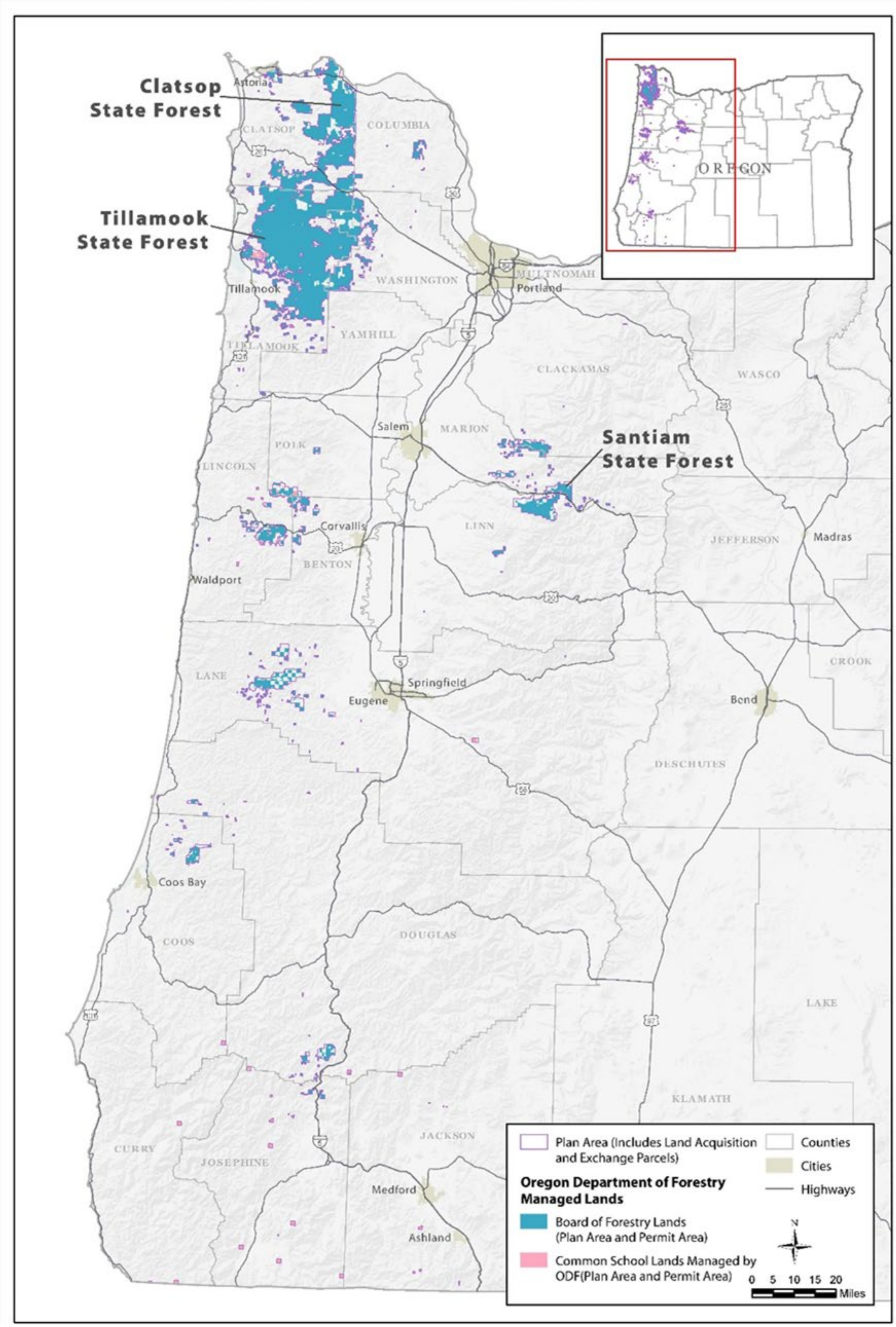

Western Oregon State Forest Habitat Conservation Plan Area.

Attachment 2.

WCR - WebEx Web-based Conferencing

Participant Guide

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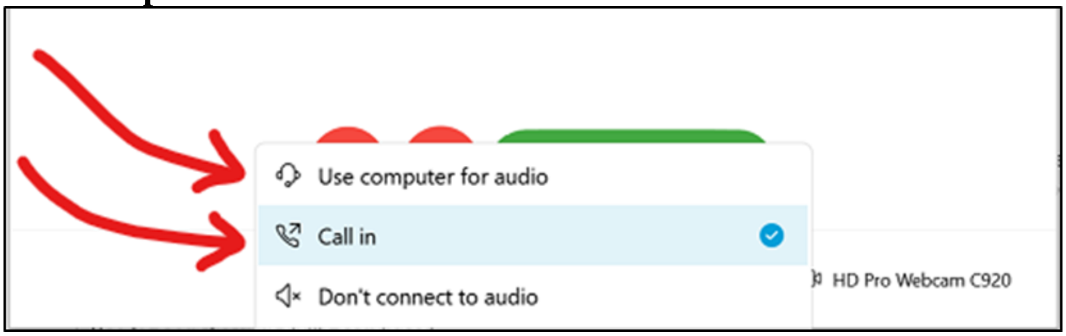

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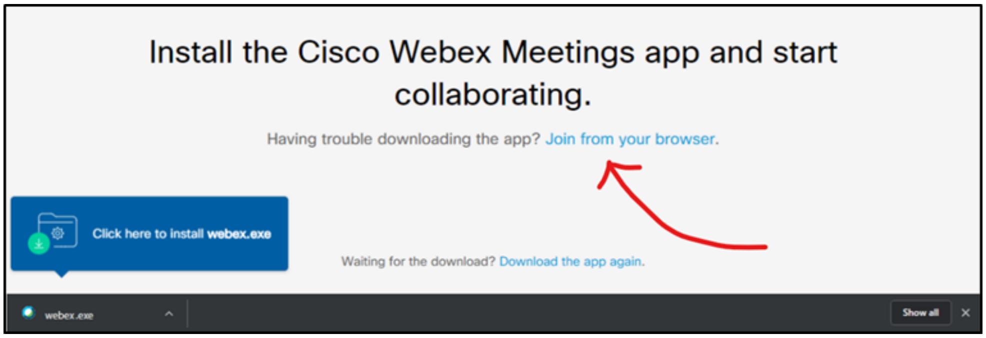

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

dcourtney@cowcreek.com

tvredenburg@cowcreek.com

jrobison@cowcreek.com

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Cheryle Kennedy
Chairwoman
Confederated Tribes of the Grand Ronde Community of Oregon

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Kennedy:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

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Sincerely,

/s/

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Kelly Dirksen, Fish and Wildlife Coordinator
Mr. Mike Wilson, Natural Resources Division Manager
Mr. Michael Karnosh, Ceded Lands Coordinator

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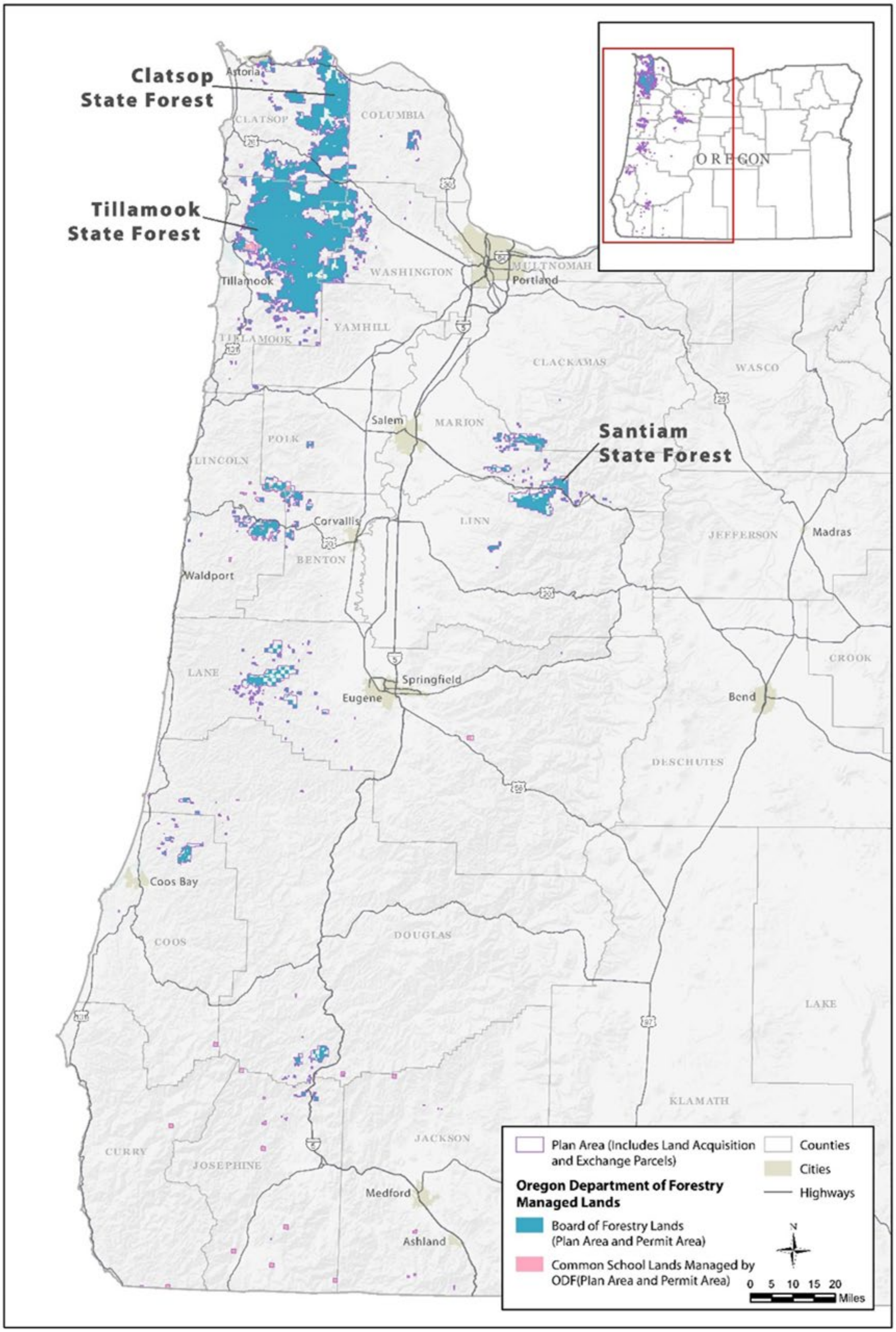

Western Oregon State Forest Habitat Conservation Plan Area.

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Participant Guide

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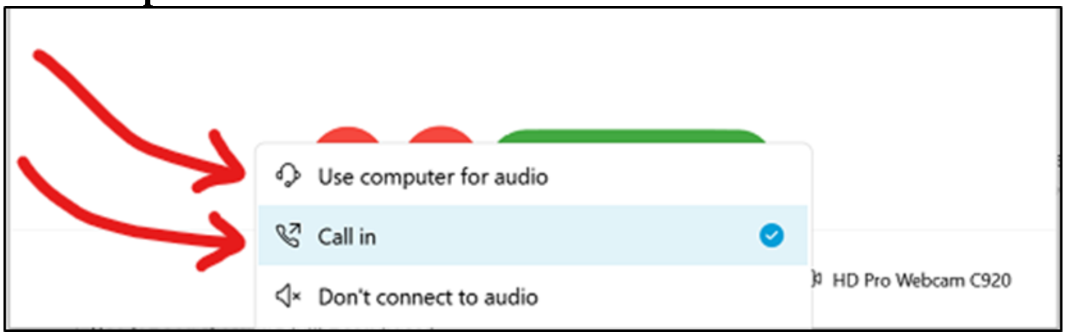

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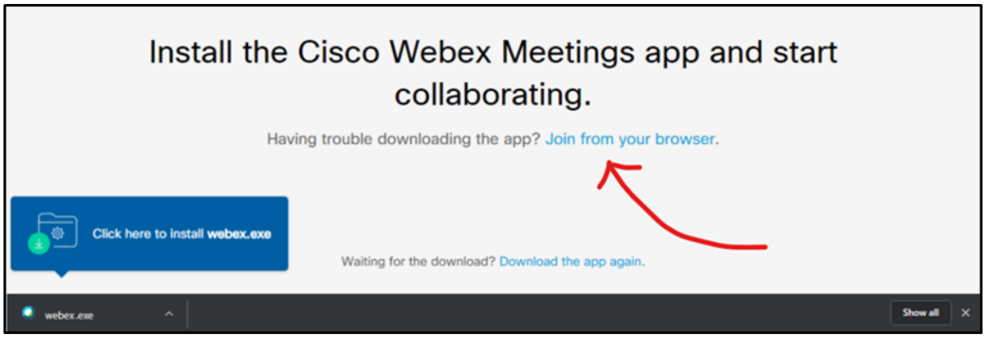

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

cheryle.kennedy@grandronde.org

kelly.dirksen@grandronde.org

mike.wilson@grandronde.org

michael.karnosh@grandronde.org

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Don Gentry
Chairman
Klamath Tribal Council

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Gentry:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

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Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Will Hatcher, Director of Natural Resources

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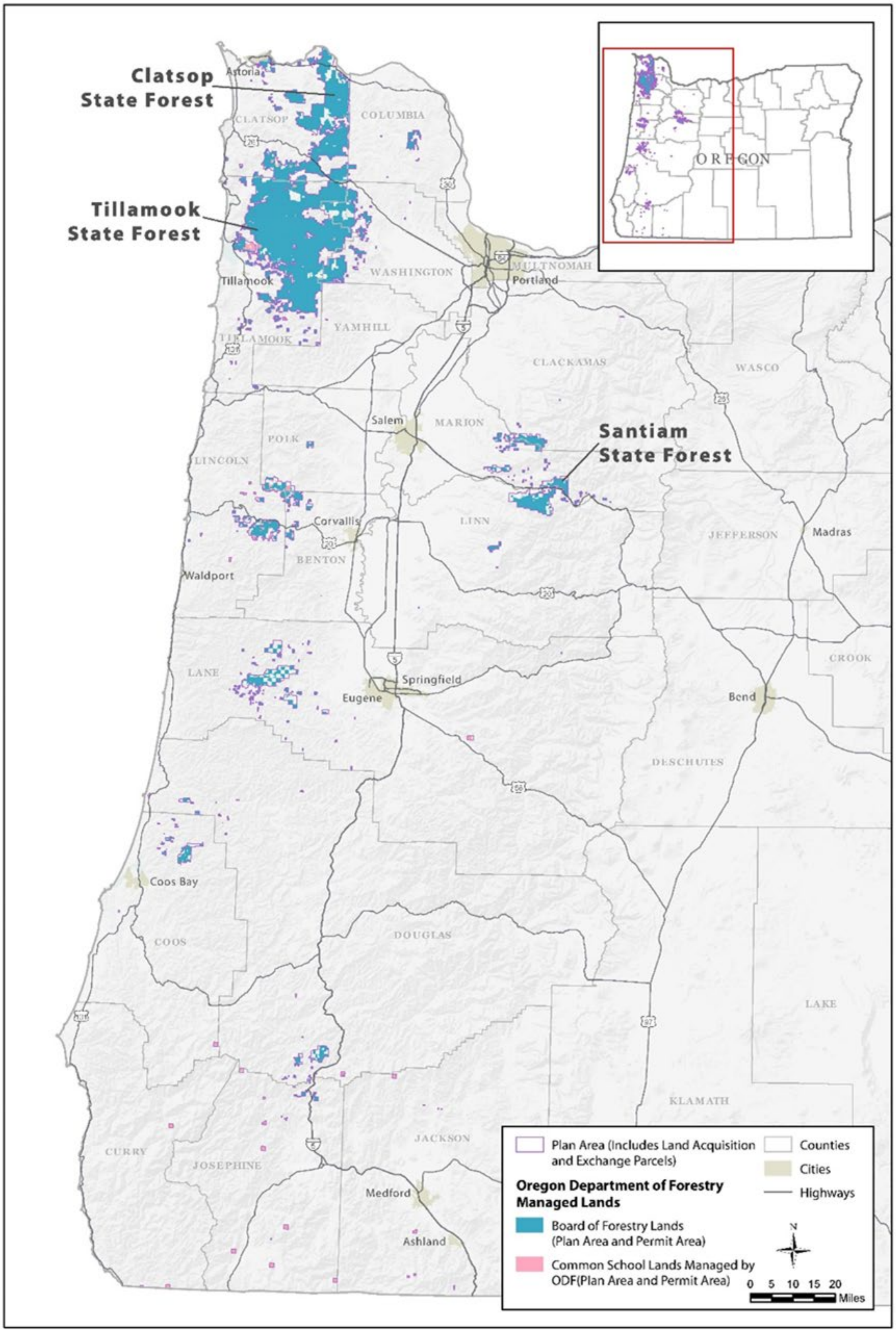

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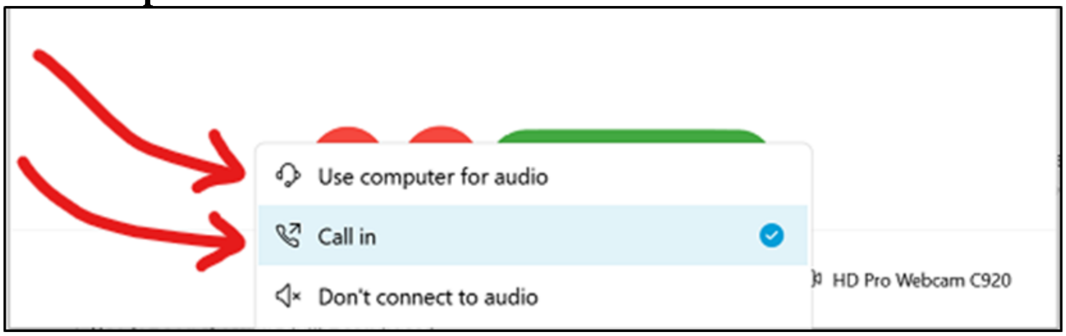

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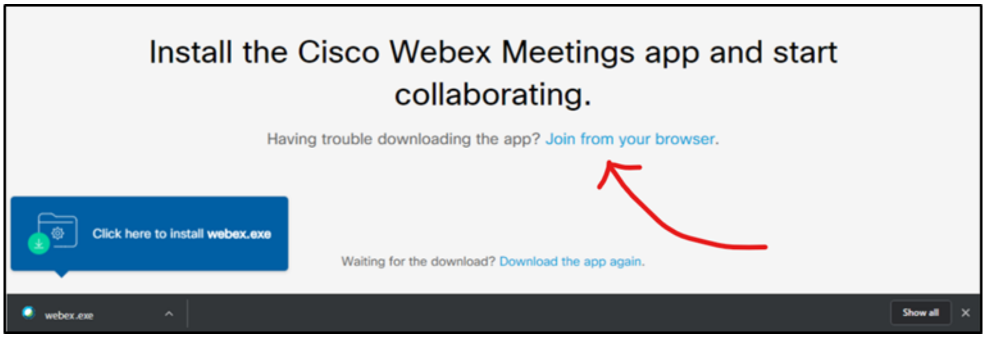

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PDFs sent to:

don.gentry@klamathtribes.com

will.hatcher@klamathtribes.com

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National Oceanic and Atmospheric Administration
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West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable Delores Pigsley
Chairperson
Siletz Tribal Council

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Pigsley:

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Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Mike Kennedy, Natural Resources Manager
Mr. Stan van de Wetering, Director of Biological Programs

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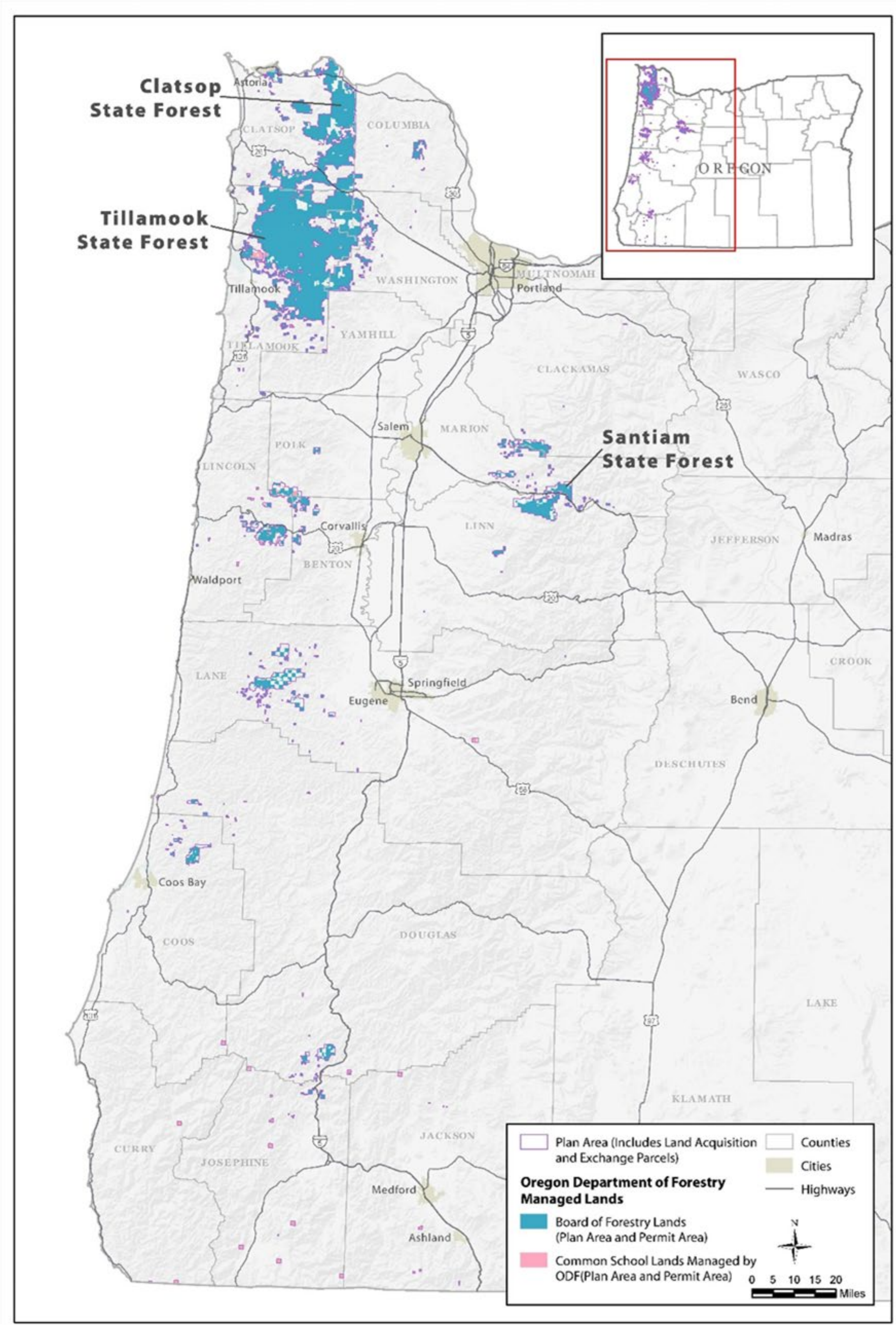

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WCR - WebEx Web-based Conferencing
Participant Guide

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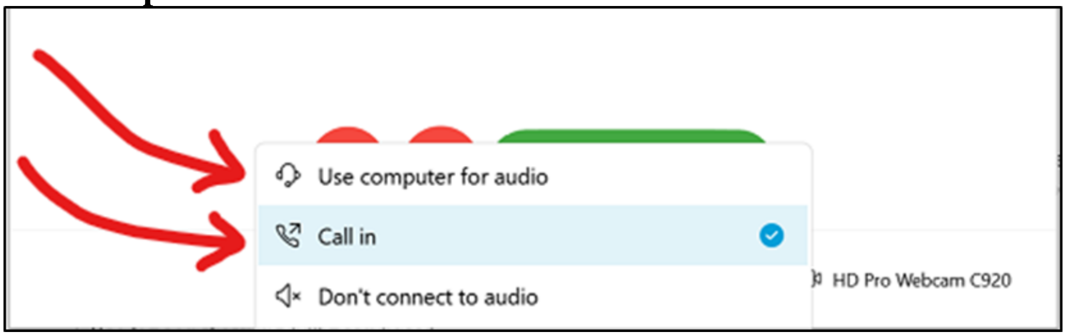

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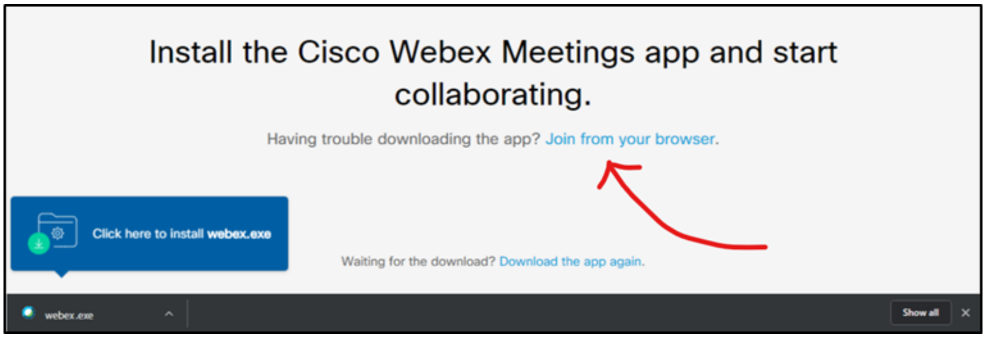

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

dpigsley@msn.com

mikek@ctsi.nsn.us

Stanvandewetering@yahoo.com

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

January 29, 2021

The Honorable M. Kathryn Brigham
BOT Chair
Board of Trustees, Confederated Tribes of the Umatilla Reservation

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Brigham:

The Oregon Department of Forestry (ODF) is developing a Habitat Conservation Plan (HCP) for Western Oregon State Forests, in coordination with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS), to provide enhanced protections for fish and wildlife species and their habitats. The HCP area includes all state forestlands west of the Cascade Range that are managed by ODF, a total of 733,695 acres (Attachment 1). More information about the HCP can be found on the ODF website at: https://www.oregon.gov/ODF/AboutODF/Pages/HCP-initiative.aspx.

NMFS will be the lead federal agency and the USFWS will be a cooperating agency for the NEPA process. The ODF will be the Applicant for the HCP Incidental Take Permit. We understand the significance of anadromous fish resources in Native American past, present, and future cultural and religious activities and look forward to working with you to hear any feedback or concerns you may have regarding this letter, NMFS' environmental impact statement, or the NEPA process in general. To facilitate this process, we invite you to an informational webinar on February 24, 2021, beginning at 1 pm PST. The webinar link is https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dmb2242d300b2165496f74a2589833634d&sa=D&source=calendar&ust=1612140199589000&usg=AOvVaw3M7W5A28yUxEwODaQzKOWT. The meeting number is 199 679 3625 and the password is 5033437777. We have attached instructions for connecting (Attachment 2). You may also participate by phone at 1-415-527-5035 with access code: 1996793625.

In the near future, NMFS will publish a Notice of Intent (NoI) to prepare an Environmental Impact Statement (EIS) under the National Environmental Protection Act (NEPA) for the Western Oregon State Forest HCP. We anticipate the NoI will be published in the Federal Register in March 2021 which will begin the official scoping period. We anticipate having a public meeting toward the end of March. While the EIS is still in early phases of development, preliminary assessments indicate the plan may affect anadromous fish populations along the Oregon Coast and in the Columbia and Willamette Rivers as well as birds, amphibians, and mammals.

We look forward to your collaboration as the proposed project matures. Please let us know if you are interested in being involved and or informed of this action, how you would like to be involved (informed via letter, email, meeting), who you would like to represent you, and if informal or formal government-to-government consultation is desired or needed. If you have any questions, concerns, or comments please feel free to contact Michelle McMullin at michelle.mcmullin@noaa.gov or Tere O'Rourke at therese.orourke@noaa.gov. We are also available to meet upon request.

Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Gordy Schumacher, Program Manager

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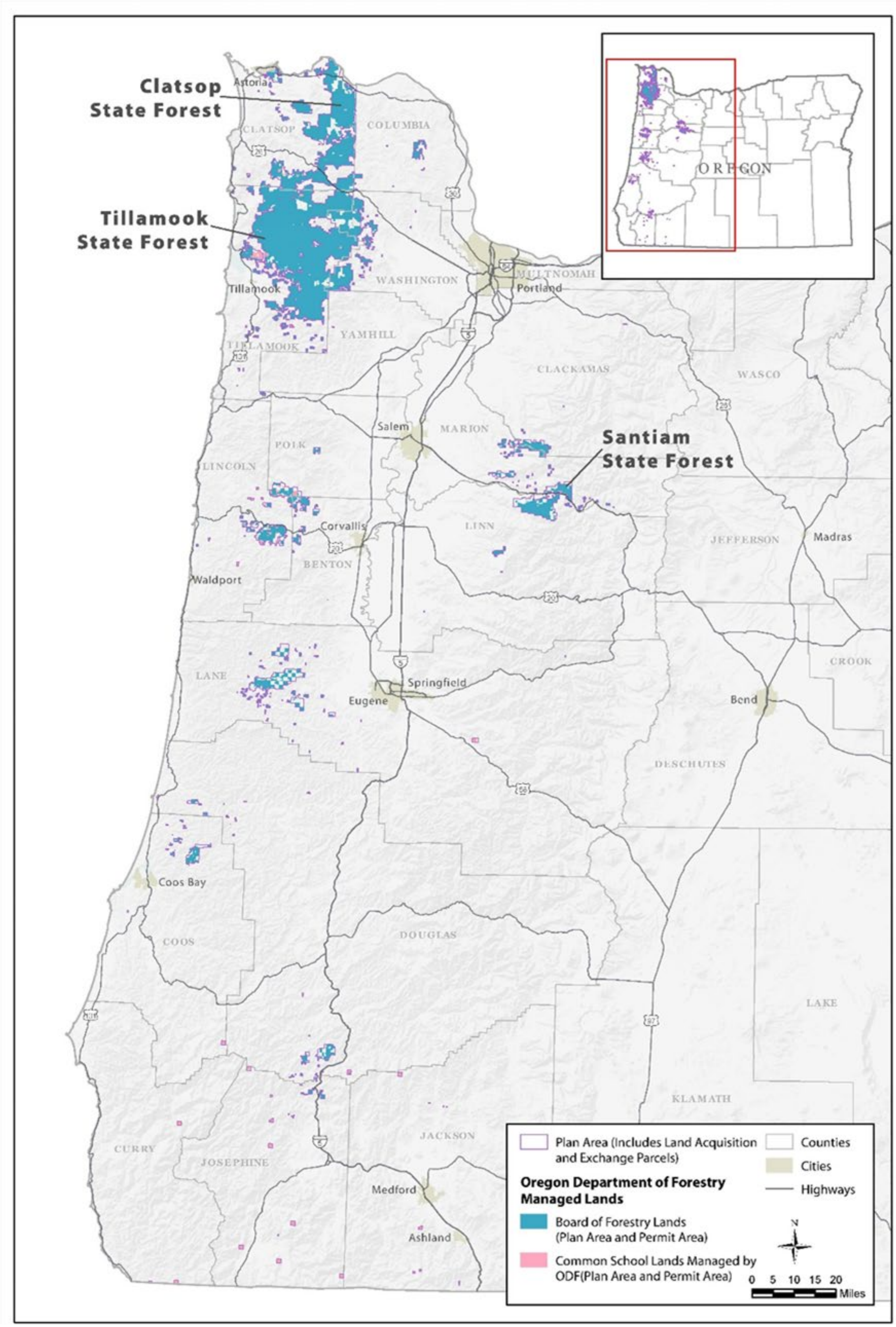

Western Oregon State Forest Habitat Conservation Plan Area.

Attachment 2.

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Participant Guide

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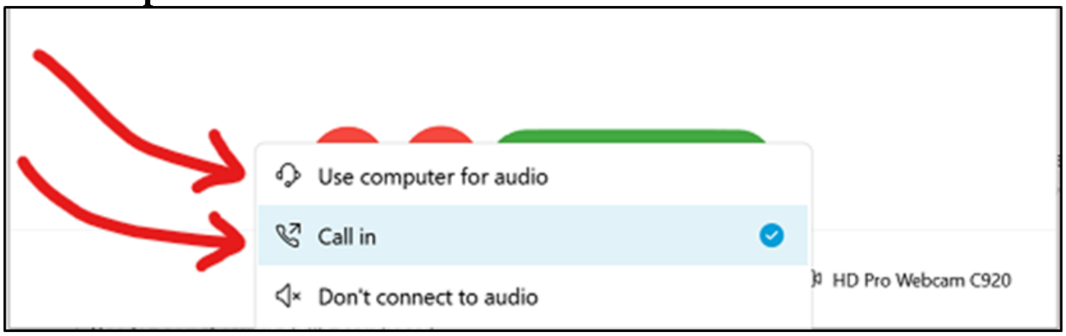

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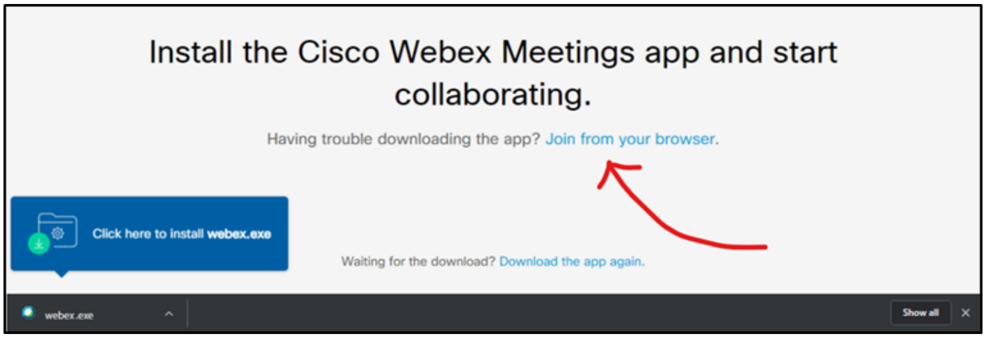

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bcc: M. McMullin, T. O'Rourke

PDFs sent to:

katbrigham@ctuir.org

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National Oceanic and Atmospheric Administration
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January 29, 2021

The Honorable Raymond Tsumpti
Chairman
Tribal Council, Confederated Tribes of the Warm Springs

Re: Western Oregon State Forest Habitat Conservation Plan Environmental Impact Statement

Dear Honorable Chairperson Tsumpti:

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Sincerely,

Kim Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

/s/

Paul Henson, Ph.D.
State Supervisor
Oregon Fish and Wildlife

cc: Mr. Robert Brunoe, General Manager of Natural Resources

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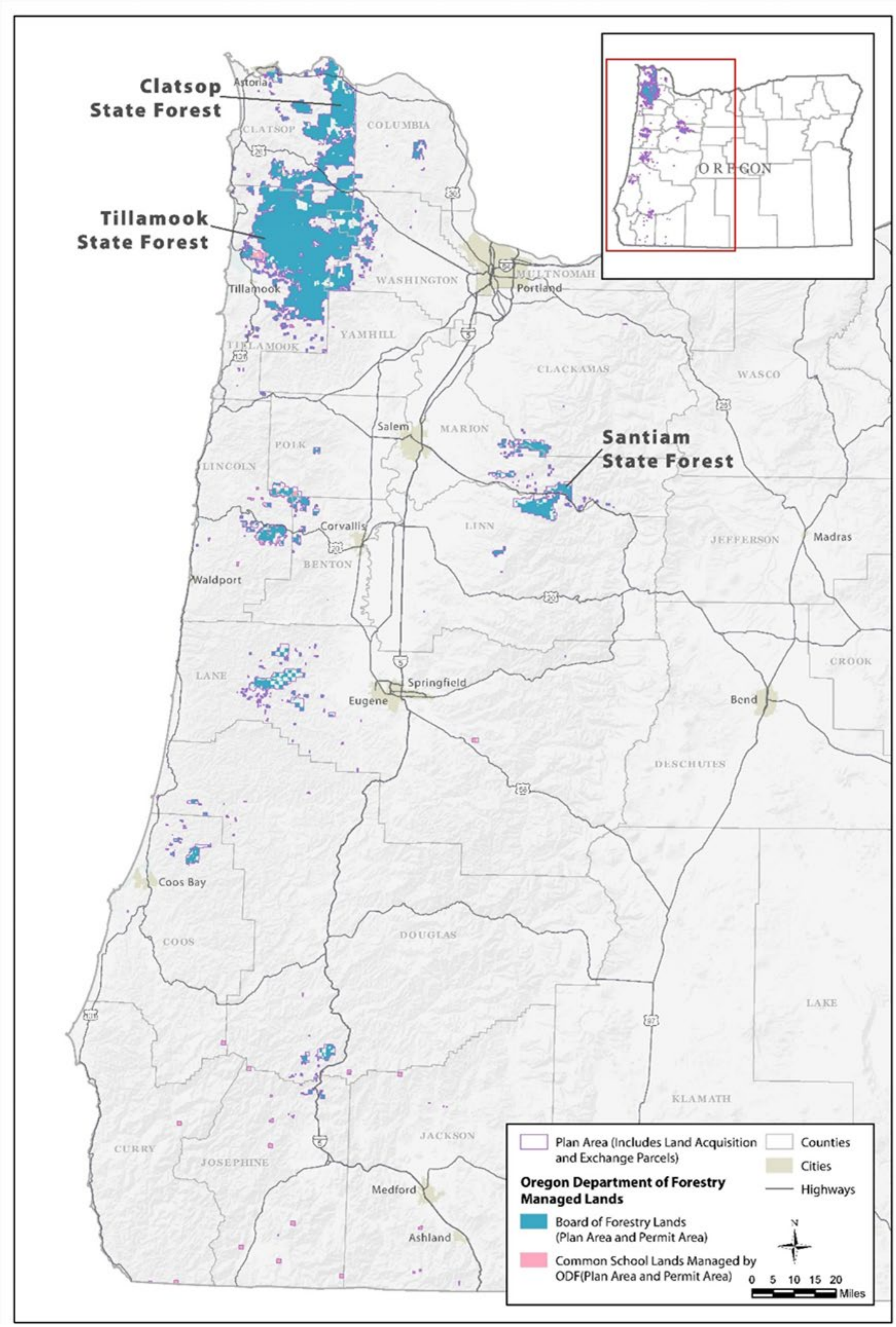

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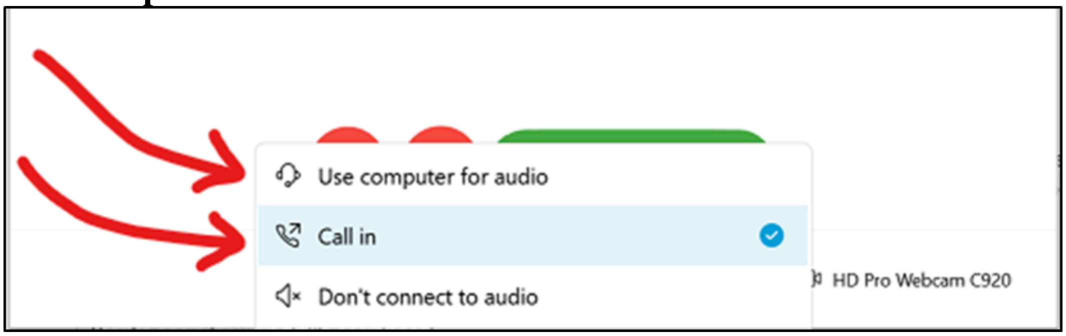

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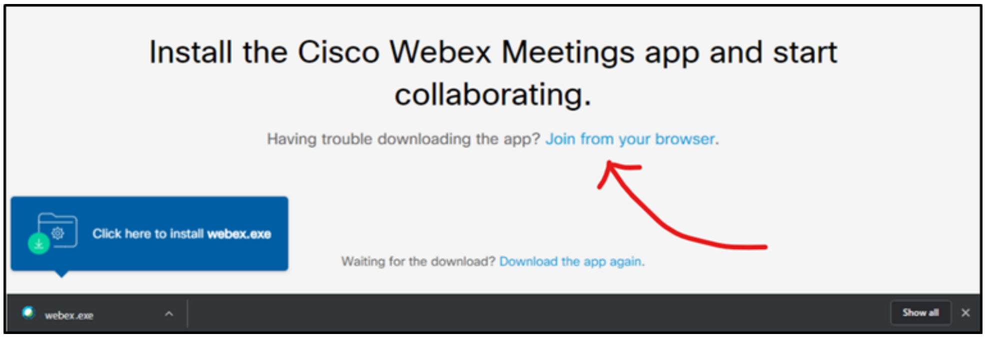

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PDFs sent to:

info@warmsprings.com

robert.brunoe@ctwsbnr.org

Appendix 3.12
Socioeconomics Technical Supplement

Population

Oregon's population was 4.1 million in 2019, an increase of 8 percent compared to 2010, and is expected to grow to 5.2 million by 2045 (U.S. Census Bureau 2010, 2021; Portland State University 2021). Between 2010 and 2019, Clackamas, Marion, Multnomah, Polk, Washington Counties grew over 8 percent in population while Coos, Curry, and Douglas Counties only grew by 1 percent in population. Coos County is the only county in the study area expected to experience a decrease in population in the next 40 years.

Table 1. Current and Future Population Estimates in the Study Area

Geography	Population (2019)	Population (2010)	Percent Change (2010–2019)	Forecasted (2060)	Forecasted Percent Change (2019–2060)
Benton County	91,107	85,579	6%	137,305	51%
Clackamas County	410,463	375,992	9%	595,974	45%
Clatsop County	39,102	37,039	6%	41,670	7%
Columbia County	51,375	49,351	4%	64,795	26%
Coos County	63,686	63,043	1%	60,974	-4%
Curry County	22,650	22,364	1%	25,397	12%
Douglas County	109,114	107,667	1%	136,327	25%
Jackson County	216,574	203,206	7%	304,414	41%
Josephine County	86,251	82,713	4%	106,073	23%
Lane County	373,340	351,715	6%	460,218	23%
Lincoln County	48,547	46,034	5%	53,714	11%
Linn County	125,048	116,672	7%	159,117	27%
Marion County	339,641	315,335	8%	442,878	30%
Multnomah County	804,606	735,334	9%	1,191,990	48%
Polk County	83,037	75,403	10%	162,168	95%
Tillamook County	26,389	25,250	5%	29,279	11%
Washington County	589,481	529,710	11%	970,762	65%
Yamhill County	104,831	99,193	6%	153,613	47%

Source: U.S. Census Bureau 2010, 2021; Portland State University 2021

Income and Employment

Timber extraction supports income and employment in the permit area across the harvest life cycle—before, during, and after harvest. Income and employment associated with preharvest activities includes the planning needed to survey and identify the appropriate lands for harvest. Some of this activity is conducted by public employees from the Oregon Department of Forestry (ODF) and some by private sector contractors. After the planning work is complete, lands are prepped for harvest. Preparation activities may include road construction and maintenance, bridge and culvert construction and maintenance, slope stabilization, and direct site preparation activities. Following harvest, activities like timber stand improvement and clearing slash material may be required.

The location of jobs and income associated with timber harvests in the permit area depend on the purchaser of the timber, which may be a mill or a logging company. Mills generally subcontract logging activities to logging contractors. Once the timber is harvested, it is sorted by species and grade, and then transported by truck and/or rail to a raw processing center. Processing sites include sawmills, paper/pulp mills, and veneer mills, or sometimes the timber is directly distributed for use as firewood.

The timber harvested in the permit area that remains in western Oregon for processing supports local jobs at mills. Milled logs then support additional jobs and income as they are used for final products, such as residential and nonresidential construction, repair, and remodeling, as well as wood furniture, wood cabinetry, paper products, pulp products, and many other wood product uses. Residual product (i.e., chips, sawdust) from log mills is also further distributed to paper and pulp mills or used as hog feed or for erosion control purposes, depending on the quality of the residual product.

After harvest, reforestation, young stand management, and maintenance occur. Seedlings for replanting usually come from local tree nurseries. Revegetation activities may be conducted by the logging company or subcontracted out to a third party. Road, bridge, and culvert maintenance, as well as noxious weed treatments are also part of postharvest activities. Many of the firms engaged in activities that support timber harvest are located in western Oregon and help support local jobs and income in the permit area.

A portion of the revenues that ODF receives from timber harvests is distributed to the counties where harvest occurs and supports local public services. Refer to the *Government Revenue* section for more information on the flow of these funds. Payments resulting from timber harvests in the permit area, support income and employment in public services sectors, such as at schools, fire departments, public safety, and other public services.

Each of these activities before, during, and after timber harvest represent ways in which income and employment levels can vary depending on the scale of allowable harvest. Accordingly, impacts on income and employment under the proposed action and alternatives are defined by the extent to which changes in harvest levels lead to changes in income and employment across these pathways.

Some income and employment is independent of harvest levels in the permit area but would also vary between each of the alternatives. For example, income and employment supported by spending on land surveys, road maintenance, planting, and thinning could vary by alternative. Recreational use could also vary by alternative and influence the total amount of income and employment generated through activities on ODF lands. These types of changes to income and employment are discussed qualitatively but not estimated quantitatively.

Methods

Overview

This section presents the assumptions for the estimate of income and employment corresponding to changes in harvest levels in the permit area. Average income and employment, calculated per thousand board feet (MBF), is used to estimate direct value added and output in the study area[1] using ratios from the Impact Analysis for Planning (IMPLAN) model (IMPLAN Group 2019a). Jobs directly affected by a change in harvest levels are used as the inputs into IMPLAN to calculate the jobs that would be supported downstream by initial harvest (i.e., secondary effects). These secondary effects are often referred to as indirect (supply chain) and induced (consumption) effects. Together, the direct and secondary effects represent the total effects on income and employment under each alternative. Only income and employment effects resulting from changes in harvest levels are quantitatively analyzed using input-output modeling. Other forest management activities, recreation use, and other expenditure changes arising from ODF management could vary by alternative.

Data Sources

This analysis used the forest model to calculate the total volume of timber harvested in the permit area over the analysis period. Historical timber harvest data is from Oregon Department of Forestry (Oregon Department of Forestry 2020a). The model of logflow by county is from ODF. The analysis used the 2019 IMPLAN model for the permit area (IMPLAN Group 2019a).

IMPLAN Input-Output Modeling

The IMPLAN modeling system was used in this analysis. Input-output models are mathematical representations of the economy that show how different parts (or sectors) are linked to one another. Input-output models that rely on survey or primary source data are expensive to construct. As a result, special modeling techniques have been developed to estimate the necessary empirical relationships. These techniques use a combination of national technological relationships and state- and county-level measures of economic activity, and have been packaged into IMPLAN. The Minnesota IMPLAN Group, Inc. has been developing and distributing IMPLAN since 1993. The IMPLAN modeling system is widely used and well respected—there are currently more than 1,500 public and private users of the IMPLAN modeling software. The IMPLAN model provides estimates of impacts of the expenditures on income and employment that follow from direct, indirect, and induced expenditures. By writing special fiscal impact modules, the model also can be used to estimate the effects on the tax revenue collected through property taxes, sales taxes, corporate income taxes, and other fiscal devices. Economic effects are classified by their relationship to the activity in question. The following three types of economic effects are measured in terms of output, labor income, and employment resulting from spending in the study area.

- **Direct effects.** Direct effects are the output, jobs, and income associated with the immediate effects of a change in final demand.
- **Indirect effects.** Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Suppliers to the directly involved industry will also purchase additional goods and services; spending leads to additional rounds

[1] Study area is defined as the regional economy of western Oregon.

of indirect impacts. Because they represent interactions among businesses, these indirect effects are often referred to as supply-chain impacts.

- **Induced effects.** Induced effects are the changes in regional household spending patterns caused by changes in household income. The direct and indirect increases in employment and income enhance the overall purchasing power in the economy, thereby inducing further spending by households. Employees in these industries, for example, will use their income to purchase groceries or take their children to the doctor. These induced effects are often referred to as consumption-driven impacts.

Total economic effects are based on the sum of the direct, indirect, and induced impacts. These three types of economic effects are measured in terms of output, labor income, and employment resulting from spending in the study area.

- **Output.** Output represents the value of goods and services produced, and is the broadest measure of economic activity
- **Income.** Income consists of employee compensation and proprietary income and is a subset of output.
  - *Employee compensation* includes workers' wages and salaries, as well as other benefits such as health, disability, and life insurance, retirement payments, and non-cash compensation.
  - *Proprietor's income* (business owner's income) represents the payments received by small-business owners or self-employed workers—in this case, drivers. Business income would include, for example, income received by private business owners, doctors, accountants, and lawyers.
- **Jobs.** Jobs are measured in terms of full-year-equivalents (FYE). One FYE job equals work over 12 months in each industry (this is the same definition used by the federal government's Bureau of Economic Analysis). For example, two jobs that last 6 months each count as one FYE job. A job can be full-time or part-time, seasonal or permanent; IMPLAN counts jobs based on the duration of employment, not the number of hours a week worked. Job impacts from operations are for 1 year of normal operation.

Timeframe of Secondary Impacts

IMPLAN does not measure long-term impacts, but rather looks at the economy at a single point in time. IMPLAN is a static model that assumes that there are no changes in wage rates or input prices. The underlying economic relationships in IMPLAN are assumed to be constant; there are no changes in the productivity of labor and capital, and no changes in population migration or business location patterns.

The IMPLAN model is based on annual averages. Therefore, the model cannot readily adjust for price spikes or sudden shortages in available labor and supplies. Future estimates should be interpreted with caution because the structural relationships of the local economy are likely to change in the future (e.g., there will be different suppliers; people will spend their wages on different items).

Because of these considerations regarding IMPLAN as a static model, secondary impacts (i.e., indirect and induced effects) are limited to the first 10 years of the analysis period, 2023 to 2032.

Direct Employment and Wages

For purposes of this analysis, direct employment is defined as all employees for the following three private-sector North American Industry Classification System (NAICS) codes.

- 321113: Sawmills
- 3221: Pulp, paper, and paperboard mills
- 113: Forestry and logging

Direct employment is defined for only these three industry sectors because these industries purchase harvests in the permit area. Other employment in larger industries, such as NAICS 321 (Wood Product Manufacturing), also have income and employment that is affected by the amount of timber harvests in the permit area. These are considered secondary, not direct, effects.

The alternatives vary by the amount of allowable harvest in the 5-year period increments, measured in MBF. Accordingly, the measure of the change is recorded in jobs and wages per MBF to understand the proportional change. On average from 2016 to 2019 there were 0.0035 jobs in the three industries per MBF of timber harvested in Oregon.[2] The annual values are provided in Table 2.

Table 2. Employment per Thousand Board Feet, 2016 to 2019, Oregon Statewide

Year	Total Harvest (MBF)	Total Employment[a] (FYE)	Employment per MBF
2016	3,888,348	14,124	0.0036
2017	3,851,038	13,312	0.0035
2018	4,064,315	13,227	0.0033
2019	3,541,291	12,916	0.0036

Source: Calculated by ECONorthwest using data from U.S. Bureau of Labor Statistics and Oregon Department of Forestry

[a] This table reflects total employment for only the NAICS industries 321113, 3221, and 113.

MBF = thousand board feet; FYE = full-year-equivalent

An assumption inherent in this approach is that jobs and wages are linearly proportional to changes in harvest levels. The analysis also assumes that the ratio of direct employment and income per MBF does not change over the analysis period.

The historical jobs estimate also provides information about the proportion of employment in the logging industry (NAICS 113) compared to milling industry (NAICS 321113 and 3221). On average, from 2016 to 2019, approximately 56.8 percent of jobs are in the milling industries and 43.2 percent of jobs are in the logging industry. Direct jobs are estimated in this analysis by applying the 0.0035 jobs per MBF to the MBF harvest levels for the 10-year period.

Jobs are reported as average annual for the 10-year period, as well as total job-years for each alternative. As mentioned above, the jobs output from IMPLAN is in terms of FYE. When summing jobs over multiple years the results can be easily misinterpreted because the same job position can be held for multiple years, so it is incorrect to assume that the total represents new jobs that are created each year. This analysis uses the term *job-years* as the sum of jobs over the analysis period

[2] Using all jobs in Oregon for NAICS 113 (Forestry and Logging) and 321 (Wood Product Manufacturing) would result in an average employment of 0.0068 per MBF for Oregon from 2016 to 2019.

to indicate that those are FYE jobs over each year, and many jobs may be the same position from year-to-year.

Location of Jobs

To perform the analysis for each county in the permit area it is necessary to identify where the direct employment is located. For this analysis, logging jobs (NAICS 113) are assumed to occur in the county where the harvest occurs. This assumption will not always be true in instances where loggers travel from outside counties or even outside western Oregon to a job site.

Milling jobs (NAICS 321113 and 3221) are assumed to occur in the location of the mill. ODF provided a "logflow" model that proportionally describes where timber harvested from ODF lands in a county goes. The flow of logs that the logflow model depicts is based on mill locations. Different types of timber go to different mills depending on purchaser, transportation costs, species of tree, age of tree, and other variables. Table 3 shows the origin/destination pairs ODF recorded for all timber sales on ODF lands between fiscal years 2018 and 2021.

For example, in Benton County, 31.8 percent of logs harvested in Benton County flowed to mills in Benton County. The remainder flowed to mills in Clackamas, Lane, and Yamhill Counties. The analysis uses these data to assign milling jobs proportionally to the destination counties based on the logflow model. Milling jobs that are outside study area counties are excluded as direct jobs because they are outside of the study area (e.g., Cowlitz County, Washington).

Table 3. Logflow by Origin and Destination County

Origin County in Oregon	Destination County, State	Percent (%)
Benton	Benton, OR	31.8
Benton	Clackamas, OR	13.7
Benton	Lane, OR	32.6
Benton	Yamhill, OR	21.9
Clackamas	Benton, OR	15.2
Clackamas	Clackamas, OR	14.6
Clackamas	Lane, OR	31.5
Clackamas	Lewis, WA	0.7
Clackamas	Linn, OR	19.2
Clackamas	Yamhill, OR	18.7
Clatsop	Benton, OR	0.2
Clatsop	Clackamas, OR	0.0
Clatsop	Clark, WA	10.5
Clatsop	Clatsop, OR	13.6
Clatsop	Columbia, OR	22.3
Clatsop	Cowlitz, WA	4.1
Clatsop	Douglas, OR	0.1
Clatsop	Grays Harbor, WA	0.2
Clatsop	Hood River, OR	0.1
Clatsop	Lane, OR	3.1

Origin County in Oregon	Destination County, State	Percent (%)
Clatsop	Lewis, WA	3.5
Clatsop	Skagit, WA	0.1
Clatsop	Skamania, WA	0.0
Clatsop	Tillamook, OR	10.1
Clatsop	Washington, OR	16.6
Clatsop	Yamhill, OR	15.5
Columbia	Clackamas, OR	2.7
Columbia	Columbia, OR	48.9
Columbia	Cowlitz, WA	48.2
Columbia	Washington, OR	0.2
Coos	Coos, OR	100.0
Curry	Curry, OR	100.0
Douglas	Benton, OR	4.7
Douglas	Douglas, OR	87.5
Douglas	Lane, OR	7.8
Jackson	Jackson, OR	100.0
Josephine	Douglas, OR	98.0
Josephine	Jackson, OR	2.0
Lane	Benton, OR	0.2
Lane	Clackamas, OR	0.8
Lane	Coos, OR	0.0
Lane	Douglas, OR	0.5
Lane	Lane, OR	97.8
Lane	Lincoln, OR	0.0
Lane	Linn, OR	0.6
Lincoln	Benton, OR	52.0
Lincoln	Clackamas, OR	2.1
Lincoln	Coos, OR	1.2
Lincoln	Lane, OR	36.6
Lincoln	Polk, OR	1.9
Lincoln	Yamhill, OR	6.3
Linn	Benton, OR	0.5
Linn	Clackamas, OR	5.0
Linn	Columbia, OR	0.0
Linn	Cowlitz, WA	12.4
Linn	Lane, OR	8.8
Linn	Linn, OR	54.2
Linn	Polk, OR	0.1
Linn	Tillamook, OR	2.6
Linn	Yamhill, OR	16.3

Origin County in Oregon	Destination County, State	Percent (%)
Marion	Benton, OR	1.0
Marion	Clackamas, OR	2.6
Marion	Clark, WA	9.7
Marion	Columbia, OR	1.4
Marion	Cowlitz, WA	2.1
Marion	Hood River, OR	3.8
Marion	Lane, OR	24.9
Marion	Linn, OR	47.9
Marion	Skamania, WA	0.3
Marion	Yamhill, OR	6.3
Multnomah	Multnomah, OR	100.0
Polk	Benton, OR	57.2
Polk	Lane, OR	11.9
Polk	Polk, OR	1.1
Polk	Tillamook, OR	0.1
Polk	Yamhill, OR	29.7
Tillamook	Benton, OR	1.4
Tillamook	Clackamas, OR	1.7
Tillamook	Clark, WA	3.2
Tillamook	Clatsop, OR	1.5
Tillamook	Columbia, OR	10.6
Tillamook	Cowlitz, WA	2.2
Tillamook	Lane, OR	4.1
Tillamook	Lewis, WA	0.3
Tillamook	Linn, OR	3.9
Tillamook	Polk, OR	0.2
Tillamook	Skagit, WA	0.0
Tillamook	Tillamook, OR	24.5
Tillamook	Washington, OR	20.5
Tillamook	Yamhill, OR	26.0
Washington	Benton, OR	0.4
Washington	Clackamas, OR	0.5
Washington	Clark, WA	9.9
Washington	Clatsop, OR	0.1
Washington	Columbia, OR	13.6
Washington	Cowlitz, WA	1.9
Washington	Lane, OR	2.2
Washington	Lewis, WA	0.1
Washington	Linn, OR	10.0
Washington	Pierce, WA	0.0

Origin County in Oregon	Destination County, State	Percent (%)
Washington	Skagit, WA	0.6
Washington	Tillamook, OR	7.1
Washington	Washington, OR	18.3
Washington	Yamhill, OR	35.4
Yamhill	Yamhill, OR	100.0

Source: ODF 2021
OR = Oregon, WA = Washington

Direct Employee Compensation

The average weekly wage information from the U.S. Bureau of Labor Statistics is used to define direct employee compensation for the analysis. Weekly wages are converted to annual wages by multiplying by 52.143 (the number of weeks in a year). In Oregon in 2019, the average annual wage was $67,055.90 for the milling industries (NAICS 321113 and 3221) and $54,124.43 for the logging industry (NAICS 113). To be modeled in IMPLAN, these wage levels need to be adjusted to account for total employee compensation, which is wages plus benefits.[3] The average ratio of total compensation to wages in the Pacific western United States is 1.292 (U.S. Bureau of Labor Statistics no date). Applying this benefits load ratio to the average annual wages indicates that the average annual employee compensation is $86,636.22 for the milling industries (NAICS 321113 and 3221) and $69,928.76 for the logging industry (NAICS 113) in 2019.

Labor Income

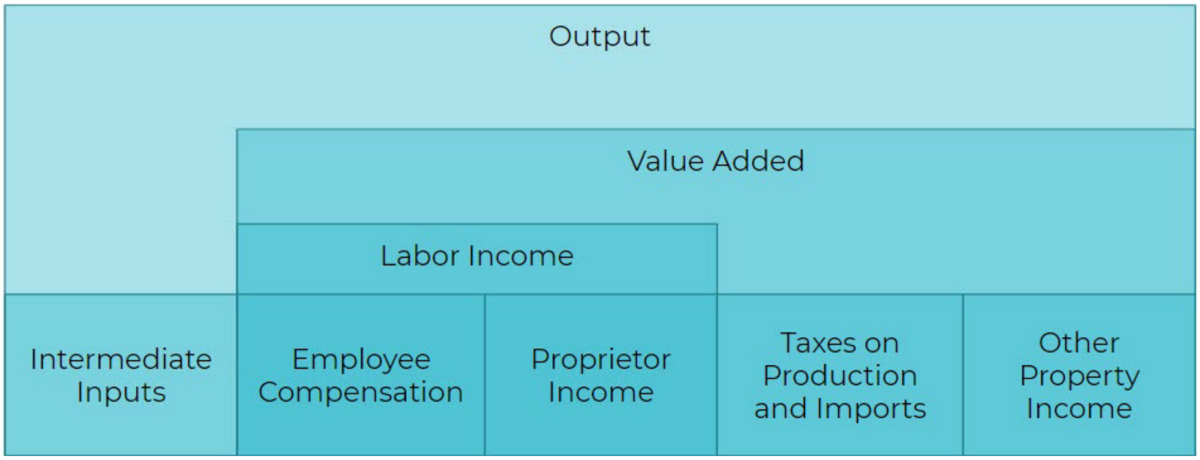
Labor income, as defined by IMPLAN, is the sum of employee compensation and proprietor income. Employee compensation as a function of changes in one MBF of timber harvests is calculated as described above. Proprietor income is available from IMPLAN for the study area counties. Proprietor income for this region for IMPLAN industry was negative in 2019 and 2018; this commonly indicates depreciating capital. This analysis assumes that proprietor income is equal to zero to avoid reflecting capital losses in total labor income generated in the study area. Direct labor income is, therefore, equivalent to employee compensation.

Direct Value Added and Output

Direct value added and output are necessary for calculating secondary effects. They are calculated in IMPLAN. Value added is equivalent to the sum of labor income, taxes on production and imports, and other property income. Output is equivalent to the sum of value added and intermediate inputs. Figure 1 summarizes the relationships between output, valued added, and labor income.

[3] Benefits include both employer-provided benefits (e.g., health insurance, 401k contributions) and as legally required benefits (e.g., Social Security, Medicare, unemployment insurance, and workers' compensation).

Figure 1. Components of Output, Value Added, and Labor Income



Source: IMPLAN Group 2019b

To calculate output for the three NAICS industries requires mapping the industries to the following IMPLAN industry categories.

- Forestry and Logging (NAICS 113) is mapped to IMPLAN industry 16, Commercial Logging.
- Sawmills (NAICS 321113) is mapped to IMPLAN industry 132, Sawmills.
- Pulp, paper, and paperboard mills (NAICS 3221) has multiple IMPLAN category mappings: 144, Pulp Mills; 145, Paper Mills; and 146, Paperboard Mills.

IMPLAN is used to estimate output and value added. Logs are an intermediate input into the milling industry. IMPLAN provides the proportion of intermediate costs that the milling industries spend on logs and other products from the logging industry. Sawmills spend 24.06 percent of their intermediate input costs on logs and spending that flows to the logging industry. Pulp mills, paper mills, and paperboard mills spend 3.58, 2.68, and 4.04 percent, respectively. The mills also purchase intermediate inputs from each other. Because it is unclear what portion of ODF timber harvest spending flows to each mill type, this analysis uses only sawmills (IMPLAN Industry 132) to calculate value added, output, and the corresponding secondary effects.

ODF provided estimates of the *cut and haul costs*, which are equivalent to the difference between pond value and stumpage value. In the case where the logging company is the purchaser on an ODF timber sale, stumpage value is the price they pay to ODF to harvest the timber. Pond value is the price at which the logging company sells the timber to the mill. Pond value is generally higher than stumpage value, and the difference between the two represents the gross return to the logging company.

This analysis divides intermediate demand by assuming that cut and haul costs are the intermediate demand that flows to the logging industry and the remainder is the intermediate demand for the milling industry.

The stumpage value, paid to ODF by either the logging or milling company, represents taxes on production and imports, which is a component of value added along with labor income. Valued added is, therefore, the sum of stumpage value and labor income. Output is the sum of intermediate demand and value added.

Indirect and Induced Effects

Indirect and induced effects are derived from the IMPLAN model. Proper inputs must be determined to model the relevant economic impacts on the industries. Double counting can occur in the analysis of secondary effects because the industries rely on each other for inputs. To avoid double counting, indirect and induced effects are calculated in IMPLAN by using the following three models.

- **2019 Industry Spending Pattern for Sawmills.** This spending pattern is adjusted to remove all spending on logs to avoid double-counting, since intermediate demand for the logging industry is modeled separately. This input is equivalent to the intermediate demand for mills, calculated using pond value as 24.06 percent of intermediate demand. This spending pattern is used to model the spending of all mill types, including pulp, paper, and paperboard mills.[4]
- **2019 Industry Spending Pattern for Logging.** The default spending pattern from IMPLAN is used for the analysis. This input is equivalent to the intermediate demand for logging, assumed to be equal to cut and haul costs.
- **Employee Compensation Labor Income Change.** The value of the input to this type of impact is employee compensation, which includes both employee wages and benefits.

Affected Environment

Table 4 presents detailed data on timber harvests in the study area across all public and private timberlands, by county, in 2010 and 2019. It also shows ODF harvest as a percent of total harvest.

[4] Although pulp, paper, and paperboard mills have their own independent spending patterns, this analysis models all spending as sawmills because of the uncertainty about what proportion of logs from the permit area flow to each mill type.

Table 4. Timber Harvest by Volume in Study Area (2010, 2019)

Geography	Total Timber Harvest in 2019 (MBF)	Federal Timber Harvest in 2019 (MBF)	State (ODF) Timber Harvest[a] in 2019 (MBF)	Local Timber Harvest in 2019 (MBF)	Tribal Timber Harvest in 2019 (MBF)	Private Timber Harvest in 2019 (MBF)	Total Timber Harvest in 2010 (MBF)	Change in Harvests (2010–2019)	ODF Harvest as a Percent of Total Harvest (2019)	ODF Harvest as a Percent of Total Harvest (2010)	Change in Share of ODF Harvest (%)
Benton Cty	109,502	11,673	8,810	1,032	-	87,987	91,368	20%	8%	5%	61%
Clackamas Cty	138,306	17,179	313	2,028	-	118,785	97,223	42%	0%	1%	-67%
Clatsop Cty	215,784	-	75,620	746	-	139,418	282,866	-24%	35%	27%	29%
Columbia Cty	149,145	5,529	4,799	3,538	-	135,279	123,027	21%	3%	4%	-28%
Coos Cty	175,942	25,467	62	18,030	-	132,383	233,586	-25%	0%	8%	-100%
Curry Cty	88,006	26,865	-	-	-	61,141	64,657	36%	0%	0%	-
Douglas Cty	659,965	44,269	293	13,545	-	601,858	435,923	51%	0%	1%	-96%
Jackson Cty	78,830	18,800	-	1,486	-	58,544	87,826	-10%	0%	0.01%	-100%
Josephine Cty	66,307	6,306	539	8,667	-	50,795	17,688	275%	1%	0%	-
Lane Cty	453,019	115,570	18,550	337	-	318,562	455,146	0%	4%	2%	142%
Lincoln Cty	155,354	14,428	8,005	-	-	132,921	121,445	28%	5%	5%	-4%
Linn Cty	292,577	12,499	13,097	3,697	-	263,284	219,462	33%	4%	8%	-46%
Marion Cty	42,072	4,232	5,745	36	-	32,059	52,376	-20%	14%	28%	-51%
Multnomah Cty	9,108	-	1	-	-	9,107	13,916	-	-	0%	-
Polk Cty	108,467	6,633	2,236	-	-	99,598	95,649	13%	2%	2%	16%
Tillamook Cty	197,902	18,270	102,714	1,885	1,556	73,477	192,361	3%	52%	42%	22%
Washington Cty	117,428	1,952	37,360	2,072	-	76,044	132,549	-11%	32%	31%	4%
Yamhill Cty	115,308	6,420	5	4,141	7,486	97,256	98,232	17%	0%	0%	-
Study area	3,173,022	336,092	278,149	61,240	9,042	2,488,498	2,815,300	13%	9%	10%	-12%
Oregon	3,541,291	524,629	289,803	73,537	9,042	2,671,191	3,226,550	10%	8%	9%	-11%

Source: University of Montana 2021.

Note: Shaded cells indicate counties where total timber harvest declined from 2010 to 2019.

[a] ODF timber harvest includes harvest from Board of Forestry Land and Common School Forest Land.

Cty = County

Environmental Consequences

Tables 5 through 8 present the total employee compensation generated under the proposed action and alternatives. Alternative 4 has identical direct employee compensation as the first 50 years of the proposed action (periods 2023–2032 through 2063–2072).

Table 5. No Action Alternative Total Employee Compensation by Decade (in 2019 dollars)

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	$14,502,542	$20,177,566	$21,433,937	$21,710,530	$20,895,761	$20,564,152	$20,638,274	$139,922,760
Clackamas	$6,750,742	$7,651,503	$6,706,729	$6,801,236	$5,600,154	$7,883,959	$6,746,863	$48,141,185
Clatsop	$79,750,468	$60,602,771	$64,992,480	$63,560,295	$60,198,214	$60,120,422	$61,913,447	$451,138,098
Columbia	$50,312,922	$40,354,960	$42,329,671	$37,390,392	$36,483,802	$36,493,256	$35,477,332	$278,842,336
Coos	$3,660,530	$10,353,878	$7,697,213	$6,977,213	$7,089,197	$8,395,853	$10,525,461	$54,699,345
Curry	$1,822,043	$194,196	$596,493	$1,278,204	$2,014,069	$1,315,561	$0	$7,220,567
Douglas	$3,408,852	$4,308,837	$6,159,916	$8,181,874	$7,251,526	$6,037,325	$5,666,842	$41,015,171
Jackson	$45,584	$29,541	$1,150,736	$135,517	$334,559	$659,682	$17,816	$2,373,435
Josephine	$1,406,417	$911,436	$169,634	$148,951	$191,685	$652,700	$549,534	$4,030,358
Lane	$46,326,536	$45,898,894	$45,919,906	$47,391,327	$44,378,485	$45,910,851	$46,132,850	$321,958,848
Lincoln	$7,180,845	$11,644,442	$11,296,483	$12,504,288	$11,441,240	$10,785,868	$11,598,810	$76,451,974
Linn	$28,634,493	$27,279,598	$28,189,270	$31,713,651	$36,213,502	$26,654,771	$26,420,072	$205,105,356
Marion	$10,568,246	$8,329,234	$8,547,967	$6,883,121	$3,008,740	$7,611,536	$10,303,183	$55,252,027
Multnomah	$0	$0	$0	$0	$0	$0	$0	$0
Polk	$1,816,591	$4,722,787	$3,642,094	$2,685,979	$2,891,216	$3,032,183	$4,975,684	$23,766,532
Tillamook	$98,994,780	$95,381,179	$96,054,303	$104,084,964	$102,975,172	$98,193,022	$98,050,927	$693,734,348
Washington	$77,731,277	$49,586,714	$48,974,060	$53,657,942	$55,502,423	$49,841,693	$53,001,261	$388,295,371
Yamhill	$65,702,254	$53,672,132	$53,279,200	$56,771,814	$57,403,793	$53,485,323	$55,020,826	$395,335,342
Total, Decadal	**$498,615,124**	**$441,099,668**	**$447,140,090**	**$461,877,297**	**$453,873,538**	**$437,638,156**	**$447,039,182**	**$3,187,283,054**

Table 6. Proposed Action Total Employee Compensation by Decade and Percent Change from No Action Alternative (in 2019 dollars)

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	$20,889,108	$29,189,979	$35,185,524	$30,199,299	$24,645,793	$28,783,720	$31,820,095	$200,713,519
	44.0%	44.7%	64.2%	39.1%	17.9%	40.0%	54.2%	43.4%
Clackamas	$12,291,746	$7,943,596	$11,226,894	$10,159,880	$8,431,060	$6,986,351	$8,556,607	$65,596,133
	82.1%	3.8%	67.4%	49.4%	50.6%	-11.4%	26.8%	36.3%
Clatsop	$105,180,578	$74,105,864	$47,891,271	$61,737,754	$86,001,531	$69,225,815	$51,110,147	$495,252,960
	31.9%	22.3%	-26.3%	-2.9%	42.9%	15.1%	-17.4%	9.8%
Columbia	$63,077,204	$54,330,753	$49,688,737	$55,483,714	$57,175,725	$45,549,325	$39,433,182	$364,738,640
	25.4%	34.6%	17.4%	48.4%	56.7%	24.8%	11.2%	30.8%
Coos	$3,233,621	$651,389	$11,535,090	$4,983,176	$17,482,566	$6,536,362	$6,649,961	$51,072,165
	-11.7%	-93.7%	49.9%	-28.6%	146.6%	-22.1%	-36.8%	-6.6%
Curry	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Douglas	$1,517,215	$1,652,573	$4,715,643	$6,683,217	$5,429,409	$11,217,908	$14,151,013	$45,366,979
	-55.5%	-61.6%	-23.4%	-18.3%	-25.1%	85.8%	149.7%	10.6%
Jackson	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Josephine	$59,882	$82,823	$0	$861,408	$332,975	$1,051,367	$999,650	$3,388,106
	-95.7%	-90.9%	N/A	478.3%	73.7%	61.1%	81.9%	-15.9%
Lane	$71,901,518	$77,325,478	$62,863,020	$59,382,297	$45,160,061	$48,943,479	$43,904,680	$409,480,533
	55.2%	68.5%	36.9%	25.3%	1.8%	6.6%	-4.8%	27.2%
Lincoln	$6,879,412	$14,990,847	$16,592,144	$13,623,622	$17,159,392	$17,947,906	$14,852,504	$102,045,827
	-4.2%	28.7%	46.9%	9.0%	50.0%	66.4%	28.1%	33.5%
Linn	$52,056,342	$41,798,528	$35,856,325	$32,484,789	$29,573,799	$26,448,623	$25,841,501	$244,059,908
	81.8%	53.2%	27.2%	2.4%	-18.3%	-0.8%	-2.2%	19.0%
Marion	$10,974,217	$8,181,013	$5,591,444	$6,512,054	$6,058,819	$5,327,717	$3,383,127	$46,028,390
	3.8%	-1.8%	-34.6%	-5.4%	101.4%	-30.0%	-67.2%	-16.7%
Multnomah	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Polk	$4,446,234	$6,187,740	$4,725,352	$5,642,347	$4,904,428	$4,672,279	$6,160,029	$36,738,409
	144.8%	31.0%	29.7%	110.1%	69.6%	54.1%	23.8%	54.6%
Tillamook	$123,747,660	$159,271,028	$173,652,659	$132,018,178	$119,471,706	$122,322,939	$153,468,457	$983,952,625
	25.0%	67.0%	80.8%	26.8%	16.0%	24.6%	56.5%	41.8%
Washington	$88,159,347	$82,003,134	$86,079,915	$84,189,379	$62,336,530	$72,714,688	$64,317,769	$539,800,763
	13.4%	65.4%	75.8%	56.9%	12.3%	45.9%	21.4%	39.0%
Yamhill	$82,693,664	$83,624,756	$86,200,499	$78,834,384	$66,093,617	$69,468,256	$71,959,903	$538,875,078
	25.9%	55.8%	61.8%	38.9%	15.1%	29.9%	30.8%	36.3%
Total, Decadal	**$647,107,747**	**$641,339,501**	**$631,804,517**	**$582,795,498**	**$550,257,410**	**$537,196,735**	**$536,608,625**	**$4,127,110,035**
	29.8%	**45.4%**	**41.3%**	**26.2%**	**21.2%**	**22.7%**	**20.0%**	**29.5%**

Table 7. Total Employee Compensation by Decade under Alternative 3 and Percent Change from No Action Alternative (in 2019 dollars)

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	$20,112,241	$29,582,304	$34,662,967	$30,511,704	$23,851,557	$28,830,836	$31,928,981	$199,480,590
	38.7%	46.6%	61.7%	40.5%	14.1%	40.2%	54.7%	42.6%
Clackamas	$12,261,963	$7,850,283	$11,062,675	$9,473,763	$8,937,510	$7,041,751	$8,428,416	$65,056,361
	81.6%	2.6%	64.9%	39.3%	59.6%	-10.7%	24.9%	35.1%
Clatsop	$104,869,727	$73,847,614	$47,455,027	$60,895,160	$86,739,637	$70,017,050	$50,015,341	$493,839,556
	31.5%	21.9%	-27.0%	-4.2%	44.1%	16.5%	-19.2%	9.5%
Columbia	$62,703,768	$54,060,782	$48,473,758	$56,347,939	$56,392,612	$45,498,214	$39,142,138	$362,619,212
	24.6%	34.0%	14.5%	50.7%	54.6%	24.7%	10.3%	30.0%
Coos	$3,187,442	$837,602	$11,687,454	$6,751,380	$15,170,379	$5,605,960	$7,621,420	$50,861,638
	-12.9%	-91.9%	51.8%	-3.2%	114.0%	-33.2%	-27.6%	-7.0%
Curry	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Douglas	$1,485,728	$1,634,812	$4,594,492	$5,972,763	$6,413,874	$11,101,521	$14,102,804	$45,305,994
	-56.4%	-62.1%	-25.4%	-27.0%	-11.6%	83.9%	148.9%	10.5%
Jackson	$1,941	$2,638	$0	$26,490	$152,142	$36,759	$27,863	$247,833
	-95.7%	-91.1%	N/A	-80.5%	-54.5%	-94.4%	56.4%	-89.6%

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Josephine	$59,882	$81,381	$0	$817,305	$269,039	$1,134,114	$859,664	$3,221,385
	-95.7%	-91.1%	N/A	448.7%	40.4%	73.8%	56.4%	-20.1%
Lane	$71,554,639	$76,313,985	$62,548,990	$58,461,390	$45,261,847	$49,071,804	$42,642,301	$405,854,956
	54.5%	66.3%	36.2%	23.4%	2.0%	6.9%	-7.6%	26.1%
Lincoln	$6,725,741	$14,767,807	$16,041,087	$15,361,419	$16,663,020	$16,886,230	$14,517,240	$100,962,546
	-6.3%	26.8%	42.0%	22.8%	45.6%	56.6%	25.2%	32.1%
Linn	$51,985,223	$41,358,401	$36,008,351	$31,109,297	$29,210,974	$25,425,353	$25,605,890	$240,703,490
	81.5%	51.6%	27.7%	-1.9%	-19.3%	-4.6%	-3.1%	17.4%
Marion	$11,113,126	$7,933,635	$5,930,997	$6,017,665	$5,975,818	$5,103,358	$3,292,662	$45,367,259
	5.2%	-4.7%	-30.6%	-12.6%	98.6%	-33.0%	-68.0%	-17.9%
Multnomah	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Polk	$4,316,865	$6,132,159	$4,841,740	$5,095,725	$4,797,136	$5,292,729	$6,085,195	$36,561,549
	137.6%	29.8%	32.9%	89.7%	65.9%	74.6%	22.3%	53.8%
Tillamook	$122,380,197	$157,491,646	$173,328,381	$130,060,477	$117,040,087	$119,560,596	$153,078,995	$972,940,380
	23.6%	65.1%	80.4%	25.0%	13.7%	21.8%	56.1%	40.2%
Washington	$86,948,733	$81,118,748	$85,712,156	$82,846,306	$61,707,369	$71,570,974	$64,127,323	$534,031,610
	11.9%	63.6%	75.0%	54.4%	11.2%	43.6%	21.0%	37.5%
Yamhill	$81,708,768	$82,917,942	$85,915,602	$77,211,405	$65,323,927	$68,706,162	$71,610,117	$533,393,924
	24.4%	54.5%	61.3%	36.0%	13.8%	28.5%	30.2%	34.9%
Total, Decadal	**$641,415,987**	**$635,931,739**	**$628,263,679**	**$576,960,189**	**$543,906,929**	**$530,883,410**	**$533,086,349**	**$4,090,448,282**
	28.6%	**44.2%**	**40.5%**	**24.9%**	**19.8%**	**21.3%**	**19.2%**	**28.3%**

Table 8. Total Employee Compensation by Decade under Alternative 5 and Percent Change from No Action Alternative (in 2019 dollars)

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Benton	$21,092,747	$31,683,843	$35,532,133	$30,089,364	$24,543,175	$31,766,580	$35,122,008	$209,829,851
	45.4%	57.0%	65.8%	38.6%	17.5%	54.5%	70.2%	50.0%
Clackamas	$11,544,608	$10,160,715	$11,942,140	$8,696,512	$7,681,295	$7,347,065	$9,749,624	$67,121,959
	71.0%	32.8%	78.1%	27.9%	37.2%	-6.8%	44.5%	39.4%
Clatsop	$111,403,670	$76,345,692	$50,594,750	$67,252,395	$90,975,454	$74,609,274	$49,752,251	$520,933,485
	39.7%	26.0%	-22.2%	5.8%	51.1%	24.1%	-19.6%	15.5%
Columbia	$65,693,584	$55,903,692	$52,036,363	$56,210,130	$58,692,814	$48,356,276	$40,072,018	$376,964,878
	30.6%	38.5%	22.9%	50.3%	60.9%	32.5%	13.0%	35.2%
Coos	$2,289,210	$1,672,400	$11,198,375	$10,062,589	$11,320,937	$6,105,934	$7,974,805	$50,624,250
	-37.5%	-83.8%	45.5%	44.2%	59.7%	-27.3%	-24.2%	-7.4%
Curry	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Douglas	$2,130,906	$1,656,088	$9,188,745	$7,328,793	$11,009,787	$13,213,668	$9,764,732	$54,292,719
	-37.5%	-61.6%	49.2%	-10.4%	51.8%	118.9%	72.3%	32.4%
Jackson	$3,785	$2,684	$4,446	$173,080	$25,451	$30,915	$440,729	$681,091
	-91.7%	-90.9%	-99.6%	27.7%	-92.4%	-95.3%	2373.7%	-71.3%
Josephine	$116,775	$82,823	$137,186	$1,156,550	$785,241	$953,829	$743,770	$3,976,174
	-91.7%	-90.9%	-19.1%	676.5%	309.7%	46.1%	35.3%	-1.3%
Lane	$77,524,521	$79,211,381	$62,377,639	$55,585,257	$46,388,058	$50,557,029	$49,146,680	$420,790,564
	67.3%	72.6%	35.8%	17.3%	4.5%	10.1%	6.5%	30.7%
Lincoln	$7,964,249	$13,941,629	$17,663,928	$15,537,682	$18,005,046	$17,291,556	$14,982,274	$105,386,364
	10.9%	19.7%	56.4%	24.3%	57.4%	60.3%	29.2%	37.8%
Linn	$52,735,873	$41,696,411	$36,964,046	$31,579,764	$33,484,262	$27,015,069	$24,171,644	$247,647,068
	84.2%	52.8%	31.1%	-0.4%	-7.5%	1.4%	-8.5%	20.7%
Marion	$11,520,070	$7,921,136	$5,139,794	$7,529,850	$6,176,667	$4,479,717	$3,190,784	$45,958,018
	9.0%	-4.9%	-39.9%	9.4%	105.3%	-41.1%	-69.0%	-16.8%
Multnomah	$0	$0	$0	$0	$0	$0	$0	$0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Polk	$4,541,649	$7,728,094	$4,611,958	$5,336,895	$3,959,583	$4,937,330	$8,330,058	$39,445,568
	150.0%	63.6%	26.6%	98.7%	37.0%	62.8%	67.4%	66.0%

County	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total, All Years
Tillamook	$126,916,710	$166,164,149	$179,663,444	$132,337,060	$122,375,517	$123,980,877	$161,790,318	$1,013,228,075
	28.2%	74.2%	87.0%	27.1%	18.8%	26.3%	65.0%	46.1%
Washington	$91,265,372	$85,916,596	$91,525,957	$84,014,762	$65,021,560	$76,417,645	$65,725,991	$559,887,883
	17.4%	73.3%	86.9%	56.6%	17.2%	53.3%	24.0%	44.2%
Yamhill	$85,043,219	$88,165,258	$90,003,892	$78,621,441	$68,168,389	$72,666,623	$75,409,659	$558,078,482
	29.4%	64.3%	68.9%	38.5%	18.8%	35.9%	37.1%	41.2%
Total, Decadal	**$671,786,948**	**$668,252,591**	**$658,584,796**	**$591,512,124**	**$568,613,237**	**$559,729,388**	**$556,367,346**	**$4,274,846,430**
	34.7%	**51.5%**	**47.3%**	**28.1%**	**25.3%**	**27.9%**	**24.5%**	**34.1%**

Government Revenue

Methods

Timber Sale Revenue from Board of Forestry Lands

To apportion the timber revenues generated on Board of Forestry Lands (BOFL) to counties in the study area, the analysis relied on the forest model for the location and amount of timber revenues generated. Since the forest model does not include impacts of future disturbance events or post-disturbance forest management, the projected volumes of BOFL timber harvests and the associated government revenue are likely to differ from actual revenue transfers under all alternatives over the analysis period. Since Oregon Revised Statute (ORS) 530.115 allocates BOFL revenues based on location of the harvest to counties and then to component taxing districts, the analysis used spatial data on counties in the study area supplied by the Oregon Spatial Data Library and spatial data on taxing districts provided by ODF. The analysis also relied on conversations with treasurer and finance departments of counties in the study area to determine the percentage of BOFL revenues distributed to the county administration, county school fund, and the taxing districts within each county. The analysis used the tax summary rolls compiled by each county's tax assessment department to calculate the tax rates of each taxing district relative to the total tax rate of taxing districts where BOFL timber harvests may occur.

The analysis used the spatial data on counties, individual tax codes, and the forest model to assign a tax code and county to each timber revenue generating stand under the alternatives. Using the county and tax codes as spatial groupings, the analysis summarized total timber harvest revenues generated in each county and tax code. The analysis apportioned the tax revenues to ODF (36.25 percent) and the remaining to the county where the harvest was located. The timber harvest revenues across time periods were then apportioned to the county administration, county school fund, and individual taxing districts based on each county's mechanism and the relative tax rates calculated for each taxing district with BOFL.

Douglas and Linn Counties did not respond to our request for information regarding BOFL payments and their distribution. As a result, the analysis assumes that these two counties comply with ORS 530.115 in the percentage of BOFL revenues retained and distributed to various funds and districts.

Timber Sale Revenue from Common School Forest Lands

The analysis used spatial data on Common School Forest Lands (CSFL) stands provided by ODF and the forest model to calculate total timber harvest revenues generated from CSFL under all alternatives over the analysis period. These calculated revenues estimated the transfer of revenues from ODF to Department of State Lands to fund the Common School Fund. The Common School Fund further distributes a portion of its accrued investments and revenue transfers to school districts in Oregon. Since the forest model does not include impacts of future disturbance events or post-disturbance forest management, the projected volumes of CSFL timber harvests and the associated government revenue are likely to differ from actual revenue transfers under all alternatives over the analysis period. Detailed historical data on the amount of Common School Fund distributed to school districts can be obtained from the Oregon Department of Education upon request.

Forest Products Harvest Tax Revenue

The analysis used the forest model to calculate the total volume of timber harvested in the permit area over the analysis period. Since the forest model does not include impacts of future disturbance events or post-disturbance forest management, the projected volumes of timber harvests and the associated tax revenue are likely to differ from actual tax collections under all alternatives over the analysis period. ODF provided available data on winning timber bids between 2018 and 2020 that informed the analysis. The analysis used the latest Forest Products Harvest Tax rates published by the Department of Revenue. Historical receipts of Forest Products Harvest Tax revenues by each agency can be found in each agency's budget and annual report documents online.

Based on data provided by ODF, 20 timber purchasers win timber bids in the permit area annually. The analysis assumed every year 20 timber harvesters would harvest timber in the permit area over the analysis period. Since 25 MBF of timber is exempt from the Forest Products Harvest Tax per taxpayer, the analysis assumed that 500 MBF of timber would be exempt from the Forest Products Harvest Tax each year over the analysis period. The analysis also assumed that the real tax rates would remain constant at the latest rates specified by the Department of Revenue (Table 9).

Table 9. Forest Products Harvest Tax Rates (in 2019 dollars)

Component	Rate for 2020	Share of Total Tax Rate (%)
Fire Protection	$ 0.62	15.13
Forestry Research	$ 0.89	21.78
Forest Practices Act	$ 1.37	33.57
OSU College of Forestry	$ 0.10	2.42
Forest Resources Institute	$ 1.11	27.10
Total Tax Rate	**$ 4.09**	**100.00**

Source: Oregon Department of Revenue Research Section 2020.

Affected Environment

Timber Sale Revenue from Board of Forestry Lands

ORS 530.115 governs the distribution and use of BOFL payments to counties where timber harvests on BOFL occur. Table 10 shows the payments to counties from harvest on BOFL between 2015 and 2020, as well as the average annual payments. Once distributed to the county, the statute requires the county use at least 10 percent of the BOFL revenue to reimburse the county general fund for any expenses incurred in managing BOFL within the county. Of the balance, 25 percent must be distributed to the county school fund, and the remainder distributed to taxing districts where the BOFL occur, prorated by the tax rate of each district relative to the sum of tax rates for all relevant districts.

With these rules as a general guide, counties have enacted local policies to distribute BOFL revenues, which vary from county to county somewhat, as described for each county below.

- **Benton County.** In line with ORS 530.115, Benton County distributes the first $200,000 of BOFL payments to maintain forest roads designated as timber routes. Of the remaining balance, 10 percent is distributed to the County General Fund for county administration and 25 percent to the County School Fund (Ambuehl pers. comm.). The balance is distributed to the taxing districts where the timber harvests occur according to their relative tax rates (Ambuehl pers. comm.).

- **Clackamas County.** In line with ORS 530.115, Clackamas County retains 25 percent of the BOFL payments for the County General Fund, 25 percent of the remaining for the County School Fund, and the remainder to the taxing districts in the tax code 035-14 (Nava pers. comm.).
- **Clatsop County.** In line with ORS 530.115, the Clatsop County Board of Commissioners created a resolution and order in April 2002 retaining 1 percent of the BOFL payments for law enforcement services on BOFL within the county (Clatsop County 2019:231). This funding offsets some of the costs incurred by the county in maintaining timber harvests on BOFL within the county. In addition, 10 percent of the payments are retained by the county government for the general fund and for special projects (Clatsop County 2019:442; Johnson pers. comm.). Of the remaining balance, 25 percent is distributed to the County School Fund and the remaining to all taxing districts where timber harvests on BOFL occur (Johnson pers. comm.).
- **Columbia County.** In line with ORS 530.115, Columbia County distributes 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to specific taxing districts (Guess pers. comm.). Unlike other counties, the taxing districts that receive BOFL revenue in Columbia County are not tied to where the timber harvests occur.
- **Coos County.** In line with ORS 530.115, Coos County distributes 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (Simms pers. comm.).
- **Curry County.** Since Curry County does not contain BOFL, the county does not receive any BOFL payments from timber harvests (Oregon Department of Forestry 2020b).
- **Douglas County.** Douglas County is assumed to adhere closely to ORS 530.115 by distributing 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (ORS 530.115).
- **Jackson County.** Since Jackson County does not contain BOFL, the county does not receive any BOFL payments from timber harvests (Oregon Department of Forestry 2020b).
- **Josephine County.** In line with ORS 530.115, Josephine County distributes 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (Arce pers. comm.).
- **Lane County.** In line with ORS 530.115, Lane County distributes 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (Tintle pers. comm.).
- **Lincoln County.** In line with ORS 530.115, Lincoln County distributes 25 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to tax code 260, regardless of where the timber harvests occurred (Shearer and Welch pers. comm.).
- **Linn County.** Linn County is assumed to adhere closely to ORS 530.115 by distributing 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the

County School Fund, and the remainder to the taxing districts where the timber harvests occur (ORS 530.115).

- **Marion County.** In line with ORS 530.115, Marion County distributes 10 percent of the BOFL payments to the County General Fund, 25 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (Steele pers. comm.).
- **Multnomah County.** Since Multnomah County does not contain BOFL, the county does not receive any BOFL payments from timber harvests (Oregon Department of Forestry 2020b).
- **Polk County.** Unlike other counties that follow the statutory requirements laid out by ORS 530.115, Polk County retains 100 percent of the BOFL payments to reimburse Public Works for maintaining timber routes in the county (Hansen pers. comm.).
- **Tillamook County.** In line with ORS 530.115, Tillamook County distributes 28 percent of the BOFL revenues to the County General Fund, 23 percent of the balance to the County School Fund, and the remainder to the taxing districts where the timber harvests occur (Blanchard pers. comm.).
- **Washington County.** In line with ORS 530.115, Washington County distributes 20 percent of the BOFL revenues to the County General Fund and the Road Fund, 25 percent of the balance to the County School Fund, and the remainder to 12 taxing districts regardless of where the timber harvests occurred (Lynn pers. comm.).**Yamhill County.** Since Yamhill County does not contain BOFL, the county does not receive any BOFL payments from timber harvests (Oregon Department of Forestry 2020b).

Table 10. BOFL Revenue Distributions to Counties between 2015 and 2020

County	2016	2017	2018	2019	2020	Average Annual Payments	Average Annual Share of Total Distribution
Benton	$312,326	$1,968,994	$750,958	$1,657,137	$1,307,952	$1,199,473	2%
Clackamas	$64	$549,755	$618,091	$407,008	$707,198	$456,423	1%
Clatsop	$24,742,787	$22,917,872	$32,267,665	$19,648,613	$22,721,180	$24,459,623	35%
Columbia	$1,695,005	$1,353,273	$970,033	$2,847,908	$376,759	$1,448,596	2%
Coos	$0	$0	$54	$0	$35,878	$7,186	0.01%
Douglas	$632,281	$440,158	$791,755	$224,770	$269,661	$471,725	1%
Josephine	$2,315	$34,391	$42,279	$501,547	$4,479	$117,002	0.2%
Lane	$348,971	$3,441,408	$4,510,877	$4,858,633	$5,574,416	$3,746,861	5%
Lincoln	$1,692,088	$1,180,473	$4,081,104	$1,853,335	$1,503,690	$2,062,138	3%
Linn	$2,231,016	$4,479,228	$3,989,617	$5,862,207	$3,289,057	$3,970,225	6%
Marion	$647,555	$2,759,790	$1,145,705	$8,580,099	$539,281	$2,734,486	4%
Polk	$63	$2,342	$72,031	$22,493	$632,096	$145,805	0.2%
Tillamook	$17,728,557	$15,470,474	$17,336,819	$24,743,274	$22,230,409	$19,501,907	28%
Washington	$9,069,513	$2,720,597	$11,820,105	$14,104,040	$8,864,702	$9,315,791	13%
Total	**$59,102,541**	**$57,318,755**	**$78,397,093**	**$85,311,064**	**$68,056,758**	**$69,637,242**	**100%**

Sources: Oregon Department of Forestry 2020b, 2019b, 2018, 2017, 2016.

Forest Products Harvest Tax

Table 11 shows the total budgets of Forest Products Harvest Tax recipient and the share of agency budgets funded by the Forest Products Harvest Tax.

Table 11. Agency Budgets and Revenues from the Forest Products Harvest Tax

Agency	Forest Products Harvest Tax Revenue (FY20)	Share of Agency Budget
Oregon Forest Land Protection Fund	$1,674,393	6.79%
ODF's Private Forests Program (Forest Practices Act)[a]	$8,546,575	36.22%
OSU (Forestry Research, College of Forestry)	$3,543,000	1.34%[b]
Oregon Forest Resources Institute	$3,951,000	76.56%

Sources: Oregon Department of Forestry Emergency Fire Cost Committee 2020; Oregon State University 2020:45; Oregon Forest Resources Institute 2020; Oregon Department of Forestry 2019a:41.

[a] Half of the FY19–21 revenue reported in the ODF budget

[b] Value denotes share of government appropriations in OSU's Budget

Environmental Consequences

Timber Sale Revenue from Board of Forestry Lands

Tables 12 through 198 present timber revenue from BOFL for each of the 14 counties for the no action alternative, proposed action, and Alternatives 3 through 5. Total revenue distributions are presented by county and then broken down by taxing districts by decade. For the proposed action and Alternatives 3 through 5, percentage change in revenue from the no action alternative is also provided.

Benton County

Table 12. BOFL Revenue Distributions to Benton County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
County Administration	$2,292,001	$2,277,332	$2,701,680	$2,710,007	$2,691,302	$2,632,612	$2,366,678	$17,671,611
County School Fund	$657,002	$623,998	$1,578,779	$1,597,516	$1,555,429	$1,423,376	$825,026	$8,261,125
Taxing Districts[a]	$1,971,006	$1,871,993	$4,736,337	$4,792,549	$4,666,286	$4,270,129	$2,475,077	$24,783,376
Benton County (Total)	$4,920,009	$4,773,323	$9,016,795	$9,100,073	$8,913,016	$8,326,118	$5,666,781	$50,716,112

Source: ECONorthwest's analysis of Forest Model

[a]For further breakdown of revenue to individual taxing districts, see Table 13.

Table 13. BOFL Revenue Distributions to Taxing Districts in Benton County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Benton County District	$431,803	$413,236	$1,031,294	$1,069,277	$1,030,792	$947,857	$552,674	$5,476,934
911 Emergency Service District	$62,576	$59,885	$149,453	$154,958	$149,381	$137,362	$80,093	$793,707
Extension District	$11,125	$10,646	$26,569	$27,548	$26,557	$24,420	$14,239	$141,104
Library	$54,886	$52,526	$131,087	$135,915	$131,023	$120,481	$70,250	$696,170
Soil and Water	$6,953	$6,654	$16,606	$17,218	$16,598	$15,262	$8,899	$88,190
Linn-Benton Community College	$93,308	$89,296	$222,851	$231,059	$222,743	$204,822	$119,427	$1,183,506
Philomath SD	$1,220,596	$1,168,112	$2,915,202	$3,022,572	$2,913,784	$2,679,347	$1,562,267	$15,481,879
Linn-Benton-Lincoln ESD	$42,399	$40,576	$101,263	$104,992	$101,214	$93,070	$54,267	$537,781
Hoskins Kings Valley FD	$19,599	$0	$88,582	$430	$12,020	$0	$203	$120,833
Blodgett Summit FD	$24,692	$26,185	$40,189	$22,532	$60,265	$41,203	$4,025	$219,092

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 14. BOFL Revenue Distributions to Benton County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Benton County	$11,680,456 (137%)	$9,517,209 (99%)	$18,256,254 (102%)	$14,065,354 (55%)	$3,392,011 (-62%)	$9,259,443 (11%)	$13,954,198 (146%)	$80,124,920 (58%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 15. BOFL Revenue Distributions to Taxing Districts in Benton County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Benton County District	$1,446,636	$1,131,210	$2,413,412	$1,817,895	$209,127	$1,069,825	$1,800,080	$9,888,185
911 Emergency Service District	$209,644	$163,933	$349,747	$263,446	$30,306	$155,037	$260,864	$1,432,978
Extension District	$37,270	$29,144	$62,177	$46,835	$5,388	$27,562	$46,376	$254,752
Library	$183,881	$143,787	$306,767	$231,072	$26,582	$135,985	$228,807	$1,256,881
Soil and Water	$23,294	$18,215	$38,861	$29,272	$3,367	$17,226	$28,985	$159,220
Linn-Benton Community College	$312,602	$244,442	$521,512	$392,827	$45,190	$231,178	$388,978	$2,136,729
Philomath SD	$4,089,267	$3,197,640	$6,822,094	$5,138,722	$591,148	$3,024,119	$5,088,362	$27,951,352
Linn-Benton-Lincoln ESD	$142,045	$111,074	$236,973	$178,499	$20,534	$105,046	$176,750	$970,922
Hoskins Kings Valley FD	$91	$936	$122,452	$551	$13	$35,207	$96	$159,346
Blodgett Summit FD	$83,373	$25,623	$89,106	$35,643	$0	$93,576	$42,176	$369,497

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department

Table 16. Percentage Increase in BOFL Revenue Distributions to Benton County under Proposed Action Relative to the No Action Alternative (2023–2092)

	Time Periods							
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Benton County	235%	174%	134%	70%	-80%	13%	226%	81%
911 Emergency Service District	235%	174%	134%	70%	-80%	13%	226%	81%
Extension District	235%	174%	134%	70%	-80%	13%	226%	81%
Library	235%	174%	134%	70%	-80%	13%	226%	81%
Soil and Water	235%	174%	134%	70%	-80%	13%	226%	81%
Linn-Benton Community College	235%	174%	134%	70%	-80%	13%	226%	81%
Philomath SD	235%	174%	134%	70%	-80%	13%	226%	81%
Linn-Benton-Lincoln ESD	235%	174%	134%	70%	-80%	13%	226%	81%
Hoskins Kings Valley FD	-100%	(+)	38%	28%	-100%	(+)	-53%	32%
Blodgett Summit FD	238%	-2%	122%	58%	-100%	127%	948%	69%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 17. BOFL Revenue Distributions to Benton County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Benton County	$10,823,318 (120%)	$10,633,660 (123%)	$17,978,701 (99%)	$13,537,274 (49%)	$2,873,799 (-68%)	$10,026,010 (20%)	$14,741,568 (160%)	$80,614,328 (59%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 18. BOFL Revenue Distributions to Taxing Districts in Benton County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Benton County District	$1,317,229	$1,295,515	$2,379,268	$1,737,996	$130,669	$1,185,355	$1,914,285	$9,960,316
911 Emergency Service District	$190,890	$187,744	$344,799	$251,867	$18,936	$171,780	$277,415	$1,443,431
Extension District	$33,936	$33,377	$61,298	$44,776	$3,366	$30,539	$49,318	$256,610
Library	$167,432	$164,672	$302,427	$220,916	$16,609	$150,670	$243,323	$1,266,049
Soil and Water	$21,210	$20,860	$38,311	$27,985	$2,104	$19,087	$30,824	$160,381
Linn-Benton Community College	$284,639	$279,947	$514,134	$375,562	$28,236	$256,142	$413,656	$2,152,316
Philomath SD	$3,723,466	$3,662,087	$6,725,576	$4,912,867	$369,368	$3,350,693	$5,411,188	$28,155,246
Linn-Benton-Lincoln ESD	$129,339	$127,207	$233,621	$170,654	$12,830	$116,390	$187,964	$978,005
Hoskins Kings Valley FD	$82	$950	$122,054	$574	$0	$35,369	$109	$159,137
Blodgett Summit FD	$81,733	$46,759	$54,409	$35,369	$0	$95,721	$64,484	$378,475

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 19. Percentage Increase in BOFL Revenue Distributions to Benton County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Benton County District	205%	214%	131%	63%	-87%	25%	246%	82%
911 Emergency Service District	205%	214%	131%	63%	-87%	25%	246%	82%
Extension District	205%	214%	131%	63%	-87%	25%	246%	82%
Library	205%	214%	131%	63%	-87%	25%	246%	82%
Soil and Water	205%	214%	131%	63%	-87%	25%	246%	82%
Linn-Benton Community College	205%	214%	131%	63%	-87%	25%	246%	82%
Philomath SD	205%	214%	131%	63%	-87%	25%	246%	82%
Linn-Benton-Lincoln ESD	205%	214%	131%	63%	-87%	25%	246%	82%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Hoskins Kings Valley FD	-100%	(+)	38%	34%	-100%	(+)	-46%	32%
Blodgett Summit FD	231%	79%	35%	57%	-100%	132%	1502%	73%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 20. BOFL Revenue Distributions to Benton County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Benton County	$11,680,456 (137%)	$9,517,209 (99%)	$18,256,254 (102%)	$14,065,354 (55%)	$3,392,011 (-62%)	$56,911,284 (55%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 21. BOFL Revenue Distributions to Taxing Districts in Benton County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Benton County District	$1,446,636	$1,131,210	$2,413,412	$1,817,895	$209,127	$7,018,281
911 Emergency Service District	$209,644	$163,933	$349,747	$263,446	$30,306	$1,017,077
Extension District	$37,270	$29,144	$62,177	$46,835	$5,388	$180,814
Library	$183,881	$143,787	$306,767	$231,072	$26,582	$892,089
Soil and Water	$23,294	$18,215	$38,861	$29,272	$3,367	$113,009
Linn-Benton Community College	$312,602	$244,442	$521,512	$392,827	$45,190	$1,516,574
Philomath SD	$4,089,267	$3,197,640	$6,822,094	$5,138,722	$591,148	$19,838,871
Linn-Benton-Lincoln ESD	$142,045	$111,074	$236,973	$178,499	$20,534	$689,126

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Hoskins Kings Valley FD	$91	$936	$122,452	$551	$13	$124,043
Blodgett Summit FD	$83,373	$25,623	$89,106	$35,643	$0	$233,745

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department

Table 22. Percentage Increase in BOFL Revenue Distributions to Benton County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Benton County District	235%	174%	134%	70%	-80%	76%
911 Emergency Service District	235%	174%	134%	70%	-80%	76%
Extension District	235%	174%	134%	70%	-80%	76%
Library	235%	174%	134%	70%	-80%	76%
Soil and Water	235%	174%	134%	70%	-80%	76%
Linn-Benton Community College	235%	174%	134%	70%	-80%	76%
Philomath SD	235%	174%	134%	70%	-80%	76%
Linn-Benton-Lincoln ESD	235%	174%	134%	70%	-80%	76%
Hoskins Kings Valley FD	-100%	(+)	38%	28%	-100%	3%
Blodgett Summit FD	238%	-2%	122%	58%	-100%	34%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 23. BOFL Revenue Distributions to Benton County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Benton County	$10,524,178 (114%)	$11,594,230 (143%)	$17,185,513 (91%)	$12,553,963 (38%)	$3,772,188 (-58%)	$13,933,714 (67%)	$15,148,686 (167%)	$84,712,472 (67%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 24. BOFL Revenue Distributions to Taxing Districts in Benton County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Benton County District	$1,271,992	$1,440,626	$2,259,394	$1,589,216	$267,918	$1,762,761	$1,984,034	$10,575,942
911 Emergency Service District	$184,335	$208,773	$327,427	$230,306	$38,826	$255,456	$287,523	$1,532,646
Extension District	$32,771	$37,115	$58,209	$40,943	$6,902	$45,414	$51,115	$272,470
Library	$161,682	$183,117	$287,190	$202,004	$34,055	$224,063	$252,189	$1,344,301
Soil and Water	$20,482	$23,197	$36,381	$25,590	$4,314	$28,384	$31,947	$170,294
Linn-Benton Community College	$274,864	$311,304	$488,231	$343,412	$57,894	$380,913	$428,728	$2,285,346
Philomath SD	$3,595,593	$4,072,278	$6,386,725	$4,492,304	$757,336	$4,982,871	$5,608,354	$29,895,461
Linn-Benton-Lincoln ESD	$124,897	$141,455	$221,850	$156,045	$26,307	$173,086	$194,813	$1,038,453
Hoskins Kings Valley FD	$89	$981	$121,514	$540	$14	$38,464	$262	$161,864
Blodgett Summit FD	$81,479	$48,078	$54,538	$30,062	$0	$156,343	$26,386	$396,886

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department

Table 25. Percentage Increase in BOFL Revenue Distributions to Benton County under Alternative 5 Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Benton County District	195%	249%	119%	49%	-74%	86%	259%	93%
911 Emergency Service District	195%	249%	119%	49%	-74%	86%	259%	93%
Extension District	195%	249%	119%	49%	-74%	86%	259%	93%
Library	195%	249%	119%	49%	-74%	86%	259%	93%
Soil and Water	195%	249%	119%	49%	-74%	86%	259%	93%
Linn-Benton Community College	195%	249%	119%	49%	-74%	86%	259%	93%
Philomath SD	195%	249%	119%	49%	-74%	86%	259%	93%
Linn-Benton-Lincoln ESD	195%	249%	119%	49%	-74%	86%	259%	93%
Hoskins Kings Valley FD	-100%	(+)	37%	26%	-100%	(+)	29%	34%
Blodgett Summit FD	230%	84%	36%	33%	-100%	279%	556%	81%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Clackamas County

Table 26. BOFL Revenue Distributions to Clackamas County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
County Administration	$957,128	$1,153,260	$771,573	$941,320	$294,639	$1,308,335	$931,420	$6,357,676
County School Fund	$717,846	$864,945	$578,680	$705,990	$220,980	$981,251	$698,565	$4,768,257
Taxing Districts[a]	$2,153,538	$2,594,836	$1,736,039	$2,117,971	$662,939	$2,943,753	$2,095,694	$14,304,771
Clackamas County (Total)	$3,828,512	$4,613,042	$3,086,292	$3,765,282	$1,178,558	$5,233,339	$3,725,679	$25,430,704

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 27.

Table 27. BOFL Revenue Distributions to Taxing Districts in Clackamas County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Clackamas Community College	$156,955	$189,118	$126,527	$154,363	$48,317	$214,548	$152,739	$1,042,567
Clackamas ESD	$78,909	$95,079	$63,611	$77,606	$24,291	$107,863	$76,789	$524,148
Molalla River SD	$1,012,231	$1,219,656	$815,994	$995,514	$311,602	$1,383,658	$985,043	$6,723,698
County Extension & 4H	$10,780	$12,989	$8,690	$10,602	$3,318	$14,735	$10,490	$71,605
Molalla Aquatic	$62,523	$75,335	$50,402	$61,491	$19,247	$85,466	$60,844	$415,308
County Library	$85,161	$102,612	$68,651	$83,755	$26,216	$116,410	$82,874	$565,679
Rural Clackamas District	$634,073	$764,006	$511,148	$623,601	$195,191	$866,739	$617,042	$4,211,799
Soil Conservation	$10,780	$12,989	$8,690	$10,602	$3,318	$14,735	$10,490	$71,605
County Public Safety	$53,468	$64,425	$43,103	$52,585	$16,460	$73,088	$52,032	$355,160
Port of Portland	$15,092	$18,184	$12,166	$14,843	$4,646	$20,630	$14,686	$100,247
Urban Renewal County/County Special Projects	$8,840	$10,651	$7,126	$8,694	$2,721	$12,083	$8,602	$58,716

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Vector Control	$6,684	$8,053	$5,388	$6,573	$2,057	$9,136	$6,504	$44,395
County Emergency Radio Bond	$20,482	$24,679	$16,511	$20,144	$6,305	$27,997	$19,932	$136,049

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District

Table 28. BOFL Revenue Distributions to Clackamas County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Clackamas County	$11,043,425 (188%)	$2,092,270 (-55%)	$5,593,921 (81%)	$5,794,096 (54%)	$5,024,916 (326%)	$3,393,269 (-35%)	$3,707,477 (-0.5%)	$36,649,376 (44%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 29. BOFL Revenue Distributions to Taxing Districts in Clackamas County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clackamas Community College	$452,741	$85,776	$229,331	$237,537	$206,003	$139,112	$151,993	$1,502,492
Clackamas ESD	$227,614	$43,123	$115,295	$119,421	$103,568	$69,938	$76,414	$755,374
Molalla River SD	$2,919,804	$553,182	$1,478,993	$1,531,918	$1,328,552	$897,156	$980,231	$9,689,836
County Extension & 4H	$31,095	$5,891	$15,751	$16,314	$14,149	$9,554	$10,439	$103,193
Molalla Aquatic	$180,350	$34,169	$91,354	$94,623	$82,062	$55,415	$60,547	$598,520
County Library	$245,649	$46,540	$124,431	$128,883	$111,774	$75,480	$82,469	$815,226
Rural Clackamas District	$1,828,997	$346,519	$926,458	$959,611	$832,220	$561,989	$614,027	$6,069,821
Soil Conservation	$31,095	$5,891	$15,751	$16,314	$14,149	$9,554	$10,439	$103,193
County Public Safety	$154,230	$29,220	$78,124	$80,919	$70,177	$47,390	$51,778	$511,838

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Port of Portland	$43,533	$8,248	$22,051	$22,840	$19,808	$13,376	$14,615	$144,470
Urban Renewal County/County Special Projects	$25,498	$4,831	$12,916	$13,378	$11,602	$7,835	$8,560	$84,618
Vector Control	$19,279	$3,653	$9,765	$10,115	$8,772	$5,924	$6,472	$63,980
County Emergency Radio Bond	$59,080	$11,193	$29,926	$30,997	$26,882	$18,153	$19,834	$196,067

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 30. Percentage Increase in BOFL Revenue Distributions in Clackamas County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clackamas Community College	188%	-55%	81%	54%	326%	-35%	0%	44%
Clackamas ESD	188%	-55%	81%	54%	326%	-35%	0%	44%
Molalla River SD	188%	-55%	81%	54%	326%	-35%	0%	44%
County Extension & 4H	188%	-55%	81%	54%	326%	-35%	0%	44%
Molalla Aquatic	188%	-55%	81%	54%	326%	-35%	0%	44%
County Library	188%	-55%	81%	54%	326%	-35%	0%	44%
Rural Clackamas District	188%	-55%	81%	54%	326%	-35%	0%	44%
Soil Conservation	188%	-55%	81%	54%	326%	-35%	0%	44%
County Public Safety	188%	-55%	81%	54%	326%	-35%	0%	44%
Port of Portland	188%	-55%	81%	54%	326%	-35%	0%	44%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Urban Renewal County/County Special Projects	188%	-55%	81%	54%	326%	-35%	0%	44%
Vector Control	188%	-55%	81%	54%	326%	-35%	0%	44%
County Emergency Radio Bond	188%	-55%	81%	54%	326%	-35%	0%	44%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Table 31. BOFL Revenue Distributions to Clackamas County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clackamas County	$11,199,834 (193%)	$1,935,556 (-58%)	$5,461,574 (77%)	$4,924,034 (31%)	$5,971,164 (407%)	$3,526,939 (-33%)	$3,435,723 (-8%)	$36,454,824 (43%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 32. BOFL Revenue Distributions to Taxing Districts in Clackamas County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clackamas Community College	$459,153	$79,351	$223,905	$201,868	$244,796	$144,592	$140,852	$1,494,516
Clackamas ESD	$230,838	$39,893	$112,568	$101,488	$123,071	$72,693	$70,813	$751,364
Molalla River SD	$2,961,157	$511,747	$1,444,002	$1,301,880	$1,578,734	$932,498	$908,381	$9,638,398
County Extension & 4H	$31,535	$5,450	$15,378	$13,865	$16,813	$9,931	$9,674	$102,645
Molalla Aquatic	$182,904	$31,610	$89,193	$80,414	$97,515	$57,598	$56,109	$595,343
County Library	$249,128	$43,054	$121,487	$109,530	$132,822	$78,453	$76,424	$810,898

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Rural Clackamas District	$1,854,902	$320,564	$904,539	$815,512	$988,936	$584,127	$569,020	$6,037,599
Soil Conservation	$31,535	$5,450	$15,378	$13,865	$16,813	$9,931	$9,674	$102,645
County Public Safety	$156,415	$27,032	$76,275	$68,768	$83,392	$49,257	$47,983	$509,121
Port of Portland	$44,149	$7,630	$21,529	$19,410	$23,538	$13,903	$13,543	$143,703
Urban Renewal County/County Special Projects	$25,859	$4,469	$12,610	$11,369	$13,787	$8,143	$7,933	$84,169
Vector Control	$19,552	$3,379	$9,534	$8,596	$10,424	$6,157	$5,998	$63,640
County Emergency Radio Bond	$59,917	$10,355	$29,218	$26,343	$31,945	$18,868	$18,380	$195,026

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 33. Percentage Increase in BOFL Revenue Distributions in Clackamas County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clackamas Community College	193%	-58%	77%	31%	407%	-33%	-8%	43%
Clackamas ESD	193%	-58%	77%	31%	407%	-33%	-8%	43%
Molalla River SD	193%	-58%	77%	31%	407%	-33%	-8%	43%
County Extension & 4H	193%	-58%	77%	31%	407%	-33%	-8%	43%
Molalla Aquatic	193%	-58%	77%	31%	407%	-33%	-8%	43%
County Library	193%	-58%	77%	31%	407%	-33%	-8%	43%
Rural Clackamas District	193%	-58%	77%	31%	407%	-33%	-8%	43%
Soil Conservation	193%	-58%	77%	31%	407%	-33%	-8%	43%
County Public Safety	193%	-58%	77%	31%	407%	-33%	-8%	43%
Port of Portland	193%	-58%	77%	31%	407%	-33%	-8%	43%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Urban Renewal County/ County Special Projects	193%	-58%	77%	31%	407%	-33%	-8%	43%
Vector Control	193%	-58%	77%	31%	407%	-33%	-8%	43%
County Emergency Radio Bond	193%	-58%	77%	31%	407%	-33%	-8%	43%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District
- sign indicates decrease in revenue relative to the no action alternative

Table 34. BOFL Revenue Distributions to Clackamas County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Clackamas County	$11,043,425 (188%)	$2,092,270 (-55%)	$5,593,921 (81%)	$5,794,096 (54%)	$5,024,916 (326%)	$29,548,630 (79%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 35. BOFL Revenue Distributions to Taxing Districts in Clackamas County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Clackamas Community College	$452,741	$85,776	$229,331	$237,537	$206,003	$1,211,387
Clackamas ESD	$227,614	$43,123	$115,295	$119,421	$103,568	$609,022
Molalla River SD	$2,919,804	$553,182	$1,478,993	$1,531,918	$1,328,552	$7,812,449
County Extension & 4H	$31,095	$5,891	$15,751	$16,314	$14,149	$83,200
Molalla Aquatic	$180,350	$34,169	$91,354	$94,623	$82,062	$482,558
County Library	$245,649	$46,540	$124,431	$128,883	$111,774	$657,277
Rural Clackamas District	$1,828,997	$346,519	$926,458	$959,611	$832,220	$4,893,805
Soil Conservation	$31,095	$5,891	$15,751	$16,314	$14,149	$83,200

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
County Public Safety	$154,230	$29,220	$78,124	$80,919	$70,177	$412,670
Port of Portland	$43,533	$8,248	$22,051	$22,840	$19,808	$116,480
Urban Renewal County/County Special Projects	$25,498	$4,831	$12,916	$13,378	$11,602	$68,224
Vector Control	$19,279	$3,653	$9,765	$10,115	$8,772	$51,584
County Emergency Radio Bond	$59,080	$11,193	$29,926	$30,997	$26,882	$158,079

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District

Table 36. Percentage Increase in BOFL Revenue Distributions in Clackamas County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Clackamas Community College	188%	-55%	81%	54%	326%	79%
Clackamas ESD	188%	-55%	81%	54%	326%	79%
Molalla River SD	188%	-55%	81%	54%	326%	79%
County Extension & 4H	188%	-55%	81%	54%	326%	79%
Molalla Aquatic	188%	-55%	81%	54%	326%	79%
County Library	188%	-55%	81%	54%	326%	79%
Rural Clackamas District	188%	-55%	81%	54%	326%	79%
Soil Conservation	188%	-55%	81%	54%	326%	79%
County Public Safety	188%	-55%	81%	54%	326%	79%
Port of Portland	188%	-55%	81%	54%	326%	79%
Urban Renewal County/County Special Projects	188%	-55%	81%	54%	326%	79%
Vector Control	188%	-55%	81%	54%	326%	79%
County Emergency Radio Bond	188%	-55%	81%	54%	326%	79%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District
- sign indicates decrease in revenue relative to the no action alternative

Table 37. BOFL Revenue Distributions to Clackamas County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Clackamas County	$9,733,949 (154%)	$4,681,485 (1%)	$6,360,516 (106%)	$4,100,418 (9%)	$3,831,050 (225%)	$2,973,322 (-43%)	$5,352,869 (44%)	$37,033,608 (46%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 38. BOFL Revenue Distributions to Taxing Districts in Clackamas County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Clackamas Community College	$399,057	$191,924	$260,758	$168,102	$157,059	$121,895	$219,448	$1,518,244
Clackamas ESD	$200,625	$96,489	$131,095	$84,513	$78,961	$61,283	$110,327	$763,293
Molalla River SD	$2,573,587	$1,237,752	$1,681,675	$1,084,121	$1,012,903	$786,125	$1,415,261	$9,791,424
County Extension & 4H	$27,408	$13,182	$17,909	$11,545	$10,787	$8,372	$15,072	$104,275
Molalla Aquatic	$158,965	$76,453	$103,873	$66,964	$62,565	$48,557	$87,418	$604,795
County Library	$216,521	$104,135	$141,483	$91,209	$85,218	$66,138	$119,069	$823,773
Rural Clackamas District	$1,612,124	$775,341	$1,053,420	$679,106	$634,493	$492,438	$886,535	$6,133,457
Soil Conservation	$27,408	$13,182	$17,909	$11,545	$10,787	$8,372	$15,072	$104,275
County Public Safety	$135,942	$65,381	$88,830	$57,266	$53,504	$41,525	$74,757	$517,204
Port of Portland	$38,371	$18,454	$25,073	$16,164	$15,102	$11,721	$21,101	$145,985
Urban Renewal County/County Special Projects	$22,474	$10,809	$14,686	$9,467	$8,845	$6,865	$12,359	$85,506
Vector Control	$16,993	$8,173	$11,104	$7,158	$6,688	$5,191	$9,345	$64,651
County Emergency Radio Bond	$52,075	$25,045	$34,028	$21,936	$20,495	$15,907	$28,637	$198,123

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District

Table 39. Percentage Increase in BOFL Revenue Distributions in Clackamas County under Alternative 5 Relative to the No Action Alternative (2023–2092)

	Time Periods							
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**Total (70 Years)**
Clackamas Community College	154%	1%	106%	9%	225%	-43%	44%	46%
Clackamas ESD	154%	1%	106%	9%	225%	-43%	44%	46%
Molalla River SD	154%	1%	106%	9%	225%	-43%	44%	46%
County Extension & 4H	154%	1%	106%	9%	225%	-43%	44%	46%
Molalla Aquatic	154%	1%	106%	9%	225%	-43%	44%	46%
County Library	154%	1%	106%	9%	225%	-43%	44%	46%
Rural Clackamas District	154%	1%	106%	9%	225%	-43%	44%	46%
Soil Conservation	154%	1%	106%	9%	225%	-43%	44%	46%
County Public Safety	154%	1%	106%	9%	225%	-43%	44%	46%
Port of Portland	154%	1%	106%	9%	225%	-43%	44%	46%
Urban Renewal County/County Special Projects	154%	1%	106%	9%	225%	-43%	44%	46%
Vector Control	154%	1%	106%	9%	225%	-43%	44%	46%
County Emergency Radio Bond	154%	1%	106%	9%	225%	-43%	44%	46%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Clatsop County

Table 40. BOFL Revenue Distributions to Clatsop County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
County Administration	$13,696,137	$10,483,361	$11,527,772	$11,233,827	$10,853,967	$10,700,242	$10,785,331	$79,280,636
County School Fund	$27,703,551	$21,204,980	$23,317,539	$22,722,968	$21,954,616	$21,643,672	$21,815,782	$160,363,105
Taxing Districts[a]	$83,110,652	$63,614,939	$69,952,618	$68,168,905	$65,863,847	$64,931,016	$65,447,347	$481,089,315
Clatsop County (Total)	$124,510,340	$95,303,280	$104,797,930	$102,125,700	$98,672,430	$97,274,930	$98,048,460	$720,733,056

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 41.

Table 41. BOFL Revenue Distributions to Taxing Districts in Clatsop County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Astoria	$28,213	$109,812	$186,994	$69,326	$0	$102,842	$179,568	$676,755
Astoria U/R Astoria East	$698	$2,715	$4,623	$1,714	$0	$2,543	$4,440	$16,733
Astoria U/R Astoria West	$1,646	$6,405	$10,907	$4,044	$0	$5,999	$10,474	$39,474
4H & Extension Service	$445,478	$329,274	$358,003	$349,070	$346,660	$334,678	$326,274	$2,489,436
4H & Extension Service Astoria East	$4	$17	$30	$11	$0	$16	$29	$108
4H & Extension Service Astoria West	$10	$41	$69	$26	$0	$38	$67	$251
Clatsop County District	$14,872,682	$10,993,281	$11,952,592	$11,654,125	$11,573,500	$11,173,697	$10,893,290	$83,113,168

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clatsop County U/R Astoria East	$131	$509	$867	$322	$0	$477	$833	$3,139
Clatsop County U/R Astoria West	$309	$1,202	$2,047	$759	$0	$1,126	$1,965	$7,407
Port Astoria	$1,047,790	$774,470	$842,042	$821,033	$815,364	$787,181	$767,414	$5,855,295
Port Astoria U/R Astoria East	$10	$41	$69	$26	$0	$38	$67	$251
Port Astoria U/R Astoria West	$25	$97	$166	$62	$0	$91	$159	$601
Care Center	$3,344,837	$2,417,479	$2,601,150	$2,597,807	$2,602,323	$2,507,549	$2,324,816	$18,395,961
Care Center U/R Astoria East	$15	$58	$99	$37	$0	$55	$95	$359
Care Center U/R Astoria West	$35	$137	$233	$86	$0	$128	$224	$843
Community College	$7,757,527	$5,734,069	$6,234,458	$6,078,752	$6,036,683	$5,828,171	$5,681,929	$43,351,589
Community College U/R Astoria East	$66	$258	$439	$163	$0	$241	$421	$1,587
Community College U/R Astoria West	$157	$610	$1,038	$385	$0	$571	$997	$3,757
New ESD	$1,283,043	$948,354	$1,031,097	$1,005,373	$998,432	$963,920	$939,714	$7,169,933
New ESD U/R Astoria East	$13	$51	$87	$32	$0	$48	$83	$314
New ESD U/R Astoria West	$31	$119	$203	$75	$0	$112	$195	$735
SD 1	$4,175,422	$5,466,867	$8,239,076	$9,376,447	$6,330,848	$5,097,122	$8,240,919	$46,926,701
SD 1 U/R Astoria East	$422	$1,641	$2,795	$1,036	$0	$1,537	$2,684	$10,115
SD 1 U/R Astoria West	$995	$3,872	$6,593	$2,444	$0	$3,626	$6,331	$23,862

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Sunset Transportation	$1,351,449	$998,917	$1,086,072	$1,058,976	$1,051,664	$1,015,313	$989,816	$7,552,207
Sunset Transportation U/R Astoria East	$13	$52	$89	$33	$0	$49	$86	$323
Sunset Transportation U/R Astoria West	$33	$127	$216	$80	$0	$119	$207	$780
Rural Law	$5,999,785	$4,426,875	$4,807,160	$4,697,183	$4,670,817	$4,500,308	$4,380,309	$33,482,436
Road District #1	$8,484,755	$6,260,383	$6,798,172	$6,642,645	$6,605,360	$6,364,229	$6,194,530	$47,350,075
Knappa-Svensen-Burnside RFD	$541,793	$537,686	$799,117	$525,485	$388,573	$756,321	$912,340	$4,461,315
John Day RFD	$22,187	$24,586	$120,486	$40,901	$25,417	$21,487	$3,706	$258,769
Lewis & Clark RFD	$0	$0	$7,770	$0	$0	$0	$9,544	$17,315
Olney Walluski RFD	$31,537	$112,379	$144,843	$245,330	$158,461	$90,643	$156,193	$939,386
Knappa SD	$2,346,535	$2,326,887	$2,640,273	$1,518,448	$1,165,060	$3,419,120	$3,258,296	$16,674,619
Elsie-Vinemaple RFD	$117,050	$308,443	$245,095	$75,267	$270,507	$403,126	$250,877	$1,670,364
Jewell SD	$24,135,187	$16,151,698	$16,986,423	$16,327,144	$18,126,816	$16,135,033	$13,633,750	$121,496,050
Clatskanie SD	$402,193	$854,407	$910,334	$588,569	$614,246	$959,135	$968,263	$5,297,147
Westport-Wauna RFD	$63,438	$22,462	$0	$30,805	$98,253	$17,893	$0	$232,851
Mist-Birkenfeld RFD	$11,070	$197,046	$30,898	$31,675	$0	$147,638	$32,895	$451,223
Sunset Park	$169,352	$243,419	$349,791	$217,409	$135,125	$118,445	$460,045	$1,693,586
Union Health	$13,597	$26,796	$37,472	$17,732	$10,731	$11,900	$48,090	$166,319
SD 10	$1,151,921	$1,647,249	$2,367,084	$1,471,239	$914,408	$801,533	$3,113,185	$11,466,620
Cannon Beach RFD	$919	$0	$0	$1	$0	$0	$0	$920
Hamlet RFD	$38,962	$72,533	$72,338	$5,974	$102,585	$55,280	$90,866	$438,538

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Warrenton Hammond SD	$5,360,581	$2,681,691	$1,150,324	$2,783,084	$2,887,842	$3,373,160	$1,633,444	$19,870,127

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

Table 42. BOFL Revenue Distributions to Clatsop County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clatsop County	$180,028,040 (45%)	$120,163,900 (26%)	$74,149,620 (-29%)	$99,926,020 (-2%)	$158,868,260 (61%)	$121,643,750 (25%)	$81,609,835 (-17%)	$836,389,504 (16%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 43. BOFL Revenue Distributions to Taxing Districts in Clatsop County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Astoria	$117,521	$130,350	$344,789	$117,585	$211,922	$70,680	$189,030	$1,181,878
Astoria U/R Astoria East	$2,906	$3,223	$8,525	$2,907	$5,240	$1,748	$4,674	$29,222
Astoria U/R Astoria West	$6,855	$7,603	$20,111	$6,858	$12,361	$4,123	$11,026	$68,936
4H & Extension Service	$633,837	$417,668	$252,135	$342,175	$535,920	$418,608	$281,139	$2,881,483
4H & Extension Service Astoria East	$19	$21	$55	$19	$34	$11	$30	$188
4H & Extension Service Astoria West	$44	$48	$128	$44	$79	$26	$70	$438
Clatsop County District	$21,161,374	$13,944,452	$8,418,438	$11,424,039	$17,892,552	$13,975,709	$9,386,442	$96,203,006

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Clatsop County U/R Astoria East	$545	$605	$1,599	$545	$983	$328	$877	$5,481
Clatsop County U/R Astoria West	$1,286	$1,427	$3,774	$1,287	$2,319	$774	$2,069	$12,935
Port Astoria	$1,490,820	$982,379	$593,032	$804,816	$1,260,514	$984,591	$661,254	$6,777,405
Port Astoria U/R Astoria East	$44	$48	$128	$44	$79	$26	$70	$438
Port Astoria U/R Astoria West	$104	$116	$306	$104	$188	$63	$168	$1,049
Care Center	$4,715,713	$3,094,876	$1,769,841	$2,513,881	$3,981,366	$3,117,986	$2,004,578	$21,198,241
Care Center U/R Astoria East	$62	$69	$183	$62	$112	$37	$100	$626
Care Center U/R Astoria West	$146	$162	$429	$146	$264	$88	$235	$1,472
Community College	$11,037,699	$7,273,390	$4,391,097	$5,958,751	$9,332,719	$7,289,680	$4,895,967	$50,179,303
Community College U/R Astoria East	$276	$306	$809	$276	$497	$166	$443	$2,772
Community College U/R Astoria West	$652	$724	$1,914	$653	$1,177	$392	$1,049	$6,562
New ESD	$1,825,542	$1,202,944	$726,177	$985,514	$1,543,525	$1,205,653	$809,718	$8,299,073
New ESD U/R Astoria East	$55	$60	$160	$55	$98	$33	$88	$548
New ESD U/R Astoria West	$128	$142	$375	$128	$230	$77	$205	$1,284
SD 1	$8,666,538	$5,848,728	$4,359,203	$7,666,641	$13,574,536	$7,236,898	$3,996,140	$51,348,684
SD 1 U/R Astoria East	$1,757	$1,948	$5,153	$1,757	$3,167	$1,056	$2,825	$17,665
SD 1 U/R Astoria West	$4,144	$4,596	$12,157	$4,146	$7,472	$2,492	$6,665	$41,672

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Sunset Transportation	$1,922,873	$1,267,081	$764,895	$1,038,058	$1,625,820	$1,269,934	$852,890	$8,741,551
Sunset Transportation U/R Astoria East	$56	$62	$164	$56	$101	$34	$90	$564
Sunset Transportation U/R Astoria West	$135	$150	$397	$136	$244	$81	$218	$1,362
Rural Law	$8,529,813	$5,616,076	$3,366,799	$4,600,027	$7,202,181	$5,634,004	$3,771,335	$38,720,235
Road District #1	$12,062,662	$7,942,122	$4,761,248	$6,505,251	$10,185,155	$7,967,476	$5,333,334	$54,757,247
Knappa-Svensen-Burnside RFD	$1,096,601	$1,087,747	$514,315	$748,522	$1,150,969	$1,213,846	$482,790	$6,294,791
John Day RFD	$135,600	$52,346	$10,439	$15,036	$139,055	$118,514	$0	$470,990
Lewis & Clark RFD	$0	$0	$0	$13,975	$0	$0	$0	$13,975
Olney Walluski RFD	$128,891	$95,528	$69,539	$137,511	$635,035	$125,491	$40,889	$1,232,884
Knappa SD	$4,310,683	$5,002,510	$2,298,788	$3,312,866	$4,800,789	$5,415,158	$2,165,481	$27,306,274
Elsie-Vinemaple RFD	$92,687	$200,630	$27,666	$474,708	$324,837	$158,801	$78	$1,279,407
Jewell SD	$32,990,684	$20,947,419	$11,618,875	$16,679,865	$24,565,876	$20,245,601	$13,293,098	$140,341,418
Clatskanie SD	$439,225	$321,458	$437,395	$132,917	$206,221	$336,657	$419,844	$2,293,717
Westport-Wauna RFD	$0	$0	$0	$0	$0	$0	$0	$0
Mist-Birkenfeld RFD	$132,860	$38,152	$72,556	$35,095	$74,818	$33,043	$58,124	$444,649
Sunset Park	$306,268	$242,929	$421,821	$238,210	$319,477	$178,369	$350,548	$2,057,623
Union Health	$32,602	$25,339	$45,428	$27,338	$29,424	$20,444	$41,046	$221,621
SD 10	$2,077,882	$1,643,933	$2,854,520	$1,612,001	$2,161,945	$1,207,047	$2,372,205	$13,929,532
Cannon Beach RFD	$830	$0	$0	$0	$0	$0	$0	$830
Hamlet RFD	$110,635	$127,917	$143,087	$106,327	$117,208	$107,051	$148,025	$860,251

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Warrenton Hammond SD	$6,262,025	$2,770,480	$1,230,897	$1,261,796	$4,254,367	$2,939,658	$2,949,644	$21,668,868

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

Table 44. Percentage Increase in BOFL Revenue Distributions in Clatsop County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Astoria	317%	19%	84%	70%	(+)	-31%	5%	75%
Astoria U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Astoria U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
4H & Extension Service	42%	27%	-30%	-2%	55%	25%	-14%	16%
4H & Extension Service Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
4H & Extension Service Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Clatsop County District	42%	27%	-30%	-2%	55%	25%	-14%	16%
Clatsop County U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Clatsop County U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Port Astoria	42%	27%	-30%	-2%	55%	25%	-14%	16%
Port Astoria U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Port Astoria U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Care Center	41%	28%	-32%	-3%	53%	24%	-14%	15%
Care Center U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Care Center U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Community College	42%	27%	-30%	-2%	55%	25%	-14%	16%
Community College U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Community College U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
New ESD	42%	27%	-30%	-2%	55%	25%	-14%	16%
New ESD U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
New ESD U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
SD 1	108%	7%	-47%	-18%	114%	42%	-52%	9%
SD 1 U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
SD 1 U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Sunset Transportation	42%	27%	-30%	-2%	55%	25%	-14%	16%
Sunset Transportation U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Sunset Transportation U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Rural Law	42%	27%	-30%	-2%	54%	25%	-14%	16%
Road District #1	42%	27%	-30%	-2%	54%	25%	-14%	16%
Knappa-Svensen-Burnside RFD	102%	102%	-36%	42%	196%	60%	-47%	41%
John Day RFD	511%	113%	-91%	-63%	447%	452%	-100%	82%
Lewis & Clark RFD	0%	0%	-100%	(+)	0%	0%	-100%	-19%
Olney Walluski RFD	309%	-15%	-52%	-44%	301%	38%	-74%	31%
Knappa SD	84%	115%	-13%	118%	312%	58%	-34%	64%
Elsie-Vinemaple RFD	-21%	-35%	-89%	531%	20%	-61%	-100%	-23%
Jewell SD	37%	30%	-32%	2%	36%	25%	-2%	16%
Clatskanie SD	9%	-62%	-52%	-77%	-66%	-65%	-57%	-57%
Westport-Wauna RFD	-100%	-100%	0%	-100%	-100%	-100%	0.00%	-100%
Mist-Birkenfeld RFD	1100%	-81%	135%	11%	(+)	-78%	77%	-1%
Sunset Park	81%	0%	21%	10%	136%	51%	-24%	21%
Union Health	140%	-5%	21%	54%	174%	72%	-15%	33%
SD 10	80%	0%	21%	10%	136%	51%	-24%	21%
Cannon Beach RFD	-10%	0%	0%	-100%	0%	0%	0%	-10%
Hamlet RFD	184%	76%	98%	1680%	14%	94%	63%	96%
Warrenton Hammond SD	17%	3%	7%	-55%	47%	-13%	81%	9%

Source: ECONorthwest's analysis of Forest Model
RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 45. BOFL Revenue Distributions to Clatsop County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Clatsop County	$179,583,300 (44%)	$119,514,790 (25%)	$73,552,990 (-30%)	$99,039,560 (-3%)	$160,240,570 (62%)	$123,412,380 (27%)	$79,319,025 (-19%)	$834,662,592 (16%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 46. BOFL Revenue Distributions to Taxing Districts in Clatsop County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Astoria	$117,414	$128,215	$341,650	$117,453	$211,793	$69,699	$187,471	$1,173,694
Astoria U/R Astoria East	$2,903	$3,170	$8,447	$2,904	$5,237	$1,723	$4,635	$29,020
Astoria U/R Astoria West	$6,849	$7,479	$19,928	$6,851	$12,353	$4,065	$10,935	$68,459
4H & Extension Service	$633,316	$414,243	$250,162	$339,822	$539,713	$425,168	$273,378	$2,875,801
4H & Extension Service Astoria East	$19	$20	$54	$19	$34	$11	$30	$187
4H & Extension Service Astoria West	$44	$48	$127	$44	$79	$26	$70	$435
Clatsop County District	$21,143,989	$13,830,075	$8,352,578	$11,345,451	$18,019,180	$14,194,721	$9,127,320	$96,013,315
Clatsop County U/R Astoria East	$545	$595	$1,584	$545	$982	$323	$869	$5,443
Clatsop County U/R Astoria West	$1,285	$1,403	$3,739	$1,285	$2,318	$763	$2,052	$12,846
Port Astoria	$1,489,596	$974,322	$588,392	$799,279	$1,269,435	$1,000,021	$642,998	$6,764,043
Port Astoria U/R Astoria East	$44	$48	$127	$44	$79	$26	$70	$435

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Port Astoria U/R Astoria West	$104	$114	$303	$104	$188	$62	$166	$1,042
Care Center	$4,714,788	$3,069,850	$1,752,227	$2,502,165	$4,009,562	$3,165,358	$1,942,449	$21,156,398
Care Center U/R Astoria East	$62	$68	$181	$62	$112	$37	$99	$622
Care Center U/R Astoria West	$146	$160	$426	$146	$264	$87	$233	$1,462
Community College	$11,028,631	$7,213,731	$4,356,744	$5,917,761	$9,398,768	$7,403,915	$4,760,810	$50,080,360
Community College U/R Astoria East	$275	$301	$801	$275	$497	$163	$440	$2,753
Community College U/R Astoria West	$652	$712	$1,897	$652	$1,176	$387	$1,041	$6,516
New ESD	$1,824,042	$1,193,077	$720,496	$978,734	$1,554,449	$1,224,547	$787,364	$8,282,711
New ESD U/R Astoria East	$54	$59	$158	$54	$98	$32	$87	$544
New ESD U/R Astoria West	$128	$139	$371	$128	$230	$76	$204	$1,275
SD 1	$8,437,867	$6,154,683	$4,260,875	$7,454,889	$14,035,322	$7,191,485	$3,858,451	$51,393,573
SD 1 U/R Astoria East	$1,755	$1,916	$5,106	$1,755	$3,166	$1,042	$2,802	$17,542
SD 1 U/R Astoria West	$4,140	$4,521	$12,046	$4,141	$7,468	$2,458	$6,610	$41,383
Sunset Transportation	$1,921,293	$1,256,688	$758,912	$1,030,917	$1,637,327	$1,289,835	$829,344	$8,724,316
Sunset Transportation U/R Astoria East	$56	$61	$163	$56	$101	$33	$89	$560
Sunset Transportation U/R Astoria West	$135	$148	$394	$135	$244	$80	$216	$1,353

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Rural Law	$8,522,807	$5,570,106	$3,340,499	$4,568,323	$7,253,297	$5,722,480	$3,666,898	$38,644,409
Road District #1	$12,052,754	$7,877,112	$4,724,056	$6,460,415	$10,257,442	$8,092,596	$5,185,641	$54,650,016
Knappa-Svensen-Burnside RFD	$1,082,928	$1,089,986	$511,088	$729,824	$1,149,006	$1,209,182	$445,003	$6,217,016
John Day RFD	$140,324	$52,067	$10,430	$14,901	$168,078	$93,227	$0	$479,027
Lewis & Clark RFD	$0	$0	$0	$13,975	$0	$0	$0	$13,975
Olney Walluski RFD	$129,708	$94,885	$67,550	$131,512	$634,492	$127,982	$56,916	$1,243,045
Knappa SD	$4,240,161	$5,061,264	$2,284,112	$3,215,892	$4,736,944	$5,483,940	$2,048,000	$27,070,313
Elsie-Vinemaple RFD	$79,921	$200,624	$27,646	$471,497	$327,033	$153,157	$77	$1,259,956
Jewell SD	$33,161,035	$20,548,317	$11,567,533	$16,678,689	$24,624,650	$20,584,268	$12,944,560	$140,109,051
Clatskanie SD	$427,921	$365,055	$370,720	$132,917	$200,657	$385,226	$389,937	$2,272,432
Westport-Wauna RFD	$0	$0	$0	$0	$0	$0	$0	$0
Mist-Birkenfeld RFD	$134,655	$47,838	$75,526	$35,031	$75,789	$48,364	$45,879	$463,081
Sunset Park	$300,292	$240,159	$427,349	$223,974	$325,689	$179,968	$363,426	$2,060,856
Union Health	$31,679	$25,021	$46,219	$25,454	$29,625	$21,216	$41,981	$221,195
SD 10	$2,037,205	$1,625,188	$2,891,924	$1,515,663	$2,203,984	$1,217,867	$2,459,351	$13,951,183
Cannon Beach RFD	$794	$0	$0	$0	$0	$0	$0	$794
Hamlet RFD	$107,361	$126,568	$150,594	$93,737	$128,123	$105,960	$138,788	$851,132
Warrenton Hammond SD	$6,223,866	$2,683,966	$1,216,814	$1,362,288	$4,250,046	$3,062,729	$2,775,732	$21,575,441

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

Table 47. Percentage Increase in BOFL Revenue Distributions in Clatsop County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Astoria	316%	17%	83%	69%	(+)	-32%	4%	73%
Astoria U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Astoria U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
4H & Extension Service	42%	26%	-30%	-3%	56%	27%	-16%	16%
4H & Extension Service Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
4H & Extension Service Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
Clatsop County District	42%	26%	-30%	-3%	56%	27%	-16%	16%
Clatsop County U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Clatsop County U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
Port Astoria	42%	26%	-30%	-3%	56%	27%	-16%	16%
Port Astoria U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Port Astoria U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
Care Center	41%	27%	-33%	-4%	54%	26%	-16%	15%
Care Center U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Care Center U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Community College	42%	26%	-30%	-3%	56%	27%	-16%	16%
Community College U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Community College U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
New ESD	42%	26%	-30%	-3%	56%	27%	-16%	16%
New ESD U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
New ESD U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
SD 1	102%	13%	-48%	-20%	122%	41%	-53%	10%
SD 1 U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
SD 1 U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
Sunset Transportation	42%	26%	-30%	-3%	56%	27%	-16%	16%
Sunset Transportation U/R Astoria East	316%	17%	83%	69%	(+)	-32%	4%	73%
Sunset Transportation U/R Astoria West	316%	17%	83%	69%	(+)	-32%	4%	73%
Rural Law	42%	26%	-31%	-3%	55%	27%	-16%	15%
Road District #1	42%	26%	-31%	-3%	55%	27%	-16%	15%
Knappa-Svensen-Burnside RFD	100%	103%	-36%	39%	196%	60%	-51%	39%
John Day RFD	532%	112%	-91%	-64%	561%	334%	-100%	85%
Lewis & Clark RFD	0%	0%	-100%	(+)	0%	0%	-100%	-19%
Olney Walluski RFD	311%	-16%	-53%	-46%	300%	41%	-64%	32%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Knappa SD	81%	118%	-13%	112%	307%	60%	-37%	62%
Elsie-Vinemaple RFD	-32%	-35%	-89%	526%	21%	-62%	-100%	-25%
Jewell SD	37%	27%	-32%	2%	36%	28%	-5%	15%
Clatskanie SD	6%	-57%	-59%	-77%	-67%	-60%	-60%	-57%
Westport-Wauna RFD	-100%	-100%	0%	-100%	-100%	-100%	0%	-100%
Mist-Birkenfeld RFD	1116%	-76%	144%	11%	(+)	-67%	39%	3%
Sunset Park	77%	-1%	22%	3%	141%	52%	-21%	22%
Union Health	133%	-7%	23%	44%	176%	78%	-13%	33%
SD 10	77%	-1%	22%	3%	141%	52%	-21%	22%
Cannon Beach RFD	-14%	0%	0%	-100%	0%	0%	0%	-14%
Hamlet RFD	176%	74%	108%	1469%	25%	92%	53%	94%
Warrenton Hammond SD	16%	0%	6%	-51%	47%	-9%	70%	9%

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 48. BOFL Revenue Distributions to Clatsop County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Clatsop County	$180,028,040 (45%)	$120,163,900 (26%)	$74,149,620 (-29%)	$99,926,020 (-2%)	$158,868,260 (61%)	$633,135,872 (21%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 49. BOFL Revenue Distributions to Taxing Districts in Clatsop County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	(50 Years)
Astoria	$117,521	$130,350	$344,789	$117,585	$211,922	$922,168
Astoria U/R Astoria East	$2,906	$3,223	$8,525	$2,907	$5,240	$22,801
Astoria U/R Astoria West	$6,855	$7,603	$20,111	$6,858	$12,361	$53,788
4H & Extension Service	$633,837	$417,668	$252,135	$342,175	$535,920	$2,181,735
4H & Extension Service Astoria East	$19	$21	$55	$19	$34	$147
4H & Extension Service Astoria West	$44	$48	$128	$44	$79	$342
Clatsop County District	$21,161,374	$13,944,452	$8,418,438	$11,424,039	$17,892,552	$72,840,855
Clatsop County U/R Astoria East	$545	$605	$1,599	$545	$983	$4,277
Clatsop County U/R Astoria West	$1,286	$1,427	$3,774	$1,287	$2,319	$10,093
Port Astoria	$1,490,820	$982,379	$593,032	$804,816	$1,260,514	$5,131,561
Port Astoria U/R Astoria East	$44	$48	$128	$44	$79	$342
Port Astoria U/R Astoria West	$104	$116	$306	$104	$188	$819
Care Center	$4,715,713	$3,094,876	$1,769,841	$2,513,881	$3,981,366	$16,075,677
Care Center U/R Astoria East	$62	$69	$183	$62	$112	$489
Care Center U/R Astoria West	$146	$162	$429	$146	$264	$1,149
Community College	$11,037,699	$7,273,390	$4,391,097	$5,958,751	$9,332,719	$37,993,656
Community College U/R Astoria East	$276	$306	$809	$276	$497	$2,163
Community College U/R Astoria West	$652	$724	$1,914	$653	$1,177	$5,120
New ESD	$1,825,542	$1,202,944	$726,177	$985,514	$1,543,525	$6,283,702
New ESD U/R Astoria East	$55	$60	$160	$55	$98	$428
New ESD U/R Astoria West	$128	$142	$375	$128	$230	$1,002
SD 1	$8,666,538	$5,848,728	$4,359,203	$7,666,641	$13,574,536	$40,115,646
SD 1 U/R Astoria East	$1,757	$1,948	$5,153	$1,757	$3,167	$13,783
SD 1 U/R Astoria West	$4,144	$4,596	$12,157	$4,146	$7,472	$32,515
Sunset Transportation	$1,922,873	$1,267,081	$764,895	$1,038,058	$1,625,820	$6,618,727

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Sunset Transportation U/R Astoria East	$56	$62	$164	$56	$101	$440
Sunset Transportation U/R Astoria West	$135	$150	$397	$136	$244	$1,063
Rural Law	$8,529,813	$5,616,076	$3,366,799	$4,600,027	$7,202,181	$29,314,896
Road District #1	$12,062,662	$7,942,122	$4,761,248	$6,505,251	$10,185,155	$41,456,438
Knappa-Svensen-Burnside RFD	$1,096,601	$1,087,747	$514,315	$748,522	$1,150,969	$4,598,155
John Day RFD	$135,600	$52,346	$10,439	$15,036	$139,055	$352,476
Lewis & Clark RFD	$0	$0	$0	$13,975	$0	$13,975
Olney Walluski RFD	$128,891	$95,528	$69,539	$137,511	$635,035	$1,066,504
Knappa SD	$4,310,683	$5,002,510	$2,298,788	$3,312,866	$4,800,789	$19,725,636
Elsie-Vinemaple RFD	$92,687	$200,630	$27,666	$474,708	$324,837	$1,120,528
Jewell SD	$32,990,684	$20,947,419	$11,618,875	$16,679,865	$24,565,876	$106,802,719
Clatskanie SD	$439,225	$321,458	$437,395	$132,917	$206,221	$1,537,216
Westport-Wauna RFD	$0	$0	$0	$0	$0	$0
Mist-Birkenfeld RFD	$132,860	$38,152	$72,556	$35,095	$74,818	$353,482
Sunset Park	$306,268	$242,929	$421,821	$238,210	$319,477	$1,528,706
Union Health	$32,602	$25,339	$45,428	$27,338	$29,424	$160,131
SD 10	$2,077,882	$1,643,933	$2,854,520	$1,612,001	$2,161,945	$10,350,280
Cannon Beach RFD	$830	$0	$0	$0	$0	$830
Hamlet RFD	$110,635	$127,917	$143,087	$106,327	$117,208	$605,175
Warrenton Hammond SD	$6,262,025	$2,770,480	$1,230,897	$1,261,796	$4,254,367	$15,779,566

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

Table 50. Percentage Increase in BOFL Revenue Distributions in Clatsop County under Alternative 4 Relative to the No Action Alternative (2023–2072)

	Time Periods					Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	(50 Years)
Astoria	317%	19%	84%	70%	(+)	134%
Astoria U/R Astoria East	317%	19%	84%	70%	(+)	134%
Astoria U/R Astoria West	317%	19%	84%	70%	(+)	134%
4H & Extension Service	42%	27%	-30%	-2%	55%	19%
4H & Extension Service Astoria East	317%	19%	84%	70%	(+)	134%
4H & Extension Service Astoria West	317%	19%	84%	70%	(+)	134%
Clatsop County District	42%	27%	-30%	-2%	55%	19%
Clatsop County U/R Astoria East	317%	19%	84%	70%	(+)	134%
Clatsop County U/R Astoria West	317%	19%	84%	70%	(+)	134%
Port Astoria	42%	27%	-30%	-2%	55%	19%
Port Astoria U/R Astoria East	317%	19%	84%	70%	(+)	134%
Port Astoria U/R Astoria West	317%	19%	84%	70%	(+)	134%
Care Center	41%	28%	-32%	-3%	53%	19%
Care Center U/R Astoria East	317%	19%	84%	70%	(+)	134%
Care Center U/R Astoria West	317%	19%	84%	70%	(+)	134%
Community College	42%	27%	-30%	-2%	55%	19%
Community College U/R Astoria East	317%	19%	84%	70%	(+)	134%
Community College U/R Astoria West	317%	19%	84%	70%	(+)	134%
New ESD	42%	27%	-30%	-2%	55%	19%
New ESD U/R Astoria East	317%	19%	84%	70%	(+)	134%
New ESD U/R Astoria West	317%	19%	84%	70%	(+)	134%
SD 1	108%	7%	-47%	-18%	114%	19%
SD 1 U/R Astoria East	317%	19%	84%	70%	(+)	134%
SD 1 U/R Astoria West	317%	19%	84%	70%	(+)	134%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Sunset Transportation	42%	27%	-30%	-2%	55%	19%
Sunset Transportation U/R Astoria East	317%	19%	84%	70%	(+)	134%
Sunset Transportation U/R Astoria West	317%	19%	84%	70%	(+)	134%
Rural Law	42%	27%	-30%	-2%	54%	19%
Road District #1	42%	27%	-30%	-2%	54%	19%
Knappa-Svensen-Burnside RFD	102%	102%	-36%	42%	196%	65%
John Day RFD	511%	113%	-91%	-63%	447%	51%
Lewis & Clark RFD	0%	0%	-100%	(+)	0%	80%
Olney Walluski RFD	309%	-15%	-52%	-44%	301%	54%
Knappa SD	84%	115%	-13%	118%	312%	97%
Elsie-Vinemaple RFD	-21%	-35%	-89%	531%	20%	10%
Jewell SD	37%	30%	-32%	2%	36%	16%
Clatskanie SD	9%	-62%	-52%	-77%	-66%	-54%
Westport-Wauna RFD	-100%	-100%	0%	-100%	-100%	-100%
Mist-Birkenfeld RFD	1100%	-81%	135%	11%	(+)	31%
Sunset Park	81%	0%	21%	10%	136%	37%
Union Health	140%	-5%	21%	54%	174%	51%
SD 10	80%	0%	21%	10%	136%	37%
Cannon Beach RFD	-10%	0%	0%	-100%	0%	-10%
Hamlet RFD	184%	76%	98%	1680%	14%	107%
Warrenton Hammond SD	17%	3%	7%	-55%	47%	6%

Source: ECONorthwest's analysis of Forest Model
RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal
- sign indicates decrease in revenue relative to the no action alternative
+ sign indicates increase in revenue relative to $0 under the no action alternative

Table 51. BOFL Revenue Distributions to Clatsop County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Clatsop County	$191,548,060 (54%)	$124,028,300 (30%)	$79,282,175 (-24%)	$111,028,760 (9%)	$168,652,660 (71%)	$131,961,520 (36%)	$79,558,240 (-19%)	$886,059,712 (23%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 52. BOFL Revenue Distributions to Taxing Districts in Clatsop County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Astoria	$117,521	$130,350	$344,789	$117,585	$211,922	$70,680	$189,030	$1,181,878
Astoria U/R Astoria East	$2,906	$3,223	$8,525	$2,907	$5,240	$1,748	$4,674	$29,222
Astoria U/R Astoria West	$6,855	$7,603	$20,111	$6,858	$12,361	$4,123	$11,026	$68,936
4H & Extension Service	$670,734	$428,972	$267,662	$375,102	$566,198	$452,666	$273,059	$3,034,393
4H & Extension Service Astoria East	$19	$21	$55	$19	$34	$11	$30	$188
4H & Extension Service Astoria West	$44	$48	$128	$44	$79	$26	$70	$438
Clatsop County District	$22,393,221	$14,321,824	$8,936,828	$12,523,324	$18,903,400	$15,112,750	$9,116,685	$101,308,032
Clatsop County U/R Astoria East	$545	$605	$1,599	$545	$983	$328	$877	$5,481
Clatsop County U/R Astoria West	$1,286	$1,427	$3,774	$1,287	$2,319	$774	$2,069	$12,935
Port Astoria	$1,577,605	$1,008,965	$629,553	$882,261	$1,331,729	$1,064,697	$642,249	$7,137,059
Port Astoria U/R Astoria East	$44	$48	$128	$44	$79	$26	$70	$438

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Port Astoria U/R Astoria West	$104	$116	$306	$104	$188	$63	$168	$1,049
Care Center	$4,995,294	$3,181,546	$1,895,007	$2,761,845	$4,218,798	$3,370,043	$1,951,421	$22,373,954
Care Center U/R Astoria East	$62	$69	$183	$62	$112	$37	$100	$626
Care Center U/R Astoria West	$146	$162	$429	$146	$264	$88	$235	$1,472
Community College	$11,680,225	$7,470,225	$4,661,487	$6,532,133	$9,859,972	$7,882,755	$4,755,263	$52,842,060
Community College U/R Astoria East	$276	$306	$809	$276	$497	$166	$443	$2,772
Community College U/R Astoria West	$652	$724	$1,914	$653	$1,177	$392	$1,049	$6,562
New ESD	$1,931,812	$1,235,500	$770,898	$1,080,348	$1,630,730	$1,303,744	$786,447	$8,739,478
New ESD U/R Astoria East	$55	$60	$160	$55	$98	$33	$88	$548
New ESD U/R Astoria West	$128	$142	$375	$128	$230	$77	$205	$1,284
SD 1	$9,435,880	$6,386,481	$5,344,757	$9,015,636	$14,673,849	$7,763,574	$3,968,141	$56,588,317
SD 1 U/R Astoria East	$1,757	$1,948	$5,153	$1,757	$3,167	$1,056	$2,825	$17,665
SD 1 U/R Astoria West	$4,144	$4,596	$12,157	$4,146	$7,472	$2,492	$6,665	$41,672
Sunset Transportation	$2,034,809	$1,301,372	$812,001	$1,137,948	$1,717,674	$1,373,255	$828,377	$9,205,436
Sunset Transportation U/R Astoria East	$56	$62	$164	$56	$101	$34	$90	$564
Sunset Transportation U/R Astoria West	$135	$150	$397	$136	$244	$81	$218	$1,362

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Rural Law	$9,026,961	$5,768,375	$3,576,010	$5,043,675	$7,610,137	$6,092,889	$3,662,467	$40,780,514
Road District #1	$12,765,716	$8,157,500	$5,057,110	$7,132,648	$10,762,077	$8,616,421	$5,179,375	$57,670,846
Knappa-Svensen-Burnside RFD	$1,401,713	$1,211,572	$637,967	$1,168,730	$1,564,773	$1,336,641	$545,763	$7,867,159
John Day RFD	$135,600	$52,346	$10,439	$15,036	$139,055	$118,514	$0	$470,990
Lewis & Clark RFD	$0	$0	$0	$13,975	$0	$0	$0	$13,975
Olney Walluski RFD	$129,327	$98,476	$69,539	$137,331	$618,495	$133,724	$48,633	$1,235,525
Knappa SD	$5,213,349	$5,505,170	$2,413,301	$4,447,515	$5,832,883	$5,886,236	$2,275,960	$31,574,415
Elsie-Vinemaple RFD	$92,686	$195,390	$27,675	$473,981	$323,742	$169,714	$79	$1,283,266
Jewell SD	$34,320,952	$20,984,731	$11,926,253	$17,310,150	$25,522,510	$21,509,743	$12,713,485	$144,287,825
Clatskanie SD	$914,327	$705,619	$983,181	$546,345	$682,847	$888,709	$737,385	$5,458,413
Westport-Wauna RFD	$145,643	$14,440	$23,722	$16,375	$103,005	$102,042	$33,817	$439,043
Mist-Birkenfeld RFD	$132,860	$14,142	$104,625	$47,958	$71,596	$17,498	$75,234	$463,913
Sunset Park	$322,674	$231,072	$391,134	$244,064	$312,641	$189,875	$317,528	$2,008,988
Union Health	$32,955	$25,136	$43,291	$28,118	$27,276	$22,596	$38,515	$217,886
SD 10	$2,188,900	$1,563,698	$2,646,854	$1,651,614	$2,115,684	$1,284,911	$2,148,753	$13,600,414
Cannon Beach RFD	$830	$0	$0	$0	$0	$0	$0	$830
Hamlet RFD	$108,101	$123,143	$143,087	$106,326	$102,959	$132,332	$126,136	$842,085
Warrenton Hammond SD	$6,210,257	$2,742,736	$1,205,548	$1,362,131	$3,760,568	$3,269,579	$2,718,891	$21,269,710

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

Table 53. Percentage Increase in BOFL Revenue Distributions in Clatsop County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Astoria	317%	19%	84%	70%	(+)	-31%	5%	75%
Astoria U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Astoria U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
4H & Extension Service	51%	30%	-25%	7%	63%	35%	-16%	22%
4H & Extension Service Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
4H & Extension Service Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Clatsop County District	51%	30%	-25%	7%	63%	35%	-16%	22%
Clatsop County U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Clatsop County U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Port Astoria	51%	30%	-25%	7%	63%	35%	-16%	22%
Port Astoria U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Port Astoria U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Care Center	49%	32%	-27%	6%	62%	34%	-16%	22%
Care Center U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Care Center U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Community College	51%	30%	-25%	7%	63%	35%	-16%	22%
Community College U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Community College U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
New ESD	51%	30%	-25%	7%	63%	35%	-16%	22%
New ESD U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
New ESD U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
SD 1	126%	17%	-35%	-4%	132%	52%	-52%	21%
SD 1 U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
SD 1 U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Sunset Transportation	51%	30%	-25%	7%	63%	35%	-16%	22%
Sunset Transportation U/R Astoria East	317%	19%	84%	70%	(+)	-31%	5%	75%
Sunset Transportation U/R Astoria West	317%	19%	84%	70%	(+)	-31%	5%	75%
Rural Law	50%	30%	-26%	7%	63%	35%	-16%	22%
Road District #1	50%	30%	-26%	7%	63%	35%	-16%	22%
Knappa-Svensen-Burnside RFD	159%	125%	-20%	122%	303%	77%	-40%	76%
John Day RFD	511%	113%	-91%	-63%	447%	452%	-100%	82%
Lewis & Clark RFD	0%	0%	-100%	(+)	0%	0%	-100%	-19%
Olney Walluski RFD	310%	-12%	-52%	-44%	290%	48%	-69%	32%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Knappa SD	122%	137%	-9%	193%	401%	72%	-30%	89%
Elsie-Vinemaple RFD	-21%	-37%	-89%	530%	20%	-58%	-100%	-23%
Jewell SD	42%	30%	-30%	6%	41%	33%	-7%	19%
Clatskanie SD	127%	-17%	8%	-7%	11%	-7%	-24%	3%
Westport-Wauna RFD	130%	-36%	(+)	-47%	5%	470%	(+)	89%
Mist-Birkenfeld RFD	1100%	-93%	239%	51%	(+)	-88%	129%	3%
Sunset Park	91%	-5%	12%	12%	131%	60%	-31%	19%
Union Health	142%	-6%	16%	59%	154%	90%	-20%	31%
SD 10	90%	-5%	12%	12%	131%	60%	-31%	19%
Cannon Beach RFD	-10%	0%	0%	-100%	0%	0%	0%	-10%
Hamlet RFD	177%	70%	98%	1680%	0%	139%	39%	92%
Warrenton Hammond SD	16%	2%	5%	-51%	30%	-3%	66%	7%

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; U/R = Urban Renewal

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Columbia County

Table 54. BOFL Revenue Distributions to Columbia County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
County Administration	$1,191,267	$1,162,587	$1,373,330	$558,661	$526,043	$619,947	$406,148	$5,837,983
County School Fund	$2,680,350	$2,615,822	$3,089,992	$1,256,986	$1,183,597	$1,394,882	$913,834	$13,135,462
Taxing Districts[a]	$8,041,049	$7,847,465	$9,269,977	$3,770,959	$3,550,792	$4,184,645	$2,741,501	$39,406,387
Columbia County (Total)	$11,912,665	$11,625,874	$13,733,299	$5,586,606	$5,260,432	$6,199,474	$4,061,483	$58,379,832

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 55.

Table 55. BOFL Distributions to Taxing Districts in Columbia County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	$1,162,695	$1,134,704	$1,340,392	$545,262	$513,426	$605,078	$396,407	$5,697,963
Columbia 4-H	$47,408	$46,266	$54,653	$22,233	$20,934	$24,671	$16,163	$232,329
Columbia County Development Agency	$552,019	$538,729	$636,385	$258,877	$243,762	$287,276	$188,204	$2,705,253
Jail Operations	$495,772	$483,837	$571,542	$232,499	$218,925	$258,005	$169,028	$2,429,608
911 Communication District	$458,810	$447,765	$528,931	$215,165	$202,603	$238,770	$156,426	$2,248,471
Greater St. Helens Aquatic District	$69,906	$68,223	$80,590	$32,784	$30,869	$36,380	$23,834	$342,587
Mist-Birkenfeld RFD	$69,103	$67,439	$79,664	$32,407	$30,515	$35,962	$23,560	$338,649
Northwestern Regional ESD	$126,153	$123,116	$145,433	$59,161	$55,707	$65,651	$43,010	$618,231

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
St Helens 502 SD	$1,887,470	$1,842,031	$2,175,936	$885,155	$833,475	$982,259	$643,511	$9,249,837
Rainier 13 SD	$626,746	$611,658	$722,533	$293,921	$276,761	$326,165	$213,682	$3,071,466
Scappoose 1 JT SD	$1,504,191	$1,467,979	$1,734,079	$705,411	$664,225	$782,796	$512,836	$7,371,518
Vernonia 47 JT SD	$605,855	$591,269	$698,449	$284,124	$267,535	$315,293	$206,559	$2,969,084
Portland Community College	$433,901	$423,455	$500,215	$203,484	$191,603	$225,807	$147,934	$2,126,399

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 56. BOFL Revenue Distributions to Columbia County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Columbia County	$17,310,236 (45%)	$13,608,766 (17%)	$12,870,094 (-6%)	$20,827,794 (273%)	$20,999,203 (299%)	$8,297,513 (34%)	$4,508,500 (11%)	$98,422,104 (69%)

Source: ECONorthwest's analysis of Forest Model

Table 57. BOFL Revenue Distributions to Taxing Districts in Columbia County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	$1,689,506	$1,328,237	$1,256,141	$2,032,825	$2,049,555	$809,850	$440,037	$9,606,152
Columbia 4-H	$68,888	$54,158	$51,218	$82,886	$83,569	$33,021	$17,942	$391,681
Columbia County Development Agency	$802,136	$630,614	$596,385	$965,135	$973,078	$384,497	$208,919	$4,560,765
Jail Operations	$720,405	$566,359	$535,618	$866,796	$873,929	$345,320	$187,631	$4,096,058
911 Communication District	$666,695	$524,135	$495,685	$802,172	$808,774	$319,575	$173,643	$3,790,679

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Greater St. Helens Aquatic District	$101,581	$79,859	$75,525	$122,222	$123,228	$48,692	$26,457	$577,564
Mist-Birkenfeld RFD	$100,413	$78,942	$74,657	$120,818	$121,812	$48,132	$26,153	$570,925
Northwestern Regional ESD	$183,312	$144,114	$136,292	$220,562	$222,377	$87,869	$47,744	$1,042,271
St Helens 502 SD	$2,742,675	$2,156,205	$2,039,168	$3,300,005	$3,327,163	$1,314,677	$714,337	$15,594,231
Rainier 13 SD	$910,722	$715,981	$677,118	$1,095,787	$1,104,805	$436,547	$237,200	$5,178,161
Scappoose 1 JT SD	$2,185,733	$1,718,355	$1,625,084	$2,629,889	$2,651,532	$1,047,712	$569,280	$12,427,586
Vernonia 47 JT SD	$880,365	$692,115	$654,548	$1,059,261	$1,067,978	$421,995	$229,293	$5,005,555
Portland Community College	$630,500	$495,679	$468,774	$758,622	$764,865	$302,225	$164,215	$3,584,881

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 58. Percentage Increase in BOFL Revenue Distributions in Columbia County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	45%	17%	-6%	273%	299%	34%	11%	69%
Columbia 4-H	45%	17%	-6%	273%	299%	34%	11%	69%
Columbia County Development Agency	45%	17%	-6%	273%	299%	34%	11%	69%
Jail Operations	45%	17%	-6%	273%	299%	34%	11%	69%
911 Communication District	45%	17%	-6%	273%	299%	34%	11%	69%
Greater St. Helens Aquatic District	45%	17%	-6%	273%	299%	34%	11%	69%
Mist-Birkenfeld RFD	45%	17%	-6%	273%	299%	34%	11%	69%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Northwestern Regional ESD	45%	17%	-6%	273%	299%	34%	11%	69%
St Helens 502 SD	45%	17%	-6%	273%	299%	34%	11%	69%
Rainier 13 SD	45%	17%	-6%	273%	299%	34%	11%	69%
Scappoose 1 JT SD	45%	17%	-6%	273%	299%	34%	11%	69%
Vernonia 47 JT SD	45%	17%	-6%	273%	299%	34%	11%	69%
Portland Community College	45%	17%	-6%	273%	299%	34%	11%	69%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Table 59. BOFL Revenue Distributions to Columbia County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County	$17,301,936 (45%)	$13,736,684 (18%)	$11,491,033 (-16%)	$23,022,095 (312%)	$19,880,629 (278%)	$8,569,901 (38%)	$4,545,178 (12%)	$98,547,456 (69%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 60. BOFL Revenue Distributions to Taxing Districts in Columbia County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	$1,688,696	$1,340,722	$1,121,543	$2,246,992	$1,940,381	$836,436	$443,617	$9,618,386
Columbia 4-H	$68,855	$54,667	$45,730	$91,619	$79,117	$34,105	$18,088	$392,180
Columbia County Development Agency	$801,751	$636,542	$532,481	$1,066,817	$921,245	$397,119	$210,618	$4,566,573

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Jail Operations	$720,059	$571,683	$478,225	$958,116	$827,377	$356,656	$189,158	$4,101,275
911 Communication District	$666,376	$529,062	$442,572	$886,685	$765,693	$330,066	$175,055	$3,795,507
Greater St. Helens Aquatic District	$101,532	$80,610	$67,432	$135,099	$116,664	$50,290	$26,672	$578,300
Mist-Birkenfeld RFD	$100,365	$79,684	$66,657	$133,546	$115,323	$49,712	$26,366	$571,653
Northwestern Regional ESD	$183,224	$145,469	$121,688	$243,799	$210,532	$90,754	$48,133	$1,043,598
St Helens 502 SD	$2,741,360	$2,176,473	$1,820,666	$3,647,675	$3,149,934	$1,357,835	$720,149	$15,614,091
Rainier 13 SD	$910,285	$722,711	$604,564	$1,211,233	$1,045,955	$450,878	$239,130	$5,184,756
Scappoose 1 JT SD	$2,184,685	$1,734,507	$1,450,952	$2,906,959	$2,510,292	$1,082,106	$573,912	$12,443,414
Vernonia 47 JT SD	$879,943	$698,621	$584,411	$1,170,859	$1,011,090	$435,848	$231,159	$5,011,930
Portland Community College	$630,198	$500,338	$418,544	$838,546	$724,123	$312,146	$165,551	$3,589,446

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 61. Percentage Increase in BOFL Revenue Distributions in Columbia County under Alternative 3 Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Columbia County District	45%	18%	-16%	312%	278%	38%	12%	69%
Columbia 4-H	45%	18%	-16%	312%	278%	38%	12%	69%
Columbia County Development Agency	45%	18%	-16%	312%	278%	38%	12%	69%
Jail Operations	45%	18%	-16%	312%	278%	38%	12%	69%
911 Communication District	45%	18%	-16%	312%	278%	38%	12%	69%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Greater St. Helens Aquatic District	45%	18%	-16%	312%	278%	38%	12%	69%
Mist-Birkenfeld RFD	45%	18%	-16%	312%	278%	38%	12%	69%
Northwestern Regional ESD	45%	18%	-16%	312%	278%	38%	12%	69%
St Helens 502 SD	45%	18%	-16%	312%	278%	38%	12%	69%
Rainier 13 SD	45%	18%	-16%	312%	278%	38%	12%	69%
Scappoose 1 JT SD	45%	18%	-16%	312%	278%	38%	12%	69%
Vernonia 47 JT SD	45%	18%	-16%	312%	278%	38%	12%	69%
Portland Community College	45%	18%	-16%	312%	278%	38%	12%	69%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Table 62. BOFL Revenue Distributions to Columbia County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Columbia County	$17,310,236 (45%)	$13,608,766 (17%)	$12,870,094 (-6%)	$20,827,794 (273%)	$20,999,203 (299%)	$85,616,096 (78%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 63. BOFL Revenue Distributions to Taxing Districts in Columbia County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Columbia County District	$1,689,506	$1,328,237	$1,256,141	$2,032,825	$2,049,555	$8,356,265
Columbia 4-H	$68,888	$54,158	$51,218	$82,886	$83,569	$340,718
Columbia County Development Agency	$802,136	$630,614	$596,385	$965,135	$973,078	$3,967,349
Jail Operations	$720,405	$566,359	$535,618	$866,796	$873,929	$3,563,107
911 Communication District	$666,695	$524,135	$495,685	$802,172	$808,774	$3,297,462
Greater St. Helens Aquatic District	$101,581	$79,859	$75,525	$122,222	$123,228	$502,415
Mist-Birkenfeld RFD	$100,413	$78,942	$74,657	$120,818	$121,812	$496,641
Northwestern Regional ESD	$183,312	$144,114	$136,292	$220,562	$222,377	$906,658
St Helens 502 SD	$2,742,675	$2,156,205	$2,039,168	$3,300,005	$3,327,163	$13,565,216
Rainier 13 SD	$910,722	$715,981	$677,118	$1,095,787	$1,104,805	$4,504,414
Scappoose 1 JT SD	$2,185,733	$1,718,355	$1,625,084	$2,629,889	$2,651,532	$10,810,593
Vernonia 47 JT SD	$880,365	$692,115	$654,548	$1,059,261	$1,067,978	$4,354,267
Portland Community College	$630,500	$495,679	$468,774	$758,622	$764,865	$3,118,440

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 64. Percentage Increase in BOFL Revenue Distributions in Columbia County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Columbia County District	45%	17%	-6%	273%	299%	78%
Columbia 4-H	45%	17%	-6%	273%	299%	78%
Columbia County Development Agency	45%	17%	-6%	273%	299%	78%
Jail Operations	45%	17%	-6%	273%	299%	78%
911 Communication District	45%	17%	-6%	273%	299%	78%
Greater St. Helens Aquatic District	45%	17%	-6%	273%	299%	78%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Mist-Birkenfeld RFD	45%	17%	-6%	273%	299%	78%
Northwestern Regional ESD	45%	17%	-6%	273%	299%	78%
St Helens 502 SD	45%	17%	-6%	273%	299%	78%
Rainier 13 SD	45%	17%	-6%	273%	299%	78%
Scappoose 1 JT SD	45%	17%	-6%	273%	299%	78%
Vernonia 47 JT SD	45%	17%	-6%	273%	299%	78%
Portland Community College	45%	17%	-6%	273%	299%	78%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Table 65. BOFL Revenue Distributions to Columbia County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County	$17,740,919 (49%)	$13,354,364 (15%)	$13,159,243 (-4%)	$20,029,173 (259%)	$20,495,184 (290%)	$9,233,763 (49%)	$4,627,323 (14%)	$98,639,968 (69%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 66. BOFL Revenue Distributions to Taxing Districts in Columbia County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	$1,731,542	$1,303,407	$1,284,363	$1,954,879	$2,000,362	$901,230	$451,634	$9,627,416
Columbia 4-H	$70,602	$53,145	$52,369	$79,708	$81,563	$36,747	$18,415	$392,548
Columbia County Development Agency	$822,093	$618,826	$609,784	$928,128	$949,723	$427,882	$214,425	$4,570,860
Jail Operations	$738,328	$555,772	$547,652	$833,559	$852,953	$384,284	$192,576	$4,105,125

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
911 Communication District	$683,283	$514,337	$506,822	$771,414	$789,362	$355,634	$178,219	$3,799,070
Greater St. Helens Aquatic District	$104,108	$78,367	$77,222	$117,536	$120,271	$54,186	$27,154	$578,843
Mist-Birkenfeld RFD	$102,911	$77,466	$76,334	$116,185	$118,888	$53,563	$26,842	$572,189
Northwestern Regional ESD	$187,873	$141,420	$139,354	$212,105	$217,040	$97,784	$49,002	$1,044,578
St Helens 502 SD	$2,810,913	$2,115,897	$2,084,982	$3,173,469	$3,247,305	$1,463,019	$733,164	$15,628,749
Rainier 13 SD	$933,381	$702,597	$692,331	$1,053,770	$1,078,288	$485,805	$243,452	$5,189,623
Scappoose 1 JT SD	$2,240,115	$1,686,232	$1,661,594	$2,529,048	$2,587,891	$1,165,931	$584,284	$12,455,095
Vernonia 47 JT SD	$902,268	$679,177	$669,253	$1,018,644	$1,042,345	$469,611	$235,337	$5,016,635
Portland Community College	$646,187	$486,413	$479,306	$729,533	$746,507	$336,326	$168,543	$3,592,816

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 67. Percentage Increase in BOFL Revenue Distributions in Columbia County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Columbia County District	49%	15%	-4%	259%	290%	49%	14%	69%
Columbia 4-H	49%	15%	-4%	259%	290%	49%	14%	69%
Columbia County Development Agency	49%	15%	-4%	259%	290%	49%	14%	69%
Jail Operations	49%	15%	-4%	259%	290%	49%	14%	69%
911 Communication District	49%	15%	-4%	259%	290%	49%	14%	69%
Greater St. Helens Aquatic District	49%	15%	-4%	259%	290%	49%	14%	69%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Mist-Birkenfeld RFD	49%	15%	-4%	259%	290%	49%	14%	69%
Northwestern Regional ESD	49%	15%	-4%	259%	290%	49%	14%	69%
St Helens 502 SD	49%	15%	-4%	259%	290%	49%	14%	69%
Rainier 13 SD	49%	15%	-4%	259%	290%	49%	14%	69%
Scappoose 1 JT SD	49%	15%	-4%	259%	290%	49%	14%	69%
Vernonia 47 JT SD	49%	15%	-4%	259%	290%	49%	14%	69%
Portland Community College	49%	15%	-4%	259%	290%	49%	14%	69%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

Coos County

Table 68. BOFL Revenue Distributions to Coos County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Year)
County Administration	$224,427	$576,558	$407,159	$305,076	$422,628	$450,492	$318,991	$2,705,331
County School Fund	$504,960	$1,297,256	$916,108	$686,421	$950,913	$1,013,606	$717,730	$6,086,995
Taxing Districts[a]	$1,514,881	$3,891,768	$2,748,324	$2,059,264	$2,852,740	$3,040,819	$2,153,189	$18,260,986
Coos County (Total)	$2,244,269	$5,765,582	$4,071,591	$3,050,761	$4,226,282	$4,504,917	$3,189,909	$27,053,312

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 69.

Table 69. BOFL Revenue Distributions to Taxing Districts in Coos County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Coos County 4H Extension	$12,320	$33,360	$24,805	$18,645	$23,267	$25,465	$18,213	$156,074
Coos County Library Services	$101,063	$273,654	$203,475	$152,950	$190,862	$208,893	$149,406	$1,280,303
Coos County District	$211,095	$571,593	$425,008	$319,473	$398,663	$436,324	$312,070	$2,674,226
South Coast ESD	$61,461	$166,421	$123,743	$93,016	$116,072	$127,037	$90,860	$778,610
Coos Bay SD 9	$848,393	$1,548,940	$870,756	$605,770	$1,534,479	$1,464,166	$979,517	$7,852,021
Southwestern Oregon Community College	$97,295	$263,450	$195,888	$147,247	$183,746	$201,104	$143,835	$1,232,564
Port of Coos Bay	$79,817	$219,225	$96,689	$65,505	$159,875	$165,612	$109,315	$896,038
Coos County Airport	$33,289	$90,139	$67,023	$50,380	$62,868	$68,807	$49,213	$421,718
Millicoma Park and Recreation	$63,767	$87,528	$42,951	$41,729	$115,335	$93,269	$60,196	$504,774
Coos County Urban Renewal	$6,631	$13,800	$8,350	$5,968	$12,192	$12,094	$8,231	$67,265
North Bend SD 13	-$1,349	$613,274	$687,631	$557,088	$53,311	$235,826	$224,477	$2,370,257
North Bay RFD	$0	$7,545	$0	$0	$0	$16	$6,279	$13,840
Lakeside RFD	$0	$12	$10	$0	$0	$0	$12	$34

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 70. BOFL Revenue Distributions to Coos County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Coos County	$1,788,356 (-20%)	$14,181 (-100%)	$6,528,528 (60%)	$2,832,584 (-7%)	$9,744,298 (131%)	$3,706,439 (-18%)	$3,498,023 (10%)	$28,112,408 (4%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 71. BOFL Revenue Distributions to Taxing Districts in Coos County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County 4H Extension	$10,726	$115	$36,606	$15,662	$57,236	$20,287	$19,396	$160,029
Coos County Library Services	$87,986	$947	$300,289	$128,478	$469,517	$166,418	$159,106	$1,312,740
Coos County District	$183,780	$1,978	$627,227	$268,357	$980,702	$347,605	$332,331	$2,741,980
South Coast ESD	$53,508	$576	$182,619	$78,133	$285,535	$101,206	$96,759	$798,337
Coos Bay SD 9	$427,015	-$5,122	$2,237,278	$1,076,452	$2,607,319	$1,394,337	$1,260,216	$8,997,496
Southwestern Oregon Community College	$84,705	$912	$289,092	$123,687	$452,010	$160,213	$153,173	$1,263,792
Port of Coos Bay	$37,872	-$512	$236,178	$107,619	$271,385	$139,399	$124,315	$916,256
Coos County Airport	$28,982	$312	$98,912	$42,319	$154,654	$54,816	$52,408	$432,402
Millicoma Park and Recreation	$32,095	-$385	$147,476	$61,449	$177,768	$104,801	$91,675	$614,880
Coos County Urban Renewal	$3,872	-$17	$18,115	$8,450	$22,852	$10,945	$10,012	$74,228
North Bend SD 13	$255,720	$10,763	$229,765	$0	$1,093,642	$0	$60,060	$1,649,950
North Bay RFD	$0	$0	$0	$0	$0	$0	$0	$0
Lakeside RFD	$2	$0	$0	$0	$4	$0	$0	$5

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 72. Percentage Increase in BOFL Revenue Distributions in Coos County under Proposed Action Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Coos County 4H Extension	-13%	-100%	48%	-16%	146%	-20%	6%	3%
Coos County Library Services	-13%	-100%	48%	-16%	146%	-20%	6%	3%
Coos County District	-13%	-100%	48%	-16%	146%	-20%	6%	3%
South Coast ESD	-13%	-100%	48%	-16%	146%	-20%	6%	3%
Coos Bay SD 9	-50%	-100%	157%	78%	70%	-5%	29%	15%
Southwestern Oregon Community College	-13%	-100%	48%	-16%	146%	-20%	6%	3%
Port of Coos Bay	-53%	-100%	144%	64%	70%	-16%	14%	2%
Coos County Airport	-13%	-100%	48%	-16%	146%	-20%	6%	3%
Millicoma Park and Recreation	-50%	-100%	243%	47%	54%	12%	52%	22%
Coos County Urban Renewal	-42%	-100%	117%	42%	87%	-9%	22%	10%
North Bend SD 13	-19054%	-98%	-67%	-100%	1951%	-100%	-73%	-30%
North Bay RFD	0%%	-100%	0%	-100%	0%%	-100%	-100%	-100%
Lakeside RFD	(+)	-100%	-100%	0%	(+)	0%	-100%	-84%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative; (-) sign indicates decrease in revenue relative to $0 under the no action alternative

Table 73. BOFL Revenue Distributions to Coos County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County	$1,762,561 (-21%)	$146,036 (-97%)	$6,610,983 (62%)	$3,841,813 (26%)	$8,379,088 (98%)	$3,199,064 (-29%)	$4,083,250 (28%)	$28,022,794 (4%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 74. BOFL Revenue Distributions to Taxing Districts in Coos County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County 4H Extension	$10,563	$835	$37,051	$22,298	$48,404	$17,510	$22,590	$159,251
Coos County Library Services	$86,650	$6,849	$303,937	$182,911	$397,064	$143,637	$185,313	$1,306,362
Coos County District	$180,990	$14,306	$634,847	$382,055	$829,366	$300,022	$387,072	$2,728,657
South Coast ESD	$52,696	$4,165	$184,838	$111,237	$241,473	$87,352	$112,697	$794,458
Coos Bay SD 9	$423,019	$45,093	$2,270,760	$1,148,155	$2,469,409	$1,203,466	$1,482,611	$9,042,515
Southwestern Oregon Community College	$83,419	$6,593	$292,604	$176,091	$382,259	$138,281	$178,403	$1,257,652
Port of Coos Bay	$37,574	$4,508	$239,295	$114,787	$257,474	$120,317	$146,571	$920,526
Coos County Airport	$28,542	$2,256	$100,114	$60,249	$130,789	$47,313	$61,040	$430,301
Millicoma Park and Recreation	$31,795	$3,389	$149,992	$66,984	$167,720	$90,455	$108,403	$618,739
Coos County Urban Renewal	$3,829	$376	$18,372	$9,688	$20,944	$9,447	$11,753	$74,407
North Bend SD 13	$249,787	$10,132	$227,362	$316,886	$706,870	$0	$57,739	$1,568,777
North Bay RFD	$0	$0	$0	$0	$0	$0	$0	$0
Lakeside RFD	$2	$0	$0	$0	$4	$0	$0	$5

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 75. Percentage Increase in BOFL Revenue Distributions in Coos County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County 4H Extension	-14%	-97%	49%	20%	108%	-31%	24%	2%
Coos County Library Services	-14%	-97%	49%	20%	108%	-31%	24%	2%
Coos County District	-14%	-97%	49%	20%	108%	-31%	24%	2%
South Coast ESD	-14%	-97%	49%	20%	108%	-31%	24%	2%
Coos Bay SD 9	-50%	-97%	161%	90%	61%	-18%	51%	15%
Southwestern Oregon Community College	-14%	-97%	49%	20%	108%	-31%	24%	2%
Port of Coos Bay	-53%	-98%	147%	75%	61%	-27%	34%	3%
Coos County Airport	-14%	-97%	49%	20%	108%	-31%	24%	2%
Millicoma Park and Recreation	-50%	-96%	249%	61%	45%	-3%	80%	23%
Coos County Urban Renewal	-42%	-97%	120%	62%	72%	-22%	43%	11%
North Bend SD 13	-18614%	-98%	-67%	-43%	1226%	-100%	-74%	-34%
North Bay RFD	0%	-100%	0%	-100%	0%	-100%	-100%	-100%
Lakeside RFD	(+)	-100%	-100%	0%	(+)	0%	-100%	-84%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 76. BOFL Revenue Distributions to Coos County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Coos County	$1,788,356 (-20%)	$14,181 (-100%)	$6,528,528 (60%)	$2,832,584 (-7%)	$9,744,298 (131%)	$20,907,948 (8%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 77. BOFL Revenue Distributions to Taxing Districts in Coos County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Coos County 4H Extension	$10,726	$115	$36,606	$15,662	$57,236	$120,346
Coos County Library Services	$87,986	$947	$300,289	$128,478	$469,517	$987,216
Coos County District	$183,780	$1,978	$627,227	$268,357	$980,702	$2,062,043
South Coast ESD	$53,508	$576	$182,619	$78,133	$285,535	$600,371
Coos Bay SD 9	$427,015	-$5,122	$2,237,278	$1,076,452	$2,607,319	$6,342,942
Southwestern Oregon Community College	$84,705	$912	$289,092	$123,687	$452,010	$950,406
Port of Coos Bay	$37,872	-$512	$236,178	$107,619	$271,385	$652,542
Coos County Airport	$28,982	$312	$98,912	$42,319	$154,654	$325,178
Millicoma Park and Recreation	$32,095	-$385	$147,476	$61,449	$177,768	$418,404
Coos County Urban Renewal	$3,872	-$17	$18,115	$8,450	$22,852	$53,272
North Bend SD 13	$255,720	$10,763	$229,765	$0	$1,093,642	$1,589,890
North Bay RFD	$0	$0	$0	$0	$0	$0
Lakeside RFD	$2	$0	$0	$0	$4	$5

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 78. Percentage Increase in BOFL Revenue Distributions in Coos County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Coos County 4H Extension	-13%	-100%	48%	-16%	146%	7%
Coos County Library Services	-13%	-100%	48%	-16%	146%	7%
Coos County District	-13%	-100%	48%	-16%	146%	7%
South Coast ESD	-13%	-100%	48%	-16%	146%	7%
Coos Bay SD 9	-50%	-100%	157%	78%	70%	17%
Southwestern Oregon Community College	-13%	-100%	48%	-16%	146%	7%
Port of Coos Bay	-53%	-100%	144%	64%	70%	5%
Coos County Airport	-13%	-100%	48%	-16%	146%	7%
Millicoma Park and Recreation	-50%	-100%	243%	47%	54%	19%
Coos County Urban Renewal	-42%	-100%	117%	42%	87%	13%
North Bend SD 13	-19054%	-98%	-67%	-100%	1951%	-17%
North Bay RFD	0%%	-100%	0%	-100%	0%%	-100%
Lakeside RFD	(+)	-100%	-100%	0%	(+)	-76%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative; (-) sign indicates decrease in revenue relative to $0 under the no action alternative

Table 79. BOFL Revenue Distributions to Coos County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County	$1,165,671 (-48%)	$519,796 (-91%)	$6,430,541 (58%)	$5,756,731 (89%)	$6,152,156 (46%)	$3,434,938 (-24%)	$4,239,758 (33%)	$27,699,592 (2%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 80. BOFL Revenue Distributions to Taxing Districts in Coos County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Coos County 4H Extension	$6,676	$2,883	$36,063	$32,906	$35,964	$18,814	$23,442	$156,748
Coos County Library Services	$54,763	$23,649	$295,831	$269,934	$295,017	$154,337	$192,301	$1,285,831
Coos County District	$114,386	$49,396	$617,915	$563,823	$616,216	$322,370	$401,667	$2,685,773
South Coast ESD	$33,304	$14,382	$179,908	$164,159	$179,413	$93,859	$116,947	$781,972
Coos Bay SD 9	$370,316	$185,086	$2,203,352	$1,871,045	$1,663,262	$1,286,745	$1,544,708	$9,124,515
Southwestern Oregon Community College	$52,721	$22,767	$284,800	$259,869	$284,017	$148,582	$185,130	$1,237,886
Port of Coos Bay	$32,204	$18,504	$232,443	$187,058	$176,449	$129,279	$152,121	$928,058
Coos County Airport	$18,038	$7,790	$97,443	$88,913	$97,175	$50,837	$63,342	$423,539
Millicoma Park and Recreation	$27,834	$13,912	$144,926	$107,867	$121,054	$96,715	$113,057	$625,364
Coos County Urban Renewal	$3,038	$1,476	$17,841	$15,373	$14,528	$10,115	$12,230	$74,601
North Bend SD 13	$72,976	$10,763	$226,940	$322,023	$666,590	$5,247	$54,813	$1,359,353
North Bay RFD	$0	$0	$0	$0	$0	$0	$0	$0
Lakeside RFD	$2	$0	$0	$0	$4	$0	$0	$5

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 81. Percentage Increase in BOFL Revenue Distributions in Coos County under Alternative 5 Relative to the No Action Alternative (2023–2092)

	Time Periods							
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**Total (70 Years)**
Coos County 4H Extension	-46%	-91%	45%	76%	55%	-26%	29%	0%
Coos County Library Services	-46%	-91%	45%	76%	55%	-26%	29%	0%
Coos County District	-46%	-91%	45%	76%	55%	-26%	29%	0%
South Coast ESD	-46%	-91%	45%	76%	55%	-26%	29%	0%
Coos Bay SD 9	-56%	-88%	153%	209%	8%	-12%	58%	16%
Southwestern Oregon Community College	-46%	-91%	45%	76%	55%	-26%	29%	0%
Port of Coos Bay	-60%	-92%	140%	186%	10%	-22%	39%	4%
Coos County Airport	-46%	-91%	45%	76%	55%	-26%	29%	0%
Millicoma Park and Recreation	-56%	-84%	237%	158%	5%	4%	88%	24%
Coos County Urban Renewal	-54%	-89%	114%	158%	19%	-16%	49%	11%
North Bend SD 13	-5509%	-98%	-67%	-42%	1150%	-98%	-76%	-43%
North Bay RFD	0%	-100%	0%	-100%	0%	-100%	-100%	-100%
Lakeside RFD	(+)	-100%	-100%	0%	(+)	0%	-100%	-84%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Curry County

Curry County does not contain BOFL and thus does not receive revenue from timber sales on BOFL.

Douglas County

Table 82. BOFL Revenue Distributions to Douglas County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
County Administration	$30,070	$64,004	$242,341	$300,967	$315,591	$132,053	$160,740	$1,245,765
County School Fund	$67,658	$144,008	$545,268	$677,175	$710,081	$297,118	$361,664	$2,802,972
Taxing Districts[a]	$202,973	$432,025	$1,635,804	$2,031,526	$2,130,242	$891,355	$1,084,992	$8,408,916
Douglas County (Total)	$300,700	$640,036	$2,423,413	$3,009,668	$3,155,914	$1,320,526	$1,607,395	$12,457,653

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 83.

Table 83. BOFL Revenue Distributions to Taxing Districts in Douglas County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Douglas County District	$26,919	$45,394	$175,146	$221,399	$249,012	$104,461	$134,080	$956,411
4H Extension	$1,452	$2,448	$9,447	$11,942	$13,431	$5,634	$7,232	$51,586
Douglas ESD	$13,206	$11,508	$48,005	$64,521	$89,921	$38,796	$56,904	$322,862
Umpqua Community College	$11,349	$9,889	$41,252	$55,445	$77,271	$33,338	$48,899	$277,444
Glendale Ambulance District	$29,176	$25,424	$106,053	$142,538	$198,654	$85,612	$125,714	$713,171
Glendale SD 77	$129,393	$112,756	$470,341	$632,151	$881,022	$379,684	$557,535	$3,162,882
Glendale FD	$0	$0	$0	$0	$0	$0	$0	$0

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Umpqua Public Transportation	-$254	$6,564	$22,988	$26,564	$18,603	$7,106	$4,502	$86,073
Lower Umpqua Hospital	-$2,930	$75,790	$265,412	$306,699	$214,781	$82,042	$51,984	$993,777
Lower Umpqua Parks and Recreation	-$178	$4,609	$16,140	$18,651	$13,061	$4,989	$3,161	$60,434
Lower Umpqua Library	-$288	$7,440	$26,054	$30,107	$21,084	$8,054	$5,103	$97,554
South Coast ESD	-$327	$8,455	$29,608	$34,214	$23,960	$9,152	$5,799	$110,862
Reedsport SD 105	-$4,177	$108,046	$378,373	$437,232	$306,194	$116,960	$74,109	$1,416,737
Southwestern Oregon Community College	-$517	$13,386	$45,797	$48,573	$21,700	$14,490	$9,181	$152,610
South Umpqua SD 19	$0	$0	$0	$15	$0	$390	$0	$405

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 84. BOFL Revenue Distributions to Douglas County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Douglas County	$444,771 (48%)	$725,948 (13%)	$1,578,417 (-35%)	$1,714,574 (-43%)	$1,830,650 (-42%)	$3,376,676 (156%)	$4,016,606 (150%)	$13,687,643 (10%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 85. BOFL Revenue Distributions to Taxing Districts in Douglas County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Douglas County District	$39,229	$63,941	$109,263	$147,092	$113,671	$217,044	$324,464	$1,014,703
4H Extension	$2,116	$3,449	$5,893	$7,934	$6,131	$11,707	$17,501	$54,730
Douglas ESD	$18,714	$30,442	$24,263	$66,378	$10,371	$27,354	$123,617	$301,139
Umpqua Community College	$16,081	$26,159	$20,850	$57,041	$8,912	$23,506	$106,227	$258,777
Glendale Ambulance District	$41,343	$67,252	$53,603	$146,644	$22,913	$60,425	$272,979	$665,158
Glendale SD 77	$183,352	$298,261	$237,726	$650,361	$101,616	$267,983	$1,210,649	$2,949,948
Glendale FD	$0	$154	$0	$9	$0	$0	$7	$170
Umpqua Public Transportation	-$24	$0	$18,034	$2,372	$28,423	$49,366	$20,049	$118,219
Lower Umpqua Hospital	-$281	$0	$208,213	$27,383	$328,170	$569,966	$231,477	$1,364,928
Lower Umpqua Parks and Recreation	-$17	$0	$12,662	$1,665	$19,957	$34,661	$14,077	$83,004
Lower Umpqua Library	-$28	$0	$20,439	$2,688	$32,215	$55,951	$22,723	$133,988
South Coast ESD	-$31	$0	$23,227	$3,055	$36,609	$63,583	$25,823	$152,266
Reedsport SD 105	-$400	$0	$296,830	$39,038	$467,841	$812,548	$329,996	$1,945,853
Southwestern Oregon Community College	-$50	$0	$33,653	$4,836	$57,962	$83,490	$9,184	$189,075
South Umpqua SD 19	$0	$0	$0	$0	$0	$19	$470	$489

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 86. Percentage Increase in BOFL Revenue Distributions in Douglas County under Proposed Action Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Douglas County District	46%	41%	-38%	-34%	-54%	108%	142%	6%
4H Extension	46%	41%	-38%	-34%	-54%	108%	142%	6%
Douglas ESD	42%	165%	-49%	3%	-88%	-29%	117%	-7%
Umpqua Community College	42%	165%	-49%	3%	-88%	-29%	117%	-7%
Glendale Ambulance District	42%	165%	-49%	3%	-88%	-29%	117%	-7%
Glendale SD 77	42%	165%	-49%	3%	-88%	-29%	117%	-7%
Glendale FD	0%	(+)	0%	(+)	0%	0%	(+)	(+)
Umpqua Public Transportation	-90%	-100%	-22%	-91%	53%	595%	345%	37%
Lower Umpqua Hospital	-90%	-100%	-22%	-91%	53%	595%	345%	37%
Lower Umpqua Parks and Recreation	-90%	-100%	-22%	-91%	53%	595%	345%	37%
Lower Umpqua Library	-90%	-100%	-22%	-91%	53%	595%	345%	37%
South Coast ESD	-90%	-100%	-22%	-91%	53%	595%	345%	37%
Reedsport SD 105	-90%	-100%	-22%	-91%	53%	595%	345%	37%
Southwestern Oregon Community College	-90%	-100%	-27%	-90%	167%	476%	0%	24%
South Umpqua SD 19	0%	0%	0%	-100%	0%	-95%	(+)	21%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 87. BOFL Revenue Distributions to Douglas County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Douglas County	$435,049 (45%)	$723,302 (13%)	$1,539,382 (-36%)	$1,605,708 (-47%)	$1,998,665 (-37%)	$3,297,331 (150%)	$4,253,370 (165%)	$13,852,806 (11%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 88. BOFL Revenue Distributions to Taxing Districts in Douglas County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Douglas County District	$38,371	$63,709	$106,784	$140,739	$124,715	$209,438	$345,298	$1,029,055
4H Extension	$2,070	$3,436	$5,760	$7,591	$6,727	$11,297	$18,625	$55,505
Douglas ESD	$18,305	$30,331	$23,964	$66,330	$12,176	$23,168	$133,491	$307,765
Umpqua Community College	$15,730	$26,064	$20,593	$56,999	$10,463	$19,909	$114,712	$264,471
Glendale Ambulance District	$40,439	$67,008	$52,941	$146,536	$26,900	$51,184	$294,789	$679,797
Glendale SD 77	$179,346	$297,176	$234,791	$649,882	$119,301	$226,997	$1,307,377	$3,014,871
Glendale FD	$0	$150	$0	$9	$0	$0	$7	$166
Umpqua Public Transportation	-$24	$0	$17,462	$438	$30,667	$49,732	$20,078	$118,353
Lower Umpqua Hospital	-$276	$0	$201,608	$5,062	$354,073	$574,199	$231,813	$1,366,479
Lower Umpqua Parks and Recreation	-$17	$0	$12,260	$308	$21,532	$34,918	$14,097	$83,098
Lower Umpqua Library	-$27	$0	$19,791	$497	$34,758	$56,366	$22,756	$134,140
South Coast ESD	-$31	$0	$22,491	$565	$39,499	$64,055	$25,860	$152,439

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Reedsport SD 105	-$393	$0	$287,414	$7,216	$504,770	$818,582	$330,474	$1,948,064
Southwestern Oregon Community College	-$49	$0	$32,470	$894	$62,537	$84,237	$9,076	$189,166
South Umpqua SD 19	$0	$0	$0	$0	$0	$0	$486	$486

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 89. Percentage Increase in BOFL Revenue Distributions in Douglas County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Douglas County District	43%	40%	-39%	-36%	-50%	100%	158%	8%
4H Extension	43%	40%	-39%	-36%	-50%	100%	158%	8%
Douglas ESD	39%	164%	-50%	3%	-86%	-40%	135%	-5%
Umpqua Community College	39%	164%	-50%	3%	-86%	-40%	135%	-5%
Glendale Ambulance District	39%	164%	-50%	3%	-86%	-40%	134%	-5%
Glendale SD 77	39%	164%	-50%	3%	-86%	-40%	134%	-5%
Glendale FD	0%	0%	0%	0%	0%	0%	(+)	(+)
Umpqua Public Transportation	-91%	-100%	-24%	-98%	65%	600%	346%	38%
Lower Umpqua Hospital	-91%	-100%	-24%	-98%	65%	600%	346%	38%
Lower Umpqua Parks and Recreation	-91%	-100%	-24%	-98%	65%	600%	346%	38%
Lower Umpqua Library	-91%	-100%	-24%	-98%	65%	600%	346%	38%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
South Coast ESD	-91%	-100%	-24%	-98%	65%	600%	346%	38%
Reedsport SD 105	-91%	-100%	-24%	-98%	65%	600%	346%	38%
Southwestern Oregon Community College	-91%	-100%	-29%	-98%	188%	481%	-1%	24%
South Umpqua SD 19	0%	0%	0%	-100%	0%	-100%	(+)	20%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 90. BOFL Revenue Distributions to Douglas County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Douglas County	$444,771 (48%)	$725,948 (13%)	$1,578,417 (-35%)	$1,714,574 (-43%)	$1,830,650 (-42%)	$6,294,360 (-34%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 91. BOFL Distributions to Taxing Districts in Douglas County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Douglas County District	$39,229	$63,941	$109,263	$147,092	$113,671	$473,196
4H Extension	$2,116	$3,449	$5,893	$7,934	$6,131	$25,523
Douglas ESD	$18,714	$30,442	$24,263	$66,378	$10,371	$150,168
Umpqua Community College	$16,081	$26,159	$20,850	$57,041	$8,912	$129,044
Glendale Ambulance District	$41,343	$67,252	$53,603	$146,644	$22,913	$331,754
Glendale SD 77	$183,352	$298,261	$237,726	$650,361	$101,616	$1,471,317
Glendale FD	$0	$154	$0	$9	$0	$164

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Umpqua Public Transportation	-$24	$0	$18,034	$2,372	$28,423	$48,804
Lower Umpqua Hospital	-$281	$0	$208,213	$27,383	$328,170	$563,485
Lower Umpqua Parks and Recreation	-$17	$0	$12,662	$1,665	$19,957	$34,267
Lower Umpqua Library	-$28	$0	$20,439	$2,688	$32,215	$55,315
South Coast ESD	-$31	$0	$23,227	$3,055	$36,609	$62,860
Reedsport SD 105	-$400	$0	$296,830	$39,038	$467,841	$803,309
Southwestern Oregon Community College	-$50	$0	$33,653	$4,836	$57,962	$96,401
South Umpqua SD 19	$0	$0	$0	$0	$0	$0

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 92. Percentage Increase in BOFL Revenue Distributions in Douglas County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Douglas County District	46%	41%	-38%	-34%	-54%	-34%
4H Extension	46%	41%	-38%	-34%	-54%	-34%
Douglas ESD	42%	165%	-49%	3%	-88%	-34%
Umpqua Community College	42%	165%	-49%	3%	-88%	-34%
Glendale Ambulance District	42%	165%	-49%	3%	-88%	-34%
Glendale SD 77	42%	165%	-49%	3%	-88%	-34%
Glendale FD	0%	(+)	0%	(+)	0%	(+)
Humphrey Road District	0%	0%	0%	0%	0%	0%
Umpqua Public Transportation	-90%	-100%	-22%	-91%	53%	-34%
Lower Umpqua Hospital	-90%	-100%	-22%	-91%	53%	-34%
Lower Umpqua Parks and Recreation	-90%	-100%	-22%	-91%	53%	-34%
Lower Umpqua Library	-90%	-100%	-22%	-91%	53%	-34%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
South Coast ESD	-90%	-100%	-22%	-91%	53%	-34%
Reedsport SD 105	-90%	-100%	-22%	-91%	53%	-34%
Southwestern Oregon Community College	-90%	-100%	-27%	-90%	167%	-25%
South Umpqua SD 19	0%	0%	-100%	0%	0%	-100%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 93. BOFL Revenue Distributions to Douglas County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Douglas County	$736,977 (145%)	$708,237 (11%)	$3,994,578 (65%)	$1,458,899 (-52%)	$3,584,122 (14%)	$3,286,455 (149%)	$3,411,461 (112%)	$17,180,728 (38%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 94. BOFL Revenue Distributions to Taxing Districts in Douglas County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Douglas County District	$64,933	$60,622	$315,939	$119,500	$260,176	$242,791	$270,138	$1,334,100
North Douglas Parks and Recreation	$0	$0	$0	$0	$0	$0	$0	$0
4H Extension	$3,502	$3,270	$17,041	$6,446	$14,033	$13,096	$14,571	$71,958
North Douglas Library	$0	$0	$0	$0	$0	$0	$0	$0
Douglas ESD	$30,914	$27,246	$116,959	$48,589	$72,721	$70,549	$96,632	$463,611

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
North Douglas SD 22	$0	$0	$0	$0	$0	$0	$0	$0
Umpqua Community College	$26,565	$23,413	$100,507	$41,754	$62,491	$60,625	$83,039	$398,393
Glendale Ambulance District	$68,296	$60,192	$258,389	$107,343	$160,302	$155,754	$212,215	$1,022,490
Glendale SD 77	$302,888	$266,948	$1,145,942	$476,064	$710,931	$690,764	$941,162	$4,534,699
Glendale FD	$0	$154	$9	$0	$0	$0	$7	$170
Humphrey Road District	$0	$0	$0	$0	$0	$0	$0	$0
Umpqua Public Transportation	$0	$1,050	$21,737	$5,395	$33,231	$29,265	$20,777	$111,454
Lower Umpqua Hospital	$0	$12,120	$250,971	$62,292	$383,676	$337,886	$239,882	$1,286,828
Lower Umpqua Parks and Recreation	$0	$737	$15,262	$3,788	$23,332	$20,548	$14,588	$78,255
Lower Umpqua Library	$0	$1,190	$24,637	$6,115	$37,664	$33,169	$23,548	$126,322
South Coast ESD	$0	$1,352	$27,997	$6,949	$42,801	$37,693	$26,760	$143,553
Reedsport SD 105	$0	$17,279	$357,787	$88,804	$546,972	$481,693	$341,977	$1,834,512
Southwestern Oregon Community College	$0	$2,141	$41,205	$11,002	$67,765	$42,499	$10,668	$175,281
South Umpqua SD 19	$0	$0	$0	$0	$1,429	$415	$5,100	$6,944

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 95. Percentage Increase in BOFL Revenue Distributions in Douglas County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Douglas County District	141%	34%	80%	-46%	4%	132%	101%	39%
North Douglas Parks and Recreation	0%	0%	0%	0%	0%	0%	0%	0%
4H Extension	141%	34%	80%	-46%	4%	132%	101%	39%
North Douglas Library	0%	0%	0%	0%	0%	0%	0%	0%
Douglas ESD	134%	137%	144%	-25%	-19%	82%	70%	44%
North Douglas SD 22	0%	0%	0%	0%	0%	0%	0%	0%
Umpqua Community College	134%	137%	144%	-25%	-19%	82%	70%	44%
Glendale Ambulance District	134%	137%	144%	-25%	-19%	82%	69%	43%
Glendale SD 77	134%	137%	144%	-25%	-19%	82%	69%	43%
Glendale FD	0%	0%	0%	0%	0%	0%	(+)	(+)
Humphrey Road District	0%	0%	0%	0%	0%	0%	0%	0%
Umpqua Public Transportation	-100%	-84%	-5%	-80%	79%	312%	361%	29%
Lower Umpqua Hospital	-100%	-84%	-5%	-80%	79%	312%	361%	29%
Lower Umpqua Parks and Recreation	-100%	-84%	-5%	-80%	79%	312%	361%	29%
Lower Umpqua Library	-100%	-84%	-5%	-80%	79%	312%	361%	29%
South Coast ESD	-100%	-84%	-5%	-80%	79%	312%	361%	29%
Reedsport SD 105	-100%	-84%	-5%	-80%	79%	312%	361%	29%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Southwestern Oregon Community College	-100%	-84%	-10%	-77%	212%	193%	16%	15%
South Umpqua SD 19	0%	0%	0%	-100%	(+)	6%	(+)	1616%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Jackson County

Jackson County does not contain BOFL and thus does not receive revenue from timber sales on BOFL.

Josephine County

Table 96. BOFL Revenue Distributions to Josephine County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Year)
County Administration	$23,542	$626	$0	$0	$15,726	$67,198	$1,169	$108,260
County School Fund	$52,968	$1,408	$0	$0	$35,384	$151,195	$2,629	$243,585
Taxing Districts[a]	$158,905	$4,224	$0	$0	$106,153	$453,585	$7,888	$730,755
Josephine County (Total)	$235,415	$6,258	$0	$0	$157,263	$671,979	$11,685	$1,082,600

Source: ECONorthwest's analysis of Forest Model
[a] For further breakdown of revenue to individual taxing districts, see Table 97.

Table 97. BOFL Revenue Distributions to Taxing Districts in Josephine County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Josephine County District	$32,688	$348	$0	$0	$23,706	$101,294	$1,268	$159,305
Three Rivers SD	$85,918	$916	$0	$0	$62,309	$266,243	$3,334	$418,720
Rogue Community College	$11,524	$123	$0	$0	$8,357	$35,710	$447	$56,161
Southern Oregon ESD	$7,214	$77	$0	$0	$5,232	$22,356	$280	$35,159
4H/Extension Service District	$940	$10	$0	$0	$681	$2,912	$36	$4,579
Josephine Community Library District	$7,984	$85	$0	$0	$5,790	$24,741	$310	$38,911
Wolf Creek RFD	$12,521	$2,662	$0	$0	$0	$0	$2,206	$17,390

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 98. BOFL Revenue Distributions to Josephine County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Josephine County	$124,278 (-47%)	$117,793 (1782%)	$0 (0%)	$773,970 (+)	$408,874 (160%)	$938,413 (40%)	$922,910 (7798%)	$3,286,238 (204%)

Source: ECONorthwest's analysis of Forest Model

+ sign indicates increase in revenue relative to $0 under the no action alternative; - sign indicates decrease in revenue relative to the no action alternative

Table 99. BOFL Distributions to Taxing Districts in Josephine County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	$13,491	$14,195	$0	$102,458	$57,390	$113,123	$112,243	$412,900
Three Rivers SD	$35,460	$37,312	$0	$269,302	$150,845	$297,335	$295,021	$1,085,274
Rogue Community College	$4,756	$5,004	$0	$36,120	$20,232	$39,880	$39,570	$145,564
Southern Oregon ESD	$2,978	$3,133	$0	$22,613	$12,666	$24,967	$24,773	$91,129
4H/Extension Service District	$388	$408	$0	$2,945	$1,650	$3,252	$3,227	$11,870
Josephine Community Library District	$3,295	$3,467	$0	$25,026	$12,897	$27,631	$27,416	$99,732
Wolf Creek RFD	$23,459	$15,933	$0	$62,401	$20,109	$126,781	$120,264	$368,947

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 100. Percentage Increase in BOFL Revenue Distributions in Josephine County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	-59%	3975%	0%	(+)	142%	12%	8749%	159%
Three Rivers SD	-59%	3975%	0%	(+)	142%	12%	8749%	159%
Rogue Community College	-59%	3975%	0%	(+)	142%	12%	8749%	159%
Southern Oregon ESD	-59%	3975%	0%	(+)	142%	12%	8749%	159%
4H/Extension Service District	-59%	3975%	0%	(+)	142%	12%	8749%	159%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine Community Library District	-59%	3975%	0%	(+)	123%	12%	8749%	156%
Wolf Creek RFD	87%	498%	0%	(+)	(+)	(+)	5352%	2022%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 101. BOFL Revenue Distributions to Josephine County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County	$124,278 (-47%)	$116,396 (1760%)	$0 (0%)	$766,207 (+)	$327,956 (109%)	$1,049,644 (56%)	$746,614 (6289%)	$3,131,095 (189%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 102. BOFL Revenue Distributions to Taxing Districts in Douglas County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	$13,491	$13,985	$0	$101,532	$45,306	$124,856	$92,770	$391,940
Three Rivers SD	$35,460	$36,758	$0	$266,868	$119,083	$328,175	$243,839	$1,030,184
Rogue Community College	$4,756	$4,930	$0	$35,794	$15,972	$44,017	$32,705	$138,174
Southern Oregon ESD	$2,978	$3,087	$0	$22,409	$9,999	$27,556	$20,475	$86,503
4H/Extension Service District	$388	$402	$0	$2,919	$1,302	$3,589	$2,667	$11,267

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine Community Library District	$3,295	$3,416	$0	$24,800	$9,982	$30,497	$22,660	$94,649
Wolf Creek RFD	$23,459	$15,933	$0	$61,314	$19,565	$149,305	$88,482	$358,058

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 103. Percentage Increase in BOFL Revenue Distributions in Josephine County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	-59%	3915%	0%	(+)	91%	23%	7213%	146%
Three Rivers SD	-59%	3915%	0%	(+)	91%	23%	7213%	146%
Rogue Community College	-59%	3915%	0%	(+)	91%	23%	7213%	146%
Southern Oregon ESD	-59%	3915%	0%	(+)	91%	23%	7213%	146%
4H/Extension Service District	-59%	3915%	0%	(+)	91%	23%	7213%	146%
Josephine Community Library District	-59%	3915%	0%	(+)	72%	23%	7213%	143%
Wolf Creek RFD	87%	498%	0%	(+)	(+)	(+)	3911%	1959%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 104. BOFL Revenue Distributions to Josephine County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Josephine County	$124,278 (-47%)	$117,793 (1782%)	$0 (0%)	$773,970 (+)	$408,874 (160%)	$1,424,915 (257%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 105. BOFL Revenue Distributions to Taxing Districts in Josephine County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Josephine County District	$13,491	$14,195	$0	$102,458	$57,390	$187,534
Three Rivers SD	$35,460	$37,312	$0	$269,302	$150,845	$492,919
Rogue Community College	$4,756	$5,004	$0	$36,120	$20,232	$66,113
Southern Oregon ESD	$2,978	$3,133	$0	$22,613	$12,666	$41,390
4H/Extension Service District	$388	$408	$0	$2,945	$1,650	$5,391
Josephine Community Library District	$3,295	$3,467	$0	$25,026	$12,897	$44,685
Wolf Creek RFD	$23,459	$15,933	$0	$62,401	$20,109	$121,902

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 106. Percentage Increase in BOFL Revenue Distributions under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Josephine County District	-59%	3975%	0%	(+)	142%	231%
Three Rivers SD	-59%	3975%	0%	(+)	142%	231%
Rogue Community College	-59%	3975%	0%	(+)	142%	231%
Southern Oregon ESD	-59%	3975%	0%	(+)	142%	231%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
4H/Extension Service District	-59%	3975%	0%	(+)	142%	231%
Josephine Community Library District	-59%	3975%	0%	(+)	123%	222%
Wolf Creek RFD	87%	498%	0%	(+)	(+)	703%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 107. BOFL Revenue Distributions to Josephine County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County	$124,278 (-47%)	$117,793 (1782%)	$105,260 (+)	$892,929 (+)	$727,835 (363%)	$1,035,050 (54%)	$748,251 (6303%)	$3,751,396 (247%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 108 BOFL Revenue Distributions to Taxing Districts in Josephine County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	$13,491	$14,195	$15,855	$120,390	$105,466	$116,610	$98,294	$484,301
Three Rivers SD	$35,460	$37,312	$41,673	$316,435	$277,210	$306,500	$258,359	$1,272,948
Rogue Community College	$4,756	$5,004	$5,589	$42,442	$37,181	$41,110	$34,653	$170,735
Southern Oregon ESD	$2,978	$3,133	$3,499	$26,571	$23,277	$25,736	$21,694	$106,888
4H/Extension Service District	$388	$408	$456	$3,461	$3,032	$3,352	$2,826	$13,922

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine Community Library District	$3,295	$3,467	$3,873	$29,406	$24,640	$28,482	$24,009	$117,172
Wolf Creek RFD	$23,459	$15,933	$54	$62,401	$20,126	$176,361	$64,868	$363,202

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 109. Percentage Increase in BOFL Revenue Distributions in Josephine County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Josephine County District	-59%	3975%	(+)	(+)	345%	15%	7649%	204%
Three Rivers SD	-59%	3975%	(+)	(+)	345%	15%	7649%	204%
Rogue Community College	-59%	3975%	(+)	(+)	345%	15%	7649%	204%
Southern Oregon ESD	-59%	3975%	(+)	(+)	345%	15%	7649%	204%
4H/Extension Service District	-59%	3975%	(+)	(+)	345%	15%	7649%	204%
Josephine Community Library District	-59%	3975%	(+)	(+)	326%	15%	7649%	201%
Wolf Creek RFD	87%	498%	(+)	(+)	(+)	(+)	2841%	1989%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Lane County

Table 110. BOFL Revenue Distributions to Lane County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
County Administration	$2,172,101	$1,708,457	$1,781,962	$1,753,139	$1,730,974	$2,001,823	$1,766,494	$12,914,950
County School Fund	$4,887,228	$3,844,027	$4,009,415	$3,944,563	$3,894,691	$4,504,101	$3,974,611	$29,058,637
Taxing Districts[a]	$14,661,683	$11,532,082	$12,028,245	$11,833,689	$11,684,072	$13,512,303	$11,923,833	$87,175,910
Lane County (Total)	$21,721,013	$17,084,566	$17,819,623	$17,531,391	$17,309,736	$20,018,226	$17,664,938	$129,149,496

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 111.

Table 111. BOFL Revenue Distributions to Taxing Districts in Lane County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	$4,180,326	$1,794,685	$1,952,747	$2,910,873	$1,461,809	$2,948,364	$4,159,119	$19,407,922
Lane Community College	$1,480,968	$1,096,923	$1,114,076	$1,201,648	$1,180,891	$1,331,542	$1,163,986	$8,570,034
Lane SD	$343,324	$254,293	$258,269	$278,571	$273,759	$308,683	$269,840	$1,986,738
Lane County 4-H Extension	$23,073	$17,090	$17,357	$18,721	$18,398	$20,745	$18,134	$133,517
Lane County Public Safety	$846,004	$626,618	$636,416	$686,442	$674,585	$760,644	$664,928	$4,895,637
Fern Ridge Library District	$456,939	$196,171	$213,449	$318,178	$159,786	$322,277	$454,620	$2,121,420
Lane County District	$1,967,804	$1,457,513	$1,480,305	$1,596,665	$1,569,084	$1,769,259	$1,546,622	$11,387,251
Lane Fire Authority	$88,812	$59,402	$305,510	$67,649	$0	$323,219	$52,030	$896,624
Port of Siuslaw	$199,259	$142,338	$147,038	$174,266	$177,216	$172,822	$155,391	$1,168,330
Mapleton SD	$456,111	$1,728,812	$1,840,999	$948,421	$1,831,176	$966,588	$536,586	$8,308,691

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Western Lane Ambulance District	$51,307	$216,354	$230,394	$69,051	$229,165	$120,965	$67,152	$984,388
Mapleton FD	$0	$5,411	$315	$22,640	$0	$0	$0	$28,366
Swisshome Deadwood RFD	$169,795	$801,033	$383,610	$81,530	$388,982	$86,652	$212,741	$2,124,344
Crow Applegate Lorane SD	$237,984	$289,747	$1,821,844	$284,269	$278,815	$1,198,450	$118,850	$4,229,960
Junction City SD	$182,267	$169,838	$0	$0	$0	$0	$138,232	$490,337
Blachly SD	$3,967,062	$2,666,966	$1,617,180	$3,166,172	$3,431,203	$3,172,281	$2,356,872	$20,377,735
Lake Creek RFD	$0	$287	$0	$0	$719	$0	$0	$1,006
Eugene SD	$0	$227	$0	$0	$0	$0	$66	$293

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 112. BOFL Revenue Distributions to Lane County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lane County	$34,852,698 (60%)	$36,307,215 (113%)	$21,916,708 (23%)	$22,998,548 (31%)	$13,199,158 (-24%)	$16,161,426 (-19%)	$11,852,300 (-33%)	$157,288,048 (22%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 113. BOFL Revenue Distributions to Taxing Districts in Lane County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	$6,600,876	$6,037,368	$1,038,508	$2,765,099	$2,279,815	$1,720,502	$2,686,108	$23,128,276
Lane Community College	$2,350,028	$2,463,602	$1,420,322	$1,526,827	$876,777	$1,070,134	$768,814	$10,476,503

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lane SD	$544,792	$571,122	$329,264	$353,955	$203,258	$248,082	$178,229	$2,428,703
Lane County 4-H Extension	$36,612	$38,382	$22,128	$23,787	$13,660	$16,672	$11,978	$163,219
Lane County Public Safety	$1,342,454	$1,407,334	$811,360	$872,201	$500,859	$611,314	$439,186	$5,984,708
Fern Ridge Library District	$721,521	$659,926	$113,516	$302,244	$249,200	$188,063	$293,610	$2,528,080
Lane County District	$3,122,549	$3,273,459	$1,887,222	$2,028,739	$1,164,999	$1,421,917	$1,021,546	$13,920,430
Lane Fire Authority	$222,437	$78,485	$295,219	$140,367	$91,545	$369,377	$60,316	$1,257,746
Port of Siuslaw	$304,056	$290,699	$177,805	$232,268	$125,320	$138,794	$90,056	$1,358,997
Mapleton SD	$1,435,113	$2,438,213	$2,729,229	$2,457,431	$1,083,011	$676,041	$571,145	$11,390,184
Western Lane Ambulance District	$177,512	$305,133	$341,553	$303,257	$70,844	$84,604	$71,477	$1,354,380
Mapleton FD	$0	$0	$141	$29,391	$284	$0	$0	$29,816
Swisshome Deadwood RFD	$269,239	$357,907	$502,309	$277,581	$161,559	$60,404	$182,495	$1,811,493
Crow Applegate Lorane SD	$462,207	$134,734	$1,777,320	$833,910	$229,283	$1,602,325	$176,178	$5,215,956
Junction City SD	$0	$576,882	$670,990	$0	$0	$75,579	$71,495	$1,394,945
Blachly SD	$5,914,022	$5,856,328	$2,665,892	$3,364,772	$1,851,854	$2,617,234	$1,371,825	$23,641,926
Lake Creek RFD	$5,067	$0	$0	$915	$694	$0	$0	$6,676
Eugene SD	$0	$0	$256	$0	$0	$0	$37	$292

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 114. Percentage Increase in BOFL Revenue Distributions in Lane County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	58%	236%	-47%	-5%	56%	-42%	-35%	19%
Lane Community College	59%	125%	27%	27%	-26%	-20%	-34%	22%
Lane SD	59%	125%	27%	27%	-26%	-20%	-34%	22%
Lane County 4-H Extension	59%	125%	27%	27%	-26%	-20%	-34%	22%
Lane County Public Safety	59%	125%	27%	27%	-26%	-20%	-34%	22%
Fern Ridge Library District	58%	236%	-47%	-5%	56%	-42%	-35%	19%
Lane County District	59%	125%	27%	27%	-26%	-20%	-34%	22%
Lane Fire Authority	150%	32%	-3%	107%	(+)	14%	16%	40%
Port of Siuslaw	53%	104%	21%	33%	-29%	-20%	-42%	16%
Mapleton SD	215%	41%	48%	159%	-41%	-30%	6%	37%
Western Lane Ambulance District	246%	41%	48%	339%	-69%	-30%	6%	38%
Mapleton FD	0%	-100%	-55%	30%	(+)	0%	0%	5%
Swisshome Deadwood RFD	59%	-55%	31%	240%	-58%	-30%	-14%	-15%
Crow Applegate Lorane SD	94%	-53%	-2%	193%	-18%	34%	48%	23%
Junction City SD	-100%	240%	(+)	0%	0%	(+)	-48%	184%
Blachly SD	49%	120%	65%	6%	-46%	-17%	-42%	16%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lake Creek RFD	(+)	-100%	0%	+	-4%	0%	0%	564%
Eugene SD	0%	-100%	(+)	0%	0%	0%	-44%	0%

Source: ECONorthwest's analysis of Forest Model
RFD = Rural Fire Department; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 115. BOFL Revenue Distributions to Lane County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lane County	$34,831,398 (60%)	$35,788,995 (109%)	$21,811,220 (22%)	$22,249,488 (27%)	$13,548,923 (-22%)	$16,768,364 (-16%)	$11,044,490 (-37%)	$156,042,880 (21%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 116. BOFL Revenue Distributions to Taxing Districts in Lane County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	$6,575,349	$6,090,096	$996,413	$2,733,983	$2,315,829	$1,985,020	$2,302,300	$22,998,990
Lane Community College	$2,350,889	$2,430,249	$1,402,321	$1,476,093	$904,911	$1,109,365	$715,355	$10,389,184
Lane SD	$544,992	$563,390	$325,091	$342,194	$209,780	$257,177	$165,836	$2,408,460
Lane County 4-H Extension	$36,626	$37,862	$21,848	$22,997	$14,098	$17,283	$11,145	$161,859
Lane County Public Safety	$1,342,947	$1,388,281	$801,076	$843,219	$516,931	$633,725	$408,647	$5,934,826
Fern Ridge Library District	$718,731	$665,690	$108,915	$298,843	$253,136	$216,976	$251,657	$2,513,949
Lane County District	$3,123,694	$3,229,142	$1,863,304	$1,961,328	$1,202,382	$1,474,045	$950,512	$13,804,406

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lane Fire Authority	$247,805	$59,691	$294,941	$139,861	$93,481	$364,015	$59,981	$1,259,776
Port of Siuslaw	$304,974	$287,770	$175,079	$224,518	$130,800	$139,458	$89,885	$1,352,483
Mapleton SD	$1,327,709	$2,448,723	$2,773,130	$2,340,013	$1,077,282	$661,356	$605,084	$11,233,298
Western Lane Ambulance District	$164,085	$306,449	$347,047	$288,592	$71,004	$82,766	$75,724	$1,335,666
Mapleton FD	$0	$0	$139	$29,391	$284	$0	$0	$29,814
Swisshome Deadwood RFD	$263,109	$301,205	$595,050	$249,342	$163,034	$61,423	$204,477	$1,837,640
Crow Applegate Lorane SD	$458,282	$134,734	$1,753,509	$848,077	$155,214	$1,587,924	$204,937	$5,142,676
Junction City SD	$0	$508,530	$671,012	$0	$0	$65,239	$71,499	$1,316,279
Blachly SD	$6,029,859	$5,688,219	$2,582,752	$3,207,106	$2,030,022	$2,654,652	$1,332,541	$23,525,151
Lake Creek RFD	$5,066	$0	$0	$1,939	$694	$0	$0	$7,699
Eugene SD	$0	$0	$256	$0	$0	$0	$37	$292

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 117. Percentage Increase in BOFL Revenue Distributions in Lane County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	57%	239%	-49%	-6%	58%	-33%	-45%	19%
Lane Community College	59%	122%	26%	23%	-23%	-17%	-39%	21%
Lane SD	59%	122%	26%	23%	-23%	-17%	-39%	21%
Lane County 4-H Extension	59%	122%	26%	23%	-23%	-17%	-39%	21%

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lane County Public Safety	59%	122%	26%	23%	-23%	-17%	-39%	21%
Fern Ridge Library District	57%	239%	-49%	-6%	58%	-33%	-45%	19%
Lane County District	59%	122%	26%	23%	-23%	-17%	-39%	21%
Lane Fire Authority	179%	0%	-3%	107%	(+)	13%	15%	41%
Port of Siuslaw	53%	102%	19%	29%	-26%	-19%	-42%	16%
Mapleton SD	191%	42%	51%	147%	-41%	-32%	13%	35%
Western Lane Ambulance District	220%	42%	51%	318%	-69%	-32%	13%	36%
Mapleton FD	0%	-100%	-56%	30%	(+)	0%	0%	5%
Swisshome Deadwood RFD	55%	-62%	55%	206%	-58%	-29%	-4%	-13%
Crow Applegate Lorane SD	93%	-53%	-4%	198%	-44%	32%	72%	22%
Junction City SD	-100%	199%	(+)	0%	0%	(+)	-48%	168%
Blachly SD	52%	113%	60%	1%	-41%	-16%	-43%	15%
Lake Creek RFD	(+)	-100%	0%	(+)	-4%	0%	0%	665%
Eugene SD	0%	-100%	(+)	0%	0%	0%	-44%	0%

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 118. BOFL Revenue Distributions to Lane County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Lane County	$34,852,698 (60%)	$36,307,215 (113%)	$21,916,708 (23%)	$22,998,548 (31%)	$13,199,158 (-24%)	$129,274,320 (41%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 119. BOFL Revenue Distributions to Taxing Districts in Lane County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Fern Ridge SD 28J	$6,600,876	$6,037,368	$1,038,508	$2,765,099	$2,279,815	$18,721,667
Lane Community College	$2,350,028	$2,463,602	$1,420,322	$1,526,827	$876,777	$8,637,555
Lane SD	$544,792	$571,122	$329,264	$353,955	$203,258	$2,002,391
Lane County 4-H Extension	$36,612	$38,382	$22,128	$23,787	$13,660	$134,569
Lane County Public Safety	$1,342,454	$1,407,334	$811,360	$872,201	$500,859	$4,934,208
Fern Ridge Library District	$721,521	$659,926	$113,516	$302,244	$249,200	$2,046,407
Lane County District	$3,122,549	$3,273,459	$1,887,222	$2,028,739	$1,164,999	$11,476,967
Lane Fire Authority	$222,437	$78,485	$295,219	$140,367	$91,545	$828,054
Port of Siuslaw	$304,056	$290,699	$177,805	$232,268	$125,320	$1,130,148
Mapleton SD	$1,435,113	$2,438,213	$2,729,229	$2,457,431	$1,083,011	$10,142,997
Western Lane Ambulance District	$177,512	$305,133	$341,553	$303,257	$70,844	$1,198,299
Mapleton FD	$0	$0	$141	$29,391	$284	$29,816
Swisshome Deadwood RFD	$269,239	$357,907	$502,309	$277,581	$161,559	$1,568,595
Crow Applegate Lorane SD	$462,207	$134,734	$1,777,320	$833,910	$229,283	$3,437,453
Junction City SD	$0	$576,882	$670,990	$0	$0	$1,247,872
Blachly SD	$5,914,022	$5,856,328	$2,665,892	$3,364,772	$1,851,854	$19,652,867

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Lake Creek RFD	$5,067	$0	$0	$915	$694	$6,676
Eugene SD	$0	$0	$256	$0	$0	$256

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 120. Percentage Increase in BOFL Revenue Distributions in Lane County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Fern Ridge SD 28J	58%	236%	-47%	-5%	56%	52%
Lane Community College	59%	125%	27%	27%	-26%	42%
Lane SD	59%	125%	27%	27%	-26%	42%
Lane County 4-H Extension	59%	125%	27%	27%	-26%	42%
Lane County Public Safety	59%	125%	27%	27%	-26%	42%
Fern Ridge Library District	58%	236%	-47%	-5%	56%	52%
Lane County District	59%	125%	27%	27%	-26%	42%
Lane Fire Authority	150%	32%	-3%	107%	(+)	59%
Port of Siuslaw	53%	104%	21%	33%	-29%	35%
Mapleton SD	215%	41%	48%	159%	-41%	49%
Western Lane Ambulance District	246%	41%	48%	339%	-69%	50%
Mapleton FD	0%	-100%	-55%	30%	(+)	5%
Swisshome Deadwood RFD	59%	-55%	31%	240%	-58%	-14%
Crow Applegate Lorane SD	94%	-53%	-2%	193%	-18%	18%
Junction City SD	-100%	240%	(+)	0%	0%	254%
Blachly SD	49%	120%	65%	6%	-46%	32%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Lake Creek RFD	(+)	-100%	0%	(+)	-4%	564%
Eugene SD	0%	-100%	(+)	0%	0%	13%

Source: ECONorthwest's analysis of Forest Model
RFD = Rural Fire Department; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 121. BOFL Revenue Distributions to Lane County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lane County	$38,587,213 (78%)	$36,410,050 (113%)	$20,511,585 (15%)	$19,969,258 (14%)	$13,412,361 (-23%)	$16,943,893 (-15%)	$14,372,401 (-19%)	$160,206,752 (24%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 122. BOFL Revenue Distributions to Taxing Districts in Lane County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Fern Ridge SD 28J	$7,311,408	$5,547,240	$1,038,512	$2,454,567	$2,755,647	$1,815,032	$2,598,355	$23,520,762
Lane Community College	$2,590,467	$2,482,294	$1,319,490	$1,328,992	$901,406	$1,123,465	$939,859	$10,685,973
Lane SD	$600,532	$575,455	$305,889	$308,092	$208,967	$260,446	$217,882	$2,477,263
Lane County 4-H Extension	$40,358	$38,673	$20,557	$20,705	$14,044	$17,503	$14,643	$166,483
Lane County Public Safety	$1,479,805	$1,418,012	$753,759	$759,188	$514,928	$641,780	$536,895	$6,104,368
Fern Ridge Library District	$799,187	$606,352	$113,517	$268,301	$301,211	$198,396	$284,018	$2,570,982
Lane County District	$3,442,028	$3,298,296	$1,753,244	$1,765,870	$1,197,724	$1,492,780	$1,248,818	$14,198,759

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lane Fire Authority	$248,631	$81,884	$256,559	$140,368	$95,074	$364,753	$67,709	$1,254,978
Port of Siuslaw	$334,009	$298,002	$166,594	$202,200	$129,124	$143,230	$117,974	$1,391,133
Mapleton SD	$1,828,147	$2,578,177	$2,769,491	$1,762,755	$748,220	$755,672	$825,354	$11,267,816
Western Lane Ambulance District	$226,698	$322,649	$346,592	$216,321	$28,946	$94,570	$103,290	$1,339,066
Mapleton FD	$0	$0	$141	$29,498	$0	$0	$0	$29,639
Swisshome Deadwood RFD	$329,592	$365,445	$500,028	$244,344	$40,362	$59,657	$321,817	$1,861,246
Crow Applegate Lorane SD	$462,207	$212,604	$1,623,465	$848,454	$169,816	$1,694,414	$260,500	$5,271,460
Junction City SD	$51,570	$569,083	$612,126	$0	$8,384	$38,079	$136,752	$1,415,995
Blachly SD	$6,277,745	$6,164,543	$2,255,303	$3,118,889	$1,932,220	$2,729,045	$2,020,395	$24,498,140
Lake Creek RFD	$5,067	$0	$0	$915	$694	$0	$0	$6,676
Eugene SD	$0	$227	$0	$0	$0	$0	$66	$293

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 123. Percentage Increase in BOFL Revenue Distributions in Lane County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Fern Ridge SD 28J	75%	209%	-47%	-16%	89%	-38%	-38%	21%
Lane Community College	75%	126%	18%	11%	-24%	-16%	-19%	25%
Lane SD	75%	126%	18%	11%	-24%	-16%	-19%	25%
Lane County 4-H Extension	75%	126%	18%	11%	-24%	-16%	-19%	25%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lane County Public Safety	75%	126%	18%	11%	-24%	-16%	-19%	25%
Fern Ridge Library District	75%	209%	-47%	-16%	89%	-38%	-38%	21%
Lane County District	75%	126%	18%	11%	-24%	-16%	-19%	25%
Lane Fire Authority	180%	38%	-16%	107%	(+)	13%	30%	40%
Port of Siuslaw	68%	109%	13%	16%	-27%	-17%	-24%	19%
Mapleton SD	301%	49%	50%	86%	-59%	-22%	54%	36%
Western Lane Ambulance District	342%	49%	50%	213%	-87%	-22%	54%	36%
Mapleton FD	0%	-100%	-55%	30%	0%	0%	0%	4%
Swisshome Deadwood RFD	94%	-54%	30%	200%	-90%	-31%	51%	-12%
Siuslaw Public Library	0%	0%	0%	0%	0%	0%	0%	0%
Crow Applegate Lorane SD	94%	-27%	-11%	198%	-39%	41%	119%	25%
Junction City SD	-72%	235%	(+)	0%	(+)	(+)	-1%	189%
Blachly SD	58%	131%	39%	-1%	-44%	-14%	-14%	20%
Lake Creek RFD	(+)	-100%	0%	(+)	-4%	0%	0%	564%
Eugene SD	0%	0%	0%	0%	0%	0%	0%	0%

Source: ECONorthwest's analysis of Forest Model

RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Lincoln County

Table 124. BOFL Revenue Distributions to Lincoln County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
County Administration	$2,502,668	$4,243,077	$4,711,480	$5,158,114	$4,475,848	$4,245,568	$4,573,804	$29,910,560
County School Fund	$1,877,001	$3,182,308	$3,533,610	$3,868,586	$3,356,886	$3,184,176	$3,430,353	$22,432,920
Taxing Districts[a]	$5,631,003	$9,546,924	$10,600,831	$11,605,757	$10,070,657	$9,552,527	$10,291,060	$67,298,760
Lincoln County (Total)	$10,010,672	$16,972,309	$18,845,921	$20,632,458	$17,903,390	$16,982,270	$18,295,218	$119,642,240

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 125.

Table 125. BOFL Revenue Distributions to Taxing Districts in Lincoln County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lincoln County District	$1,533,190	$2,675,797	$2,981,970	$3,112,679	$2,741,675	$2,588,031	$2,855,359	$18,488,701
Animal Service District	$59,801	$104,368	$116,310	$121,408	$106,937	$100,944	$111,371	$721,139
Lincoln County SD	$3,082,037	$5,378,920	$5,994,393	$6,257,144	$5,511,349	$5,202,490	$5,739,877	$37,166,209
Extension District	$24,518	$42,791	$47,687	$49,777	$43,844	$41,387	$45,662	$295,667
Transportation District	$52,951	$92,413	$102,987	$107,501	$94,688	$89,382	$98,614	$638,536
Community College	$227,951	$397,831	$443,352	$462,785	$407,625	$384,782	$424,527	$2,748,852
Linn-Benton ESD	$165,758	$289,288	$322,389	$336,521	$296,410	$279,799	$308,701	$1,998,867
Library	$182,937	$319,270	$355,802	$371,398	$327,131	$308,798	$340,695	$2,206,031
Port of Toledo	$127,485	$222,493	$247,951	$258,820	$227,971	$215,195	$237,423	$1,537,338

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 126. BOFL Revenue Distributions to Lincoln County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lincoln County	$11,311,991 (13%)	$22,906,130 (35%)	$26,965,343 (43%)	$22,375,465 (8%)	$27,468,025 (53%)	$28,654,258 (69%)	$23,211,945 (27%)	$162,893,152 (36%)

Source: ECONorthwest's analysis of Forest Model

Table 127. BOFL Revenue Distributions to Taxing Districts in Lincoln County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lincoln County District	$1,743,325	$3,506,712	$4,254,866	$3,408,709	$4,337,054	$4,434,189	$3,598,774	$25,283,629
Animal Service District	$67,997	$136,777	$165,958	$132,954	$169,164	$172,953	$140,368	$986,171
Lincoln County SD	$3,504,453	$7,049,235	$8,553,183	$6,852,227	$8,718,398	$8,913,661	$7,234,299	$50,825,457
Extension District	$27,879	$56,079	$68,043	$54,511	$69,357	$70,911	$57,551	$404,330
Transportation District	$60,208	$121,110	$146,948	$117,725	$149,787	$153,142	$124,289	$873,210
Community College	$259,193	$521,369	$632,602	$506,798	$644,822	$659,264	$535,056	$3,759,104
Linn-Benton ESD	$188,476	$379,121	$460,006	$368,525	$468,892	$479,393	$389,074	$2,733,487
Library	$208,010	$418,413	$507,681	$406,720	$517,488	$529,078	$429,398	$3,016,787
Port of Toledo	$144,958	$291,584	$353,793	$283,435	$360,627	$368,703	$299,239	$2,102,337

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 128. Percentage Increase in BOFL Revenue Distributions in Lincoln County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lincoln County District	14%	31%	43%	10%	58%	71%	26%	37%
Animal Service District	14%	31%	43%	10%	58%	71%	26%	37%
Lincoln County SD	14%	31%	43%	10%	58%	71%	26%	37%
Extension District	14%	31%	43%	10%	58%	71%	26%	37%
Transportation District	14%	31%	43%	10%	58%	71%	26%	37%
Community College	14%	31%	43%	10%	58%	71%	26%	37%
Linn-Benton ESD	14%	31%	43%	10%	58%	71%	26%	37%
Library	14%	31%	43%	10%	58%	71%	26%	37%
Port of Toledo	14%	31%	43%	10%	58%	71%	26%	37%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 129. BOFL Revenue Distributions to Lincoln County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Lincoln County	$11,090,540 (11%)	$22,549,918 (33%)	$26,242,558 (39%)	$24,029,783 (16%)	$28,272,393 (58%)	$26,768,975 (58%)	$22,806,050 (25%)	$161,760,208 (35%)

Source: ECONorthwest's analysis of Forest Model

Table 130. BOFL Revenue Distributions to Taxing Districts in Lincoln County (2023–2092)—Alternative 3 (in 2019 dollars)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Lincoln County District	$1,708,285	$3,448,355	$4,140,506	$3,670,470	$4,466,864	$4,135,875	$3,509,031	$25,079,385
Animal Service District	$66,631	$134,501	$161,498	$143,164	$174,227	$161,317	$136,867	$978,204
Lincoln County SD	$3,434,015	$6,931,925	$8,323,294	$7,378,422	$8,979,343	$8,313,986	$7,053,896	$50,414,881
Extension District	$27,319	$55,145	$66,214	$58,697	$71,433	$66,140	$56,116	$401,064
Transportation District	$58,998	$119,094	$142,999	$126,765	$154,270	$142,839	$121,190	$866,156
Community College	$253,983	$512,692	$615,600	$545,716	$664,122	$614,911	$521,714	$3,728,738
Linn-Benton ESD	$184,688	$372,812	$447,642	$396,825	$482,926	$447,141	$379,371	$2,711,405
Library	$203,829	$411,450	$494,036	$437,952	$532,976	$493,483	$418,690	$2,992,416
Port of Toledo	$142,044	$286,731	$344,284	$305,200	$371,420	$343,899	$291,776	$2,085,354

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 131. Percentage Increase in BOFL Revenue Distributions in Lincoln County under Alternative 3 Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Lincoln County District	11%	29%	39%	18%	63%	60%	23%	36%
Animal Service District	11%	29%	39%	18%	63%	60%	23%	36%
Lincoln County SD	11%	29%	39%	18%	63%	60%	23%	36%
Extension District	11%	29%	39%	18%	63%	60%	23%	36%
Transportation District	11%	29%	39%	18%	63%	60%	23%	36%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Community College	11%	29%	39%	18%	63%	60%	23%	36%
Linn-Benton ESD	11%	29%	39%	18%	63%	60%	23%	36%
Library	11%	29%	39%	18%	63%	60%	23%	36%
Port of Toledo	11%	29%	39%	18%	63%	60%	23%	36%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 132. BOFL Revenue Distributions to Lincoln County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Lincoln County	$11,311,991 (13%)	$22,906,130 (35%)	$26,965,343 (43%)	$22,375,465 (8%)	$27,468,025 (53%)	$111,026,952 (32%)

Source: ECONorthwest's analysis of Forest Model

Table 133. BOFL Revenue Distributions to Taxing Districts in Lincoln County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Lincoln County District	$1,743,325	$3,506,712	$4,254,866	$3,408,709	$4,337,054	$17,250,666
Animal Service District	$67,997	$136,777	$165,958	$132,954	$169,164	$672,851
Lincoln County SD	$3,504,453	$7,049,235	$8,553,183	$6,852,227	$8,718,398	$34,677,497
Extension District	$27,879	$56,079	$68,043	$54,511	$69,357	$275,869
Transportation District	$60,208	$121,110	$146,948	$117,725	$149,787	$595,779
Community College	$259,193	$521,369	$632,602	$506,798	$644,822	$2,564,784
Linn-Benton ESD	$188,476	$379,121	$460,006	$368,525	$468,892	$1,865,020
Library	$208,010	$418,413	$507,681	$406,720	$517,488	$2,058,311
Port of Toledo	$144,958	$291,584	$353,793	$283,435	$360,627	$1,434,395

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 134. Percentage Increase in BOFL Revenue Distributions in Lincoln County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods					Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	(50 Years)
Lincoln County District	14%	31%	43%	10%	58%	32%
Animal Service District	14%	31%	43%	10%	58%	32%
Lincoln County SD	14%	31%	43%	10%	58%	32%
Extension District	14%	31%	43%	10%	58%	32%
Transportation District	14%	31%	43%	10%	58%	32%
Community College	14%	31%	43%	10%	58%	32%
Linn-Benton ESD	14%	31%	43%	10%	58%	32%
Library	14%	31%	43%	10%	58%	32%
Port of Toledo	14%	31%	43%	10%	58%	32%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 135. BOFL Revenue Distributions to Lincoln County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Lincoln County	$13,481,539 (35%)	$20,287,928 (20%)	$28,758,580 (53%)	$24,805,115 (20%)	$30,408,718 (70%)	$28,337,203 (67%)	$22,598,910 (24%)	$168,677,984 (41%)

Source: ECONorthwest's analysis of Forest Model

Table 136. BOFL Revenue Distributions to Taxing Districts in Lincoln County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Lincoln County District	$2,081,245	$3,092,437	$4,538,609	$3,739,233	$4,797,015	$4,434,712	$3,451,290	$26,134,540
Animal Service District	$81,178	$120,618	$177,025	$145,846	$187,104	$172,973	$134,615	$1,019,360

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lincoln County SD	$4,183,743	$6,216,453	$9,123,566	$7,516,651	$9,643,016	$8,914,712	$6,937,825	$52,535,966
Extension District	$33,283	$49,454	$72,580	$59,797	$76,713	$70,919	$55,192	$417,938
Transportation District	$71,879	$106,802	$156,748	$129,140	$165,672	$153,160	$119,196	$902,597
Community College	$309,434	$459,775	$674,789	$555,939	$713,208	$659,341	$513,129	$3,885,615
Linn-Benton ESD	$225,009	$334,332	$490,682	$404,259	$518,619	$479,450	$373,129	$2,825,481
Library	$248,329	$368,983	$541,537	$446,157	$572,369	$529,140	$411,800	$3,118,315
Port of Toledo	$173,056	$257,137	$377,386	$310,918	$398,872	$368,747	$286,975	$2,173,090

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Table 137. Percentage Increase in BOFL Revenue Distributions in Lincoln County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Lincoln County District	36%	16%	52%	20%	75%	71%	21%	41%
Animal Service District	36%	16%	52%	20%	75%	71%	21%	41%
Lincoln County SD	36%	16%	52%	20%	75%	71%	21%	41%
Extension District	36%	16%	52%	20%	75%	71%	21%	41%
Transportation District	36%	16%	52%	20%	75%	71%	21%	41%
Community College	36%	16%	52%	20%	75%	71%	21%	41%
Linn-Benton ESD	36%	16%	52%	20%	75%	71%	21%	41%
Library	36%	16%	52%	20%	75%	71%	21%	41%
Port of Toledo	36%	16%	52%	20%	75%	71%	21%	41%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District

Linn County

Table 138. BOFL Revenue Distributions to Linn County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
County Administration	$1,366,721	$1,689,380	$1,902,912	$2,272,506	$3,497,490	$1,684,388	$1,273,577	$13,686,973
County School Fund	$3,075,123	$3,801,105	$4,281,551	$5,113,137	$7,869,351	$3,789,873	$2,865,548	$30,795,689
Taxing Districts[a]	$9,225,368	$11,403,316	$12,844,653	$15,339,412	$23,608,054	$11,369,619	$8,596,643	$92,387,066
Linn County (Total)	$13,667,213	$16,893,801	$19,029,116	$22,725,055	$34,974,895	$16,843,880	$12,735,768	$136,869,728

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 139.

Table 139. BOFL Revenue Distributions to Taxing Districts in Linn County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County District	$3,086,201	$3,798,710	$4,321,951	$5,164,113	$7,891,504	$3,809,339	$2,877,277	$30,949,095
Linn-Benton-Lincoln ESD	$223,320	$274,878	$312,740	$373,680	$571,037	$275,647	$208,202	$2,239,505
Linn-Benton Community College	$44,765	$0	$182,644	$201,892	$8,189	$83,214	$41,125	$561,830
Lebanon SD	$447,976	$0	$1,827,774	$1,900,199	$81,951	$832,752	$411,547	$5,502,199
Lebanon Aquatic Center	$16,011	$0	$65,327	$67,916	$2,929	$29,764	$14,709	$196,656
4H Extension District	$51,271	$63,107	$71,800	$85,791	$131,101	$63,284	$47,800	$514,153
Sweet Home SD	$0	$0	$0	$122,670	$0	$0	$0	$122,670
Sweet Home Ambulance District	$0	$0	$0	$6,265	$0	$0	$0	$6,265
Chemeketa Community College	$589,898	$798,851	$667,692	$819,376	$1,648,731	$691,196	$550,770	$5,766,514

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Chemeketa Library	$54,456	$73,746	$61,638	$75,640	$152,202	$63,807	$50,844	$532,334
Santiam Canyon SD	$4,686,566	$6,346,629	$5,304,615	$6,509,698	$13,098,679	$5,491,342	$4,375,702	$45,813,232
Gates RFD	$18,202	$39,114	$19,950	$1,031	$4,586	$21,016	$12,659	$116,558

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 140. BOFL Revenue Distributions to Linn County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County	$42,052,460 (208%)	$29,873,435 (77%)	$22,625,498 (19%)	$19,021,830 (-16%)	$18,715,231 (-46%)	$13,805,191 (-18%)	$15,688,999 (23%)	$161,782,640 (18%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 141. BOFL Revenue Distributions to Taxing Districts in Linn County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County District	$9,508,034	$6,744,329	$5,112,501	$4,297,460	$4,264,729	$3,147,020	$3,555,569	$36,629,643
Linn-Benton-Lincoln ESD	$688,010	$488,026	$369,945	$310,968	$308,600	$227,721	$257,284	$2,650,555
Linn-Benton Community College	$135,503	$20,714	$142,671	$32,815	$228,779	$172,953	$106,693	$840,130
Lebanon SD	$1,356,024	$207,292	$1,407,800	$290,953	$2,289,463	$1,666,592	$1,067,714	$8,285,838
Lebanon Aquatic Center	$48,466	$7,409	$50,317	$10,399	$81,829	$59,566	$38,162	$296,148
4H Extension District	$157,956	$112,043	$84,933	$71,393	$70,849	$52,281	$59,068	$608,524
Sweet Home SD	$0	$0	$20,362	$38,210	$0	$65,525	$0	$124,097

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Sweet Home Ambulance District	$0	$0	$1,040	$1,951	$0	$3,347	$0	$6,338
Chemeketa Community College	$1,820,553	$1,390,946	$886,728	$860,401	$594,734	$433,407	$606,823	$6,593,592
Chemeketa Library	$168,064	$128,405	$81,858	$79,428	$54,903	$40,010	$56,019	$608,685
Santiam Canyon SD	$14,463,751	$11,050,649	$7,044,789	$6,835,625	$4,724,985	$3,443,289	$4,821,031	$52,384,120
Gates RFD	$18,432	$112	$58,176	$1,485	$4,735	$25	$14,020	$96,985

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 142. Percentage Increase in BOFL Revenue Distributions in Linn County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County District	208%	78%	18%	-17%	-46%	-17%	24%	18%
Linn-Benton-Lincoln ESD	208%	78%	18%	-17%	-46%	-17%	24%	18%
Linn-Benton Community College	203%	(+)	-22%	-84%	2694%	108%	159%	50%
Lebanon SD	203%	(+)	-23%	-85%	2694%	100%	159%	51%
Lebanon Aquatic Center	203%	(+)	-23%	-85%	2694%	100%	159%	51%
4H Extension District	208%	78%	18%	-17%	-46%	-17%	24%	18%
Sweet Home SD	0%	0%	(+)	-69%	0%	(+)	0%	1%
Sweet Home Ambulance District	0%	0%	(+)	-69%	0%	(+)	0%	1%
Chemeketa Community College	209%	74%	33%	5%	-64%	-37%	10%	14%
Chemeketa Library	209%	74%	33%	5%	-64%	-37%	10%	14%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Santiam Canyon SD	209%	74%	33%	5%	-64%	-37%	10%	14%
Gates RFD	1%	-100%	192%	44%	3%	-100%	11%	-17%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 143. BOFL Revenue Distributions to Linn County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County	$41,933,453 (207%)	$29,974,010 (77%)	$22,430,160 (18%)	$18,329,019 (-19%)	$18,276,360 (-48%)	$13,024,705 (-23%)	$15,574,521 (22%)	$159,542,224 (17%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 144. BOFL Revenue Distributions to Taxing Districts in Linn County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County District	$9,480,110	$6,759,294	$5,077,537	$4,141,117	$4,168,004	$2,963,929	$3,534,097	$36,124,089
Linn-Benton-Lincoln ESD	$685,990	$489,109	$367,415	$299,655	$301,601	$214,473	$255,731	$2,613,973
Linn-Benton Community College	$130,059	$20,558	$142,489	$32,696	$240,851	$147,999	$119,607	$834,259
Lebanon SD	$1,301,539	$205,733	$1,405,976	$289,896	$2,410,268	$1,417,099	$1,196,943	$8,227,454
Lebanon Aquatic Center	$46,519	$7,353	$50,252	$10,361	$86,146	$50,649	$42,780	$294,061
4H Extension District	$157,492	$112,291	$84,352	$68,796	$69,243	$49,239	$58,712	$600,125
Sweet Home SD	$0	$0	$20,362	$38,072	$0	$65,289	$0	$123,724

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Sweet Home Ambulance District	$0	$0	$1,040	$1,944	$0	$3,335	$0	$6,319
Chemeketa Community College	$1,821,870	$1,394,299	$879,616	$827,680	$558,452	$427,857	$585,255	$6,495,029
Chemeketa Library	$168,185	$128,714	$81,201	$76,407	$51,553	$39,497	$54,028	$599,586
Santiam Canyon SD	$14,474,217	$11,077,288	$6,988,286	$6,575,668	$4,436,733	$3,399,199	$4,649,676	$51,601,066
Gates RFD	$18,541	$23,125	$30,836	$1,485	$4,734	$6,724	$8,340	$93,785

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 145. Percentage Increase in BOFL Revenue Distributions in Linn County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Linn County District	207%	78%	17%	-20%	-47%	-22%	23%	17%
Linn-Benton-Lincoln ESD	207%	78%	17%	-20%	-47%	-22%	23%	17%
Linn-Benton Community College	191%	(+)	-22%	-84%	2841%	78%	191%	48%
Lebanon SD	191%	(+)	-23%	-85%	2841%	70%	191%	50%
Lebanon Aquatic Center	191%	(+)	-23%	-85%	2841%	70%	191%	50%
4H Extension District	207%	78%	17%	-20%	-47%	-22%	23%	17%
Sweet Home SD	0%	0%	(+)	-69%	0%	(+)	0%	1%
Sweet Home Ambulance District	0%	0%	(+)	-69%	0%	(+)	0%	1%
Chemeketa Community College	209%	75%	32%	1%	-66%	-38%	6%	13%
Chemeketa Library	209%	75%	32%	1%	-66%	-38%	6%	13%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Santiam Canyon SD	209%	75%	32%	1%	-66%	-38%	6%	13%
Gates RFD	2%	-41%	55%	44%	3%	-68%	-34%	-20%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 146. BOFL Revenue Distributions to Linn County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Linn County	$42,052,460 (208%)	$29,873,435 (77%)	$22,625,498 (19%)	$19,021,830 (-16%)	$18,715,231 (-46%)	$132,288,448 (23%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 147. BOFL Revenue Distributions to Taxing Districts in Linn County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Linn County District	$9,508,034	$6,744,329	$5,112,501	$4,297,460	$4,264,729	$29,927,054
Linn-Benton-Lincoln ESD	$688,010	$488,026	$369,945	$310,968	$308,600	$2,165,549
Linn-Benton Community College	$135,503	$20,714	$142,671	$32,815	$228,779	$560,483
Lebanon SD	$1,356,024	$207,292	$1,407,800	$290,953	$2,289,463	$5,551,532
Lebanon Aquatic Center	$48,466	$7,409	$50,317	$10,399	$81,829	$198,420
4H Extension District	$157,956	$112,043	$84,933	$71,393	$70,849	$497,174
Sweet Home SD	$0	$0	$20,362	$38,210	$0	$58,572
Sweet Home Ambulance District	$0	$0	$1,040	$1,951	$0	$2,991
Chemeketa Community College	$1,820,553	$1,390,946	$886,728	$860,401	$594,734	$5,553,362
Chemeketa Library	$168,064	$128,405	$81,858	$79,428	$54,903	$512,657

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Santiam Canyon SD	$14,463,751	$11,050,649	$7,044,789	$6,835,625	$4,724,985	$44,119,799
Gates RFD	$18,432	$112	$58,176	$1,485	$4,735	$82,940

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 148. Percentage Increase in BOFL Revenue Distributions in Linn County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Linn County District	208%	78%	18%	-17%	-46%	23%
Linn-Benton-Lincoln ESD	208%	78%	18%	-17%	-46%	23%
Linn-Benton Community College	203%	(+)	-22%	-84%	2694%	28%
Lebanon SD	203%	(+)	-23%	-85%	2694%	30%
Lebanon Aquatic Center	203%	(+)	-23%	-85%	2694%	30%
4H Extension District	208%	78%	18%	-17%	-46%	23%
Sweet Home SD	0%	0%	(+)	-69%	0%	-52%
Sweet Home Ambulance District	0%	0%	(+)	-69%	0%	-52%
Chemeketa Community College	209%	74%	33%	5%	-64%	23%
Chemeketa Library	209%	74%	33%	5%	-64%	23%
Santiam Canyon SD	209%	74%	33%	5%	-64%	23%
Gates RFD	1%	-100%	192%	44%	3%	0%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 149. BOFL Revenue Distributions to Linn County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Linn County	$42,204,770 (209%)	$28,916,518 (71%)	$23,394,430 (23%)	$17,241,276 (-24%)	$23,629,575 (-32%)	$15,134,134 (-10%)	$12,996,503 (2%)	$163,517,216 (19%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 150. BOFL Revenue Distributions to Taxing Districts in Linn County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Linn County District	$9,543,709	$6,526,913	$5,286,003	$3,896,171	$5,381,529	$3,438,451	$2,945,666	$37,018,441
Linn-Benton-Lincoln ESD	$690,592	$472,293	$382,500	$281,931	$389,412	$248,809	$213,151	$2,678,689
Linn-Benton Community College	$142,550	$12,729	$142,671	$32,815	$273,620	$128,696	$94,143	$827,223
Lebanon SD	$1,426,539	$127,379	$1,407,800	$290,953	$2,738,200	$1,223,690	$942,115	$8,156,676
Lebanon Aquatic Center	$50,987	$4,553	$50,317	$10,399	$97,867	$43,736	$33,673	$291,531
4H Extension District	$158,548	$108,431	$87,816	$64,727	$89,403	$57,123	$48,936	$614,983
Sweet Home SD	$0	$0	$20,362	$38,210	$0	$65,525	$0	$124,097
Sweet Home Ambulance District	$0	$0	$1,040	$1,951	$0	$3,347	$0	$6,338
Chemeketa Community College	$1,818,750	$1,355,770	$923,215	$776,011	$770,376	$553,139	$495,138	$6,692,399
Chemeketa Library	$167,897	$125,157	$85,226	$71,637	$71,117	$51,063	$45,708	$617,806
Santiam Canyon SD	$14,449,427	$10,771,186	$7,334,665	$6,165,178	$6,120,410	$4,394,523	$3,933,722	$53,169,110
Gates RFD	$18,533	$66	$58,159	$104	$6,446	$21	$14,016	$97,345

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District

Table 151. Percentage Increase in BOFL Revenue Distributions in Linn County under Alternative 5 Relative to the No Action Alternative (2023–2092)

	Time Periods							
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**Total (70 Years)**
Linn County District	209%	72%	22%	-25%	-32%	-10%	2%	20%
Linn-Benton-Lincoln ESD	209%	72%	22%	-25%	-32%	-10%	2%	20%
Linn-Benton Community College	218%	(+)	-22%	-84%	3241%	55%	129%	47%
Lebanon SD	218%	(+)	-23%	-85%	3241%	47%	129%	48%
Lebanon Aquatic Center	218%	(+)	-23%	-85%	3241%	47%	129%	48%
4H Extension District	209%	72%	22%	-25%	-32%	-10%	2%	20%
Sweet Home SD	0%	0%	(+)	-69%	0%	(+)	0%	1%
Sweet Home Ambulance District	0%	0%	(+)	-69%	0%	(+)	0%	1%
Chemeketa Community College	208%	70%	38%	-5%	-53%	-20%	-10%	16%
Chemeketa Library	208%	70%	38%	-5%	-53%	-20%	-10%	16%
Santiam Canyon SD	208%	70%	38%	-5%	-53%	-20%	-10%	16%
Gates RFD	2%	-100%	192%	-90%	41%	-100%	11%	-16%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Marion County

Table 152. BOFL Revenue Distributions to Marion County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
County Administration	$2,431,173	$1,655,004	$1,721,670	$1,337,316	$619,667	$1,645,150	$2,100,624	$11,510,603
County School Fund	$5,470,138	$3,723,759	$3,873,757	$3,008,960	$1,394,251	$3,701,588	$4,726,403	$25,898,857
Taxing Districts[a]	$16,410,414	$11,171,276	$11,621,271	$9,026,881	$4,182,754	$11,104,763	$14,179,209	$77,696,572
Marion County (Total)	$24,311,725	$16,550,039	$17,216,698	$13,373,158	$6,196,673	$16,451,500	$21,006,235	$115,106,032

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 153.

Table 153. BOFL Revenue Distributions to Taxing Districts in Marion County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
Taxing Districts	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	(70 Years)
Marion County District	$4,440,733	$2,960,002	$3,158,418	$2,396,271	$1,128,449	$3,031,352	$3,784,068	$20,899,294
Marion Soil and Water District	$73,396	$48,922	$52,202	$39,605	$18,651	$50,102	$62,542	$345,420
Marion 4-H Extension District	$73,396	$48,922	$52,202	$39,605	$18,651	$50,102	$62,542	$345,420
Silver Falls SD	$3,013,173	$1,485,222	$3,079,012	$1,425,376	$520,049	$2,481,654	$2,581,673	$14,586,158
Willamette Reg ESD	$222,066	$87,822	$217,210	$92,301	$41,597	$195,178	$153,764	$1,009,938
Chemeketa Community College	$1,300,719	$867,003	$925,120	$701,883	$330,530	$887,902	$1,108,377	$6,121,534
Silver Falls Library	$261,118	$128,708	$266,824	$123,522	$45,067	$215,057	$223,725	$1,264,021
Regional Library	$120,075	$80,037	$85,402	$64,794	$30,513	$81,966	$102,319	$565,107
Drakes Crossing FD	$0	$0	$30,069	$14,875	$0	$0	$8,554	$53,498

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
North Santiam SD	$1,596,584	$391,193	$1,453,881	$522,092	$335,371	$1,539,648	$700,256	$6,539,025
Stayton FD	$34	$0	$303	$0	$0	$0	$79	$416
Santiam Canyon SD	$5,064,860	$4,804,327	$2,196,067	$3,386,223	$1,638,997	$2,423,133	$5,157,369	$24,670,975
Linn-Benton-Lincoln ESD	$219,364	$208,080	$95,114	$146,660	$70,986	$104,948	$223,370	$1,068,522
Gates FD	$12,980	$52,925	$1,008	$67,119	$856	$35,656	$273	$170,817

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 154. BOFL Revenue Distributions to Marion County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Marion County	$27,682,038 (14%)	$17,579,110 (6%)	$11,187,195 (-35%)	$13,499,654 (1%)	$12,398,384 (100%)	$9,360,049 (-43%)	$7,264,446 (-65%)	$98,970,872 (-14%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 155. BOFL Revenue Distributions to Taxing Districts in Marion County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Marion County District	$5,205,116	$3,280,246	$1,990,262	$2,389,594	$2,315,026	$1,701,293	$1,341,281	$18,222,818
Marion Soil and Water District	$86,029	$54,215	$32,895	$39,495	$38,262	$28,119	$22,168	$301,184
Marion 4-H Extension District	$86,029	$54,215	$32,895	$39,495	$38,262	$28,119	$22,168	$301,184
Silver Falls SD	$3,268,809	$1,777,212	$1,610,311	$2,333,977	$1,832,737	$1,871,268	$692,069	$13,386,383
Willamette Reg ESD	$345,709	$189,141	$88,478	$108,165	$161,593	$115,932	$69,260	$1,078,277

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Chemeketa Community College	$1,524,611	$960,805	$582,960	$699,927	$678,086	$498,319	$392,870	$5,337,577
Silver Falls Library	$283,271	$154,011	$139,548	$202,260	$158,823	$162,162	$59,974	$1,160,050
Regional Library	$140,744	$88,696	$53,816	$64,614	$62,597	$46,002	$36,268	$492,737
Drakes Crossing FD	$0	$0	$31,262	$6,470	$0	$0	$16,545	$54,277
North Santiam SD	$3,649,121	$2,005,616	$300,840	$68,821	$1,456,271	$589,504	$700,632	$8,770,805
Stayton FD	$0	$40	$65	$0	$0	$0	$128	$233
Santiam Canyon SD	$3,909,936	$3,145,567	$2,532,124	$2,994,287	$1,553,078	$1,208,285	$1,477,911	$16,821,187
Linn-Benton-Lincoln ESD	$169,343	$136,237	$109,669	$129,685	$67,265	$52,332	$64,010	$728,541
Gates FD	$3,084	$11,274	$40,747	$28,858	$830	$12,104	$4,656	$101,553

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 156. Percentage Increase in BOFL Revenue Distributions in Marion County under Proposed Action Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Marion County District	17%	11%	-37%	0%	105%	-44%	-65%	-13%
Marion Soil and Water District	17%	11%	-37%	0%	105%	-44%	-65%	-13%
Marion 4-H Extension District	17%	11%	-37%	0%	105%	-44%	-65%	-13%
Silver Falls SD	8%	20%	-48%	64%	252%	-25%	-73%	-8%
Willamette Reg ESD	56%	115%	-59%	17%	288%	-41%	-55%	7%
Chemeketa Community College	17%	11%	-37%	0%	105%	-44%	-65%	-13%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Silver Falls Library	8%	20%	-48%	64%	252%	-25%	-73%	-8%
Regional Library	17%	11%	-37%	0%	105%	-44%	-65%	-13%
Drakes Crossing FD	0%	0%	4%	-57%	0%	0%	93%	1%
North Santiam SD	129%	413%	-79%	-87%	334%	-62%	0%	34%
Stayton FD	-100%	(+)	-78%	0%	0%	0%	62%	-44%
Santiam Canyon SD	-23%	-35%	15%	-12%	-5%	-50%	-71%	-32%
Linn-Benton-Lincoln ESD	-23%	-35%	15%	-12%	-5%	-50%	-71%	-32%
Gates FD	-76%	-79%	3943%	-57%	-3%	-66%	1607%	-41%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 157. BOFL Revenue Distributions to Marion County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Marion County	$28,002,023 (15%)	$17,045,839 (3%)	$11,949,954 (-31%)	$12,422,528 (-7%)	$12,292,874 (98%)	$8,908,278 (-46%)	$6,963,838 (-67%)	$97,585,328 (-15%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 158. BOFL Revenue Distributions to Taxing Districts in Marion County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Marion County District	$5,267,927	$3,173,157	$2,126,422	$2,197,651	$2,295,851	$1,621,904	$1,286,190	$17,969,102
Marion Soil and Water District	$87,067	$52,445	$35,145	$36,322	$37,945	$26,807	$21,258	$296,990
Marion 4-H Extension District	$87,067	$52,445	$35,145	$36,322	$37,945	$26,807	$21,258	$296,990
Silver Falls SD	$3,293,375	$1,770,101	$1,602,571	$2,327,219	$1,743,293	$1,863,233	$688,496	$13,288,288
Willamette Reg ESD	$350,876	$180,500	$88,132	$107,820	$156,953	$116,315	$68,059	$1,068,655
Chemeketa Community College	$1,543,009	$929,437	$622,842	$643,706	$672,469	$475,066	$376,733	$5,263,262
Silver Falls Library	$285,400	$153,395	$138,877	$201,674	$151,072	$161,466	$59,664	$1,151,549
Regional Library	$142,442	$85,801	$57,497	$59,423	$62,079	$43,856	$34,778	$485,876
Drakes Crossing FD	$0	$0	$31,262	$6,470	$0	$0	$16,545	$54,277
North Santiam SD	$3,723,529	$1,853,380	$300,840	$68,042	$1,444,586	$603,095	$681,593	$8,675,065
Stayton FD	$0	$30	$65	$0	$0	$0	$100	$196
Santiam Canyon SD	$3,933,511	$3,101,378	$2,857,192	$2,555,808	$1,618,544	$1,014,441	$1,378,200	$16,459,074
Linn-Benton-Lincoln ESD	$170,364	$134,323	$123,748	$110,694	$70,101	$43,936	$59,691	$712,857
Gates FD	$3,064	$11,186	$40,621	$27,962	$825	$11,793	$4,612	$100,063

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 159. Percentage Increase in BOFL Revenue Distributions in Marion County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Marion County District	19%	7%	-33%	-8%	103%	-46%	-66%	-14%
Marion Soil and Water District	19%	7%	-33%	-8%	103%	-46%	-66%	-14%
Marion 4-H Extension District	19%	7%	-33%	-8%	103%	-46%	-66%	-14%
Silver Falls SD	9%	19%	-48%	63%	235%	-25%	-73%	-9%
Willamette Reg ESD	58%	106%	-59%	17%	277%	-40%	-56%	6%
Chemeketa Community College	19%	7%	-33%	-8%	103%	-46%	-66%	-14%
Silver Falls Library	9%	19%	-48%	63%	235%	-25%	-73%	-9%
Regional Library	19%	7%	-33%	-8%	103%	-46%	-66%	-14%
Drakes Crossing FD	0%	0%	4%	-57%	0%	0%	93%	1%
North Santiam SD	133%	374%	-79%	-87%	331%	-61%	-3%	33%
Stayton FD	-100%	(+)	-78%	0%	0%	0%	27%	-53%
Santiam Canyon SD	-22%	-35%	30%	-25%	-1%	-58%	-73%	-33%
Linn-Benton-Lincoln ESD	-22%	-35%	30%	-25%	-1%	-58%	-73%	-33%
Gates FD	-76%	-79%	3931%	-58%	-4%	-67%	1591%	-41%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 160. BOFL Revenue Distributions to Marion County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Marion County	$27,682,038 (14%)	$17,579,110 (6%)	$11,187,195 (-35%)	$13,499,654 (1%)	$12,398,384 (100%)	$82,346,376 (6%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 161. BOFL Revenue Distributions to Taxing Districts in Marion County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Marion County District	$5,205,116	$3,280,246	$1,990,262	$2,389,594	$2,315,026	$15,180,244
Marion Soil and Water District	$86,029	$54,215	$32,895	$39,495	$38,262	$250,897
Marion 4-H Extension District	$86,029	$54,215	$32,895	$39,495	$38,262	$250,897
Silver Falls SD	$3,268,809	$1,777,212	$1,610,311	$2,333,977	$1,832,737	$10,823,046
Willamette Reg ESD	$345,709	$189,141	$88,478	$108,165	$161,593	$893,085
Chemeketa Community College	$1,524,611	$960,805	$582,960	$699,927	$678,086	$4,446,388
Silver Falls Library	$283,271	$154,011	$139,548	$202,260	$158,823	$937,914
Regional Library	$140,744	$88,696	$53,816	$64,614	$62,597	$410,467
Drakes Crossing FD	$0	$0	$31,262	$6,470	$0	$37,732
North Santiam SD	$3,649,121	$2,005,616	$300,840	$68,821	$1,456,271	$7,480,669
Stayton FD	$0	$40	$65	$0	$0	$105
Santiam Canyon SD	$3,909,936	$3,145,567	$2,532,124	$2,994,287	$1,553,078	$14,134,991
Linn-Benton-Lincoln ESD	$169,343	$136,237	$109,669	$129,685	$67,265	$612,199
Gates FD	$3,084	$11,274	$40,747	$28,858	$830	$84,793

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department

Table 162. Percentage Increase in BOFL Revenue Distributions in Marion County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Marion County District	17%	11%	-37%	0%	105%	8%
Marion Soil and Water District	17%	11%	-37%	0%	105%	8%
Marion 4-H Extension District	17%	11%	-37%	0%	105%	8%
Silver Falls SD	8%	20%	-48%	64%	252%	14%
Willamette Reg ESD	56%	115%	-59%	17%	288%	35%
Chemeketa Community College	17%	11%	-37%	0%	105%	8%
Silver Falls Library	8%	20%	-48%	64%	252%	14%
Regional Library	17%	11%	-37%	0%	105%	8%
Drakes Crossing FD	0%	0%	4%	-57%	0%	-16%
North Santiam SD	129%	413%	-79%	-87%	334%	74%
Stayton FD	-100%	(+)	-78%	0%	0%	-69%
Santiam Canyon SD	-23%	-35%	15%	-12%	-5%	-17%
Linn-Benton-Lincoln ESD	-23%	-35%	15%	-12%	-5%	-17%
Gates FD	-76%	-79%	3943%	-57%	-3%	-37%

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; SD = School District; FD = Fire Department
- sign indicates decrease in revenue relative to the no action alternative
(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 163. BOFL Revenue Distributions to Marion County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Marion County	$28,700,068 (18%)	$16,979,090 (3%)	$10,429,506 (39%)	$15,685,704 (17%)	$12,200,129 (97%)	$7,778,502 (-53%)	$6,880,011 (-67%)	$98,653,016 (-14%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 164. BOFL Revenue Distributions to Taxing Districts in Marion County (2023–2092)—Alternative 5 (in 2019 dollars)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Marion County District	$5,406,799	$3,150,827	$1,856,128	$2,776,346	$2,285,290	$1,415,338	$1,272,966	$18,163,694
Marion Soil and Water District	$89,363	$52,076	$30,678	$45,887	$37,771	$23,392	$21,039	$300,206
Marion 4-H Extension District	$89,363	$52,076	$30,678	$45,887	$37,771	$23,392	$21,039	$300,206
Silver Falls SD	$3,424,852	$1,750,689	$1,446,992	$2,843,352	$1,360,028	$1,734,024	$652,964	$13,212,901
Willamette Reg ESD	$367,279	$172,298	$81,173	$130,950	$142,341	$106,555	$67,510	$1,068,105
Chemeketa Community College	$1,583,685	$922,897	$543,672	$813,209	$669,376	$414,561	$372,860	$5,320,260
Silver Falls Library	$296,794	$151,713	$125,395	$246,402	$117,859	$150,269	$56,585	$1,145,016
Regional Library	$146,197	$85,197	$50,189	$75,071	$61,793	$38,270	$34,420	$491,138
Drakes Crossing FD	$0	$0	$31,262	$6,470	$0	$0	$16,545	$54,277
North Santiam SD	$3,915,996	$1,719,236	$300,840	$68,821	$1,490,901	$530,272	$700,632	$8,726,698
Stayton FD	$0	$40	$65	$0	$0	$0	$128	$233
Santiam Canyon SD	$3,867,480	$3,244,018	$2,393,328	$3,353,656	$1,940,670	$765,346	$1,360,442	$16,924,939
Linn-Benton-Lincoln ESD	$167,504	$140,501	$103,657	$145,250	$84,052	$33,148	$58,922	$733,034
Gates FD	$3,161	$10,989	$40,747	$28,858	$1,255	$12,104	$4,581	$101,696

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

Table 165. Percentage Increase in BOFL Revenue Distributions in Marion County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Marion County District	22%	6%	-41%	16%	103%	-53%	-66%	-13%
Marion Soil and Water District	22%	6%	-41%	16%	103%	-53%	-66%	-13%
Marion 4-H Extension District	22%	6%	-41%	16%	103%	-53%	-66%	-13%
Silver Falls SD	14%	18%	-53%	99%	162%	-30%	-75%	-9%
Willamette Reg ESD	65%	96%	-63%	42%	242%	-45%	-56%	6%
Chemeketa Community College	22%	6%	-41%	16%	103%	-53%	-66%	-13%
Silver Falls Library	14%	18%	-53%	99%	162%	-30%	-75%	-9%
Regional Library	22%	6%	-41%	16%	103%	-53%	-66%	-13%
Drakes Crossing FD	0%	0%	4%	-57%	0%	0%	93%	1%
North Santiam SD	145%	339%	-79%	-87%	345%	-66%	0%	33%
Stayton FD	-100%	(+)	-78%	0%	0%	0%	62%	-44%
Santiam Canyon SD	-24%	-32%	9%	-1%	18%	-68%	-74%	-31%
Linn-Benton-Lincoln ESD	-24%	-32%	9%	-1%	18%	-68%	-74%	-31%
Gates FD	-76%	-79%	3943%	-57%	47%	-66%	1580%	-40%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Multnomah County

Multnomah County does not contain BOFL and thus does not receive revenue from timber sales on BOFL.

Polk County

Table 166. BOFL Revenue Distributions to Polk County (2023–2092)—No Action Alternative (in 2019 dollars)

	Time Periods							Total
County Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
County Administration	$1,916,889	$6,517,858	$3,344,254	$3,241,541	$3,306,024	$4,153,298	$7,452,671	$29,932,534
County School Fund	$0	$0	$0	$0	$0	$0	$0	$0
Taxing Districts	$0	$0	$0	$0	$0	$0	$0	$0
Polk County (Total)	$1,916,889	$6,517,858	$3,344,254	$3,241,541	$3,306,024	$4,153,298	$7,452,671	$29,932,534

Source: ECONorthwest's analysis of Forest Model

Table 167. BOFL Revenue Distributions to Polk County (2023–2092)—Proposed Action (in 2019 dollars)

County	Total Revenue (% Increase Relative to the No Action Alternative)							Total
Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Polk County	$8,600,343 (349%)	$8,878,424 (36%)	$6,413,259 (92%)	$7,730,533 (138%)	$6,858,373 (107%)	$4,888,607 (18%)	$9,563,404 (28%)	$52,932,940 (77%)

Source: ECONorthwest's analysis of Forest Model

Table 168. BOFL Revenue Distributions to Polk County (2023–2092)—Alternative 3 (in 2019 dollars)

County	Total Revenue (% Increase Relative to the No Action Alternative)							Total
Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Polk County	$8,407,460 (339%)	$8,675,101 (33%)	$6,643,823 (99%)	$6,751,985 (108%)	$6,719,690 (103%)	$6,088,899 (47%)	$9,383,405 (26%)	$52,670,364 (76%)

Source: ECONorthwest's analysis of Forest Model

Table 169. BOFL Revenue Distributions to Polk County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Polk County	$8,600,343 (349%)	$8,878,424 (36%)	$6,413,259 (92%)	$7,730,533 (138%)	$6,858,373 (107%)	$38,480,932 (110%)

Source: ECONorthwest's analysis of Forest Model

Table 170. BOFL Revenue Distributions to Polk County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Polk County	$8,721,690 (355%)	$10,717,888 (64%)	$6,117,806 (83%)	$8,004,098 (147%)	$4,881,346 (48%)	$6,388,066 (54%)	$12,822,846 (72%)	$57,653,740 (93%)

Source: ECONorthwest's analysis of Forest Model

Tillamook County

Table 171. BOFL Revenue Distributions to Tillamook County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
County Administration	$31,247,331	$29,989,428	$28,860,404	$31,201,047	$34,283,880	$33,585,728	$30,862,079	$220,029,896
County School Fund	$18,480,564	$17,736,605	$17,068,867	$18,453,191	$20,276,466	$19,863,559	$18,252,715	$130,131,967
Taxing Districts[a]	$61,869,715	$59,379,067	$57,143,599	$61,778,073	$67,882,083	$66,499,742	$61,106,916	$435,659,193
Tillamook County (Total)	$111,597,610	$107,105,100	$103,072,870	$111,432,310	$122,442,430	$119,949,030	$110,221,710	$785,821,056

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 172.

Table 172. BOFL Revenue Distributions to Taxing Districts in Tillamook County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Tillamook County District	$11,804,092	$11,328,087	$10,917,161	$11,856,464	$13,000,317	$12,675,513	$11,719,258	$83,300,892
County Library	$4,555,439	$4,371,739	$4,213,154	$4,575,650	$5,017,086	$4,891,738	$4,522,700	$32,147,506
Nestucca Valley SD 101	$5,999,126	$7,958,717	$6,293,726	$3,016,334	$4,797,923	$6,579,392	$5,630,670	$40,275,887
Northwest Regional ESD	$993,011	$961,011	$927,811	$1,005,749	$1,104,851	$1,068,245	$995,978	$7,056,656
Tillamook Bay Community College	$2,504,057	$2,403,079	$2,315,908	$2,515,166	$2,757,817	$2,688,915	$2,486,060	$17,671,002
4-H Extension	$450,065	$431,916	$416,248	$452,062	$495,674	$483,290	$446,830	$3,176,085
Emergency-911	$1,228,220	$1,178,692	$1,135,935	$1,233,670	$1,352,688	$1,318,892	$1,219,393	$8,667,491
Tillamook Transportation	$1,304,536	$1,251,930	$1,206,516	$1,310,324	$1,436,737	$1,400,841	$1,295,160	$9,206,044
Tillamook Soil and Water Conservation	$391,361	$375,579	$361,955	$393,097	$431,021	$420,252	$388,548	$2,761,813
Port Tillamook Bay	$63,113	$60,872	$53,736	$46,670	$74,576	$68,921	$62,347	$430,235
Nestucca RFD	$335	$23,852	$124,078	$52,883	$21,528	$45,178	$53,466	$321,320
SD 9	$16,351,744	$14,707,134	$13,029,824	$15,713,993	$19,506,143	$17,582,969	$15,383,072	$112,274,879
Port Garibaldi	$735,880	$695,886	$663,790	$842,907	$902,984	$741,122	$829,509	$5,412,077
Tillamook FD	$2,054	$369	$1,069	$0	$34,776	$3,333	$647	$42,247
SD 56	$13,563,795	$12,409,101	$14,082,364	$16,868,707	$15,423,807	$14,499,568	$14,788,761	$101,636,102
Port of Nehalem	$178,097	$130,319	$161,453	$210,220	$175,114	$192,770	$147,119	$1,195,091
North County Recreation District	$1,232,411	$901,793	$1,117,236	$1,454,703	$1,211,769	$1,333,948	$1,018,046	$8,269,905
Nehalem Bay Health District	$48,444	$35,448	$43,916	$57,181	$47,632	$52,435	$40,017	$325,073
City of Garibaldi	$3,211	$16,043	$8,166	$25,550	$7,054	$30,553	$4,989	$95,567

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
SD 63	$365,806	$61,932	$0	$67,912	$0	$323,572	$0	$819,222
Willamette ESD	$19,634	$3,324	$0	$3,645	$0	$17,367	$0	$43,969

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 173. BOFL Revenue Distributions to Tillamook County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County	$153,915,160 (38%)	$191,509,040 (79%)	$191,613,480 (86%)	$148,696,730 (33%)	$145,669,260 (19%)	$147,929,810 (23%)	$178,630,480 (62%)	$1,157,964,032 (47%)

Source: ECONorthwest's analysis of Forest Model

Table 174. BOFL Revenue Distributions to Taxing Districts in Tillamook County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County District	$16,326,143	$20,326,994	$20,339,458	$15,878,503	$15,515,780	$15,734,944	$18,964,591	$123,086,413
County Library	$6,300,590	$7,844,600	$7,849,410	$6,127,837	$5,987,855	$6,072,435	$7,318,821	$47,501,548
Nestucca Valley SD 101	$7,299,902	$7,800,408	$9,621,957	$4,670,656	$5,785,656	$4,750,839	$7,346,425	$47,275,843
Northwest Regional ESD	$1,367,827	$1,713,232	$1,728,579	$1,345,938	$1,318,631	$1,336,482	$1,602,686	$10,413,376
Tillamook Bay Community College	$3,463,340	$4,312,059	$4,314,703	$3,368,380	$3,291,434	$3,337,926	$4,023,046	$26,110,888
4-H Extension	$622,481	$775,025	$775,500	$605,413	$591,584	$599,940	$723,079	$4,693,022
Emergency-911	$1,698,742	$2,115,032	$2,116,329	$1,652,165	$1,614,423	$1,637,227	$1,973,273	$12,807,190
Tillamook Transportation	$1,804,293	$2,246,449	$2,247,827	$1,754,822	$1,714,735	$1,738,956	$2,095,882	$13,602,963
Tillamook Soil and Water Conservation	$541,288	$673,935	$674,348	$526,446	$514,421	$521,687	$628,765	$4,080,889
Port Tillamook Bay	$54,535	$83,312	$87,320	$37,257	$84,060	$69,890	$92,484	$508,857
Nestucca RFD	$0	$36,183	$155,356	$81,058	$11,224	$8,453	$156,664	$448,938

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
SD 9	$19,911,854	$29,622,580	$25,772,522	$17,653,061	$24,364,911	$23,433,295	$27,690,883	$168,449,105
Port Garibaldi	$1,133,691	$1,500,889	$1,419,978	$1,304,124	$1,217,054	$1,158,075	$1,344,584	$9,078,395
Tillamook FD	$20,063	$4,019	$16,557	$5,704	$9,404	$6,203	$8,558	$70,508
SD 56	$21,701,770	$24,175,697	$26,586,779	$25,003,597	$17,421,881	$19,622,742	$22,594,744	$157,107,210
Port of Nehalem	$271,216	$274,587	$288,187	$262,982	$145,849	$224,024	$244,157	$1,711,004
North County Recreation District	$1,876,786	$1,900,114	$1,994,224	$1,819,810	$1,009,261	$1,550,225	$1,689,543	$11,839,964
Nehalem Bay Health District	$73,773	$74,690	$78,389	$71,533	$39,672	$60,936	$66,413	$465,405
City of Garibaldi	$13,344	$22,516	$33,831	$34,412	$22,932	$18,856	$5,009	$150,900
SD 63	$707,127	$513,538	$0	$126,500	$0	$27,861	$325,175	$1,700,201
Willamette ESD	$37,953	$27,563	$0	$6,790	$0	$1,495	$17,453	$91,254

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 175. Percentage Increase in BOFL Revenue Distributions in Tillamook County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County District	38%	79%	86%	34%	19%	24%	62%	48%
County Library	38%	79%	86%	34%	19%	24%	62%	48%
Nestucca Valley SD 101	22%	-2%	53%	55%	21%	-28%	30%	17%
Northwest Regional ESD	38%	78%	86%	34%	19%	25%	61%	48%
Tillamook Bay Community College	38%	79%	86%	34%	19%	24%	62%	48%
4-H Extension	38%	79%	86%	34%	19%	24%	62%	48%
Emergency-911	38%	79%	86%	34%	19%	24%	62%	48%
Tillamook Transportation	38%	79%	86%	34%	19%	24%	62%	48%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook Soil and Water Conservation	38%	79%	86%	34%	19%	24%	62%	48%
Port Tillamook Bay	-14%	37%	62%	-20%	13%	1%	48%	18%
Nestucca RFD	-100%	52%	25%	53%	-48%	-81%	193%	40%
SD 9	22%	101%	98%	12%	25%	33%	80%	50%
Port Garibaldi	54%	116%	114%	55%	35%	56%	62%	68%
Tillamook FD	877%	990%	1449%	(+)	-73%	86%	1222%	67%
SD 56	60%	95%	89%	48%	13%	35%	53%	55%
Port of Nehalem	52%	111%	78%	25%	-17%	16%	66%	43%
North County Recreation District	52%	111%	78%	25%	-17%	16%	66%	43%
Nehalem Bay Health District	52%	111%	78%	25%	-17%	16%	66%	43%
City of Garibaldi	316%	40%	314%	35%	225%	-38%	0%	58%
SD 63	93%	729%	0%	86%	0%	-91%	(+)	108%
Willamette ESD	93%	729%	0%	86%	0%	-91%	(+)	108%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 176. BOFL Revenue Distributions to Tillamook County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County	$152,868,250 (37%)	$188,752,200 (76%)	$190,725,300 (85%)	$146,567,110 (32%)	$141,648,240 (16%)	$145,876,050 (22%)	$177,844,820 (61%)	$1,144,281,984 (46%)

Source: ECONorthwest's analysis of Forest Model

Table 177. BOFL Revenue Distributions to Taxing Districts in Tillamook County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Tillamook County District	$16,218,754	$20,033,502	$20,256,790	$15,638,327	$15,077,324	$15,512,805	$18,882,638	$121,620,140
County Library	$6,259,147	$7,731,335	$7,817,507	$6,035,148	$5,818,646	$5,986,707	$7,287,194	$46,935,683
Nestucca Valley SD 101	$7,270,774	$7,610,948	$9,511,422	$4,607,588	$5,892,311	$4,719,973	$7,243,068	$46,856,084
Northwest Regional ESD	$1,358,425	$1,688,268	$1,721,553	$1,326,313	$1,280,646	$1,317,603	$1,595,879	$10,288,688
Tillamook Bay Community College	$3,440,559	$4,249,799	$4,297,166	$3,317,430	$3,198,422	$3,290,803	$4,005,661	$25,799,841
4-H Extension	$618,386	$763,835	$772,348	$596,256	$574,866	$591,470	$719,955	$4,637,116
Emergency-911	$1,687,568	$2,084,494	$2,107,727	$1,627,174	$1,568,802	$1,614,114	$1,964,746	$12,654,624
Tillamook Transportation	$1,792,425	$2,214,014	$2,238,690	$1,728,278	$1,666,279	$1,714,406	$2,086,825	$13,440,917
Tillamook Soil and Water Conservation	$537,727	$664,204	$671,607	$518,484	$499,884	$514,322	$626,048	$4,032,275
Port Tillamook Bay	$53,538	$82,277	$85,736	$38,713	$82,064	$69,268	$90,496	$502,094
Nestucca RFD	$0	$35,205	$153,161	$79,025	$10,558	$8,175	$154,784	$440,908
SD 9	$19,409,241	$29,467,346	$25,378,864	$17,630,770	$23,731,453	$23,236,592	$27,527,050	$166,381,315
Port Garibaldi	$1,121,644	$1,488,055	$1,426,502	$1,254,748	$1,182,530	$1,135,693	$1,352,502	$8,961,675
Tillamook FD	$16,765	$4,498	$16,293	$5,608	$10,321	$2,602	$15,140	$71,228
SD 56	$21,853,071	$23,643,281	$26,785,032	$24,431,313	$16,646,671	$19,200,763	$22,595,350	$155,155,482
Port of Nehalem	$273,476	$266,843	$285,709	$266,356	$139,573	$221,090	$243,024	$1,696,070
North County Recreation District	$1,892,422	$1,846,528	$1,977,074	$1,843,155	$965,832	$1,529,919	$1,681,698	$11,736,628
Nehalem Bay Health District	$74,387	$72,583	$77,715	$72,451	$37,965	$60,138	$66,104	$461,343
City of Garibaldi	$13,201	$27,999	$28,541	$37,106	$22,710	$19,457	$2,389	$151,403

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
SD 63	$717,026	$514,270	$0	$98,248	$25,957	$27,876	$319,498	$1,702,874
Willamette ESD	$38,484	$27,602	$0	$5,273	$1,393	$1,496	$17,148	$91,397

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 178. Percentage Increase in BOFL Revenue Distributions in Tillamook County under Alternative 3 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County District	37%	77%	86%	32%	16%	22%	61%	46%
County Library	37%	77%	86%	32%	16%	22%	61%	46%
Nestucca Valley SD 101	21%	-4%	51%	53%	23%	-28%	29%	16%
Northwest Regional ESD	37%	76%	86%	32%	16%	23%	60%	46%
Tillamook Bay Community College	37%	77%	86%	32%	16%	22%	61%	46%
4-H Extension	37%	77%	86%	32%	16%	22%	61%	46%
Emergency-911	37%	77%	86%	32%	16%	22%	61%	46%
Tillamook Transportation	37%	77%	86%	32%	16%	22%	61%	46%
Tillamook Soil and Water Conservation	37%	77%	86%	32%	16%	22%	61%	46%
Port Tillamook Bay	-15%	35%	60%	-17%	10%	1%	45%	17%
Nestucca RFD	-100%	48%	23%	49%	-51%	-82%	189%	37%
SD 9	19%	100%	95%	12%	22%	32%	79%	48%
Port Garibaldi	52%	114%	115%	49%	31%	53%	63%	66%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook FD	716%	1120%	1424%	(+)	-70%	-22%	2238%	69%
SD 56	61%	91%	90%	45%	8%	32%	53%	53%
Port of Nehalem	54%	105%	77%	27%	-20%	15%	65%	42%
North County Recreation District	54%	105%	77%	27%	-20%	15%	65%	42%
Nehalem Bay Health District	54%	105%	77%	27%	-20%	15%	65%	42%
Nehalem Bay Fire and Rescue	0%	0%	0%	-99%	0%	0%	0%	-99%
City of Garibaldi	311%	75%	249%	45%	222%	-36%	-52%	58%
SD 63	96%	730%	0%	45%	(+)	-91%	(+)	108%
Willamette ESD	96%	730%	0%	45%	(+)	-91%	(+)	108%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 179. BOFL Revenue Distributions to Tillamook County (2023–2072)—Alternative 4 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Tillamook County	$153,915,160 (38%)	$191,509,040 (79%)	$191,613,480 (86%)	$148,696,730 (33%)	$145,669,260 (19%)	$831,403,712 (50%)

Source: ECONorthwest's analysis of Forest Model

Table 180. BOFL Revenue Distributions to Taxing Districts in Tillamook County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Tillamook County District	$16,326,143	$20,326,994	$20,339,458	$15,878,503	$15,515,780	$88,386,877
County Library	$6,300,590	$7,844,600	$7,849,410	$6,127,837	$5,987,855	$34,110,292
Nestucca Valley SD 101	$7,299,902	$7,800,408	$9,621,957	$4,670,656	$5,785,656	$35,178,578
Northwest Regional ESD	$1,367,827	$1,713,232	$1,728,579	$1,345,938	$1,318,631	$7,474,207
Tillamook Bay Community College	$3,463,340	$4,312,059	$4,314,703	$3,368,380	$3,291,434	$18,749,915
4-H Extension	$622,481	$775,025	$775,500	$605,413	$591,584	$3,370,003
Emergency-911	$1,698,742	$2,115,032	$2,116,329	$1,652,165	$1,614,423	$9,196,690
Tillamook Transportation	$1,804,293	$2,246,449	$2,247,827	$1,754,822	$1,714,735	$9,768,125
Tillamook Soil and Water Conservation	$541,288	$673,935	$674,348	$526,446	$514,421	$2,930,437
Port Tillamook Bay	$54,535	$83,312	$87,320	$37,257	$84,060	$346,483
Nestucca RFD	$0	$36,183	$155,356	$81,058	$11,224	$283,821
SD 9	$19,911,854	$29,622,580	$25,772,522	$17,653,061	$24,364,911	$117,324,927
Port Garibaldi	$1,133,691	$1,500,889	$1,419,978	$1,304,124	$1,217,054	$6,575,736
Tillamook FD	$20,063	$4,019	$16,557	$5,704	$9,404	$55,747
SD 56	$21,701,770	$24,175,697	$26,586,779	$25,003,597	$17,421,881	$114,889,724
Port of Nehalem	$271,216	$274,587	$288,187	$262,982	$145,849	$1,242,822
North County Recreation District	$1,876,786	$1,900,114	$1,994,224	$1,819,810	$1,009,261	$8,600,195
Nehalem Bay Health District	$73,773	$74,690	$78,389	$71,533	$39,672	$338,056
City of Garibaldi	$13,344	$22,516	$33,831	$34,412	$22,932	$127,034
SD 63	$707,127	$513,538	$0	$126,500	$0	$1,347,165
Willamette ESD	$37,953	$27,563	$0	$6,790	$0	$72,305

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 181. Percentage Increase in BOFL Revenue Distributions in Tillamook County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods					Total (50 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	
Tillamook County District	38%	79%	86%	34%	19%	50%
County Library	38%	79%	86%	34%	19%	50%
Nestucca Valley SD 101	22%	-2%	53%	55%	21%	25%
Northwest Regional ESD	38%	78%	86%	34%	19%	50%
Tillamook Bay Community College	38%	79%	86%	34%	19%	50%
4-H Extension	38%	79%	86%	34%	19%	50%
Emergency-911	38%	79%	86%	34%	19%	50%
Tillamook Transportation	38%	79%	86%	34%	19%	50%
Tillamook Soil and Water Conservation	38%	79%	86%	34%	19%	50%
Port Tillamook Bay	-14%	37%	62%	-20%	13%	16%
Nestucca RFD	-100%	52%	25%	53%	-48%	27%
SD 9	22%	101%	98%	12%	25%	48%
Port Garibaldi	54%	116%	114%	55%	35%	71%
Tillamook FD	877%	990%	1449%	(+)	-73%	46%
SD 56	60%	95%	89%	48%	13%	59%
Port of Nehalem	52%	111%	78%	25%	-17%	45%
North County Recreation District	52%	111%	78%	25%	-17%	45%
Nehalem Bay Health District	52%	111%	78%	25%	-17%	45%
City of Garibaldi	316%	40%	314%	35%	225%	112%
SD 63	93%	729%	0%	86%	0%	172%
Willamette ESD	93%	729%	0%	86%	0%	172%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Table 182. BOFL Revenue Distributions to Tillamook County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Tillamook County	$156,743,290 (40%)	$198,738,640 (86%)	$190,955,840 (85%)	$147,417,850 (32%)	$147,871,080 (21%)	$150,969,380 (26%)	$189,990,740 (72%)	$1,182,686,848 (51%)

Source: ECONorthwest's analysis of Forest Model

Table 183. BOFL Revenue Distributions to Taxing Districts in Tillamook County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Tillamook County District	$16,619,542	$21,107,349	$20,272,091	$15,742,799	$15,751,445	$16,047,459	$20,151,330	$125,692,015
County Library	$6,413,819	$8,145,755	$7,823,412	$6,075,466	$6,078,803	$6,193,041	$7,776,807	$48,507,103
Nestucca Valley SD 101	$7,308,965	$8,182,060	$9,294,326	$4,678,834	$5,514,011	$4,824,271	$7,886,308	$47,688,775
Northwest Regional ESD	$1,392,762	$1,779,935	$1,722,853	$1,334,405	$1,338,660	$1,363,042	$1,703,543	$10,635,200
Tillamook Bay Community College	$3,525,580	$4,477,599	$4,300,412	$3,339,593	$3,341,427	$3,404,222	$4,274,794	$26,663,626
4-H Extension	$633,668	$804,778	$772,932	$600,239	$600,569	$611,855	$768,327	$4,792,368
Emergency-911	$1,729,270	$2,196,228	$2,109,319	$1,638,044	$1,638,944	$1,669,745	$2,096,754	$13,078,304
Tillamook Transportation	$1,836,718	$2,332,690	$2,240,381	$1,739,824	$1,740,780	$1,773,494	$2,227,035	$13,890,923
Tillamook Soil and Water Conservation	$551,015	$699,807	$672,114	$521,947	$522,234	$532,048	$668,111	$4,167,277
Port Tillamook Bay	$55,683	$84,511	$85,918	$36,748	$83,446	$70,296	$104,009	$520,612
Nestucca RFD	$0	$36,183	$157,989	$81,058	$11,224	$8,453	$156,664	$451,572
SD 9	$20,368,360	$30,415,531	$25,893,595	$16,481,243	$24,161,306	$24,460,174	$29,861,147	$171,641,356
Port Garibaldi	$1,140,823	$1,586,524	$1,430,151	$1,240,991	$1,201,146	$1,189,686	$1,376,093	$9,165,414

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook FD	$20,838	$8,290	$16,557	$5,704	$9,613	$5,954	$10,725	$77,682
SD 56	$22,113,467	$25,368,214	$26,551,464	$25,636,019	$18,465,233	$19,542,795	$23,585,235	$161,262,427
Port of Nehalem	$284,118	$277,025	$288,231	$282,618	$171,541	$226,714	$269,943	$1,800,190
North County Recreation District	$1,966,064	$1,916,982	$1,994,530	$1,955,690	$1,187,048	$1,568,836	$1,867,974	$12,457,123
Nehalem Bay Health District	$77,282	$75,353	$78,401	$76,874	$46,660	$61,668	$73,426	$489,664
City of Garibaldi	$9,677	$25,244	$32,415	$27,444	$15,884	$12,480	$1,854	$124,998
SD 63	$707,127	$499,748	$0	$126,500	$0	$27,861	$325,175	$1,686,412
Willamette ESD	$37,953	$26,823	$0	$6,790	$0	$1,495	$17,453	$90,513

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 184. Percentage Increase in BOFL Revenue Distributions in Tillamook County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook County District	41%	86%	86%	33%	21%	27%	72%	51%
County Library	41%	86%	86%	33%	21%	27%	72%	51%
Nestucca Valley SD 101	22%	3%	48%	55%	15%	-27%	40%	18%
Northwest Regional ESD	40%	85%	86%	33%	21%	28%	71%	51%
Tillamook Bay Community College	41%	86%	86%	33%	21%	27%	72%	51%
4-H Extension	41%	86%	86%	33%	21%	27%	72%	51%
Emergency-911	41%	86%	86%	33%	21%	27%	72%	51%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Tillamook Transportation	41%	86%	86%	33%	21%	27%	72%	51%
Tillamook Soil and Water Conservation	41%	86%	86%	33%	21%	27%	72%	51%
Port Tillamook Bay	-12%	39%	60%	-21%	12%	2%	67%	21%
Nestucca RFD	-100%	52%	27%	53%	-48%	-81%	193%	41%
SD 9	25%	107%	99%	5%	24%	39%	94%	53%
Port Garibaldi	55%	128%	115%	47%	33%	61%	66%	69%
Tillamook FD	914%	2149%	1449%	(+)	-72%	79%	1557%	84%
SD 56	63%	104%	89%	52%	20%	35%	59%	59%
Port of Nehalem	60%	113%	79%	34%	-2%	18%	83%	51%
North County Recreation District	60%	113%	79%	34%	-2%	18%	83%	51%
Nehalem Bay Health District	60%	113%	79%	34%	-2%	18%	83%	51%
City of Garibaldi	201%	57%	297%	7%	125%	-59%	-63%	31%
SD 63	93%	707%	0%	86%	0%	-91%	(+)	106%
Willamette ESD	93%	707%	0%	86%	0%	-91%	(+)	106%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

(+) sign indicates increase in revenue relative to $0 under the no action alternative

Washington County

Table 185. BOFL Revenue Distributions to Washington County (2023–2092)—No Action Alternative (in 2019 dollars)

County Revenues	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
County Administration	$12,910,779	$5,114,895	$4,476,193	$5,072,335	$6,545,955	$4,887,613	$4,989,868	$43,997,638
County School Fund	$12,910,779	$5,114,895	$4,476,193	$5,072,335	$6,545,955	$4,887,613	$4,989,868	$43,997,638
Taxing Districts[a]	$38,732,337	$15,344,685	$13,428,579	$15,217,005	$19,637,865	$14,662,838	$14,969,603	$131,992,915
Washington County (Total)	$64,553,895	$25,574,475	$22,380,965	$25,361,675	$32,729,775	$24,438,063	$24,949,338	$219,988,192

Source: ECONorthwest's analysis of Forest Model

[a] For further breakdown of revenue to individual taxing districts, see Table 186.

Table 186. BOFL Revenue Distributions to Taxing Districts in Washington County (2023–2092)—No Action Alternative (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County District	$2,547,409	$1,009,214	$883,192	$1,000,816	$1,291,574	$964,369	$984,544	$8,681,118
Port of Portland	$60,415	$23,935	$20,946	$23,735	$30,631	$22,871	$23,350	$205,882
Tualatin Valley FD	$1,824,244	$722,715	$632,469	$716,702	$924,919	$690,601	$705,049	$6,216,700
Forest Grove RFD	$1,100,217	$435,876	$381,448	$432,249	$557,826	$416,508	$425,221	$3,749,345
Tri City RFD	$2,160,532	$855,943	$749,061	$848,821	$1,095,422	$817,909	$835,021	$7,362,708
SD 511 (Gaston)	$6,052,574	$2,397,864	$2,098,440	$2,377,911	$3,068,745	$2,291,313	$2,339,251	$20,626,098
SD 13 (Banks)	$5,920,714	$2,345,624	$2,052,724	$2,326,106	$3,001,889	$2,241,395	$2,288,288	$20,176,741
SD 15 (Forest Grove)	$6,478,321	$2,566,533	$2,246,047	$2,545,177	$3,284,604	$2,452,487	$2,503,797	$22,076,965
SD 49 (Vernonia)	$5,671,471	$2,246,881	$1,966,311	$2,228,185	$2,875,520	$2,147,040	$2,191,959	$19,327,366
SD 1J (Hillsboro)	$6,248,642	$2,475,540	$2,166,417	$2,454,942	$3,168,154	$2,365,538	$2,415,028	$21,294,261
Northwest Regional ESD	$132,550	$52,513	$45,955	$52,076	$67,205	$50,179	$51,229	$451,707

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Portland Community College	$585,875	$232,108	$203,124	$230,176	$297,047	$221,794	$226,434	$1,996,557

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 187. BOFL Revenue Distributions to Washington County (2023–2092)—Proposed Action (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative)							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Washington County	$77,044,580 (19%)	$56,677,320 (122%)	$63,839,715 (185%)	$64,725,395 (155%)	$30,013,003 (-8%)	$51,053,325 (109%)	$27,107,135 (9%)	$370,460,448 (68%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 188. BOFL Revenue Distributions to Taxing Districts in Washington County (2023–2092)—Proposed Action (in 2019 dollars)

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Washington County District	$3,040,314	$2,236,586	$2,519,227	$2,554,177	$1,184,365	$2,014,653	$1,069,695	$14,619,017
Port of Portland	$72,104	$53,043	$59,746	$60,575	$28,089	$47,780	$25,369	$346,706
Tualatin Valley FD	$2,177,222	$1,601,658	$1,804,062	$1,829,091	$848,145	$1,442,729	$766,027	$10,468,933
Forest Grove RFD	$1,313,101	$965,974	$1,088,045	$1,103,140	$511,523	$870,122	$461,998	$6,313,904
Tri City RFD	$2,578,578	$1,896,913	$2,136,629	$2,166,272	$1,004,495	$1,708,686	$907,239	$12,398,813
SD 511 (Gaston)	$7,223,702	$5,314,066	$5,985,613	$6,068,655	$2,814,020	$4,786,761	$2,541,566	$34,734,383
SD 13 (Banks)	$7,066,327	$5,198,295	$5,855,212	$5,936,444	$2,752,714	$4,682,478	$2,486,195	$33,977,665
SD 15 (Forest Grove)	$7,731,827	$5,687,865	$6,406,649	$6,495,532	$3,011,962	$5,123,469	$2,720,343	$37,177,646
SD 49 (Vernonia)	$6,768,858	$4,979,464	$5,608,727	$5,686,539	$2,636,834	$4,485,361	$2,381,535	$32,547,318
SD 1J (Hillsboro)	$7,457,707	$5,486,211	$6,179,512	$6,265,243	$2,905,177	$4,941,824	$2,623,897	$35,859,570

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Northwest Regional ESD	$158,198	$116,377	$131,084	$132,902	$61,626	$104,829	$55,660	$760,676
Portland Community College	$699,237	$514,389	$579,393	$587,431	$272,390	$463,347	$246,018	$3,362,206

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 189. Percentage Increase in BOFL Revenue Distributions in Washington County under Proposed Action Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County District	19%	122%	185%	155%	-8%	109%	9%	68%
Port of Portland	19%	122%	185%	155%	-8%	109%	9%	68%
Tualatin Valley FD	19%	122%	185%	155%	-8%	109%	9%	68%
Forest Grove RFD	19%	122%	185%	155%	-8%	109%	9%	68%
Tri City RFD	19%	122%	185%	155%	-8%	109%	9%	68%
SD 511 (Gaston)	19%	122%	185%	155%	-8%	109%	9%	68%
SD 13 (Banks)	19%	122%	185%	155%	-8%	109%	9%	68%
SD 15 (Forest Grove)	19%	122%	185%	155%	-8%	109%	9%	68%
SD 49 (Vernonia)	19%	122%	185%	155%	-8%	109%	9%	68%
SD 1J (Hillsboro)	19%	122%	185%	155%	-8%	109%	9%	68%
Northwest Regional ESD	19%	122%	185%	155%	-8%	109%	9%	68%
Portland Community College	19%	122%	185%	155%	-8%	109%	9%	68%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

Table 190. BOFL Revenue Distributions to Washington County (2023–2092)—Alternative 3 (in 2019 dollars)

County Revenues	Time Periods (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County	$75,513,585 (17%)	$56,021,640 (119%)	$63,180,000 (182%)	$64,028,895 (152%)	$29,720,965 (-9%)	$49,958,665 (104%)	$27,386,308 (10%)	$365,810,080 (66%)

Source: ECONorthwest's analysis of Forest Model
- sign indicates decrease in revenue relative to the no action alternative

Table 191. BOFL Revenue Distributions to Taxing Districts in Washington County (2023–2092)—Alternative 3 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County District	$2,979,898	$2,210,712	$2,493,193	$2,526,692	$1,172,841	$1,971,456	$1,080,712	$14,435,503
Port of Portland	$70,672	$52,429	$59,129	$59,923	$27,815	$46,755	$25,630	$342,354
Tualatin Valley FD	$2,133,957	$1,583,129	$1,785,419	$1,809,408	$839,892	$1,411,794	$773,916	$10,337,516
Forest Grove RFD	$1,287,008	$954,799	$1,076,802	$1,091,270	$506,546	$851,465	$466,756	$6,234,645
Tri City RFD	$2,527,338	$1,874,969	$2,114,550	$2,142,961	$994,721	$1,672,049	$916,583	$12,243,170
SD 511 (Gaston)	$7,080,156	$5,252,590	$5,923,759	$6,003,351	$2,786,638	$4,684,126	$2,567,741	$34,298,360
SD 13 (Banks)	$6,925,908	$5,138,158	$5,794,705	$5,872,563	$2,725,929	$4,582,078	$2,511,800	$33,551,141
SD 15 (Forest Grove)	$7,578,183	$5,622,064	$6,340,444	$6,425,634	$2,982,654	$5,013,614	$2,748,359	$36,710,952
SD 49 (Vernonia)	$6,634,351	$4,921,859	$5,550,767	$5,625,347	$2,611,176	$4,389,188	$2,406,062	$32,138,749
SD 1J (Hillsboro)	$7,309,510	$5,422,743	$6,115,653	$6,197,824	$2,876,909	$4,835,864	$2,650,920	$35,409,423
Northwest Regional ESD	$155,054	$115,031	$129,729	$131,472	$61,027	$102,581	$56,233	$751,127
Portland Community College	$685,342	$508,438	$573,406	$581,110	$269,740	$453,412	$248,551	$3,320,000

Source: ECONorthwest's analysis of Forest Model
ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 192. Percentage Increase in BOFL Revenue Distributions in Washington County under Alternative 3 Relative to the No Action Alternative (2023–2092)

	Time Periods							Total
Taxing Districts	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**2073–2082**	**2083–2092**	**(70 Years)**
Washington County District	17%	119%	182%	152%	-9%	104%	10%	66%
Port of Portland	17%	119%	182%	152%	-9%	104%	10%	66%
Tualatin Valley FD	17%	119%	182%	152%	-9%	104%	10%	66%
Forest Grove RFD	17%	119%	182%	152%	-9%	104%	10%	66%
Tri City RFD	17%	119%	182%	152%	-9%	104%	10%	66%
SD 511 (Gaston)	17%	119%	182%	152%	-9%	104%	10%	66%
SD 13 (Banks)	17%	119%	182%	152%	-9%	104%	10%	66%
SD 15 (Forest Grove)	17%	119%	182%	152%	-9%	104%	10%	66%
SD 49 (Vernonia)	17%	119%	182%	152%	-9%	104%	10%	66%
SD 1J (Hillsboro)	17%	119%	182%	152%	-9%	104%	10%	66%
Northwest Regional ESD	17%	119%	182%	152%	-9%	104%	10%	66%
Portland Community College	17%	119%	182%	152%	-9%	104%	10%	66%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

Table 193. BOFL Revenue Distributions to Washington County (2023–2072)—Alternative 4 (in 2019 dollars)

County	Total Revenue (% Increase Relative to the No Action Alternative)					Total
Revenues	**2023–2032**	**2033–2042**	**2043–2052**	**2053–2062**	**2063–2072**	**(50 Years)**
Washington County	$77,044,580 (19%)	$56,677,320 (122%)	$63,839,715 (185%)	$64,725,395 (155%)	$30,013,003 (-8%)	$292,300,000 (71%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 194. BOFL Revenue Distributions to Taxing Districts in Washington County (2023–2072)—Alternative 4 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Washington County District	$3,040,314	$2,236,586	$2,519,227	$2,554,177	$1,184,365	$11,534,668
Port of Portland	$72,104	$53,043	$59,746	$60,575	$28,089	$273,557
Tualatin Valley FD	$2,177,222	$1,601,658	$1,804,062	$1,829,091	$848,145	$8,260,178
Forest Grove RFD	$1,313,101	$965,974	$1,088,045	$1,103,140	$511,523	$4,981,784
Tri City RFD	$2,578,578	$1,896,913	$2,136,629	$2,166,272	$1,004,495	$9,782,888
SD 511 (Gaston)	$7,223,702	$5,314,066	$5,985,613	$6,068,655	$2,814,020	$27,406,056
SD 13 (Banks)	$7,066,327	$5,198,295	$5,855,212	$5,936,444	$2,752,714	$26,808,991
SD 15 (Forest Grove)	$7,731,827	$5,687,865	$6,406,649	$6,495,532	$3,011,962	$29,333,835
SD 49 (Vernonia)	$6,768,858	$4,979,464	$5,608,727	$5,686,539	$2,636,834	$25,680,422
SD 1J (Hillsboro)	$7,457,707	$5,486,211	$6,179,512	$6,265,243	$2,905,177	$28,293,849
Northwest Regional ESD	$158,198	$116,377	$131,084	$132,902	$61,626	$600,187
Portland Community College	$699,237	$514,389	$579,393	$587,431	$272,390	$2,652,841

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 195. Percentage Increase in BOFL Revenue Distributions in Washington County under Alternative 4 Relative to the No Action Alternative (2023–2072)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
Washington County District	19%	122%	185%	155%	-8%	71%
Port of Portland	19%	122%	185%	155%	-8%	71%
Tualatin Valley FD	19%	122%	185%	155%	-8%	71%
Forest Grove RFD	19%	122%	185%	155%	-8%	71%
Tri City RFD	19%	122%	185%	155%	-8%	71%
SD 511 (Gaston)	19%	122%	185%	155%	-8%	71%
SD 13 (Banks)	19%	122%	185%	155%	-8%	71%

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	Total (50 Years)
SD 15 (Forest Grove)	19%	122%	185%	155%	-8%	71%
SD 49 (Vernonia)	19%	122%	185%	155%	-8%	71%
SD 1J (Hillsboro)	19%	122%	185%	155%	-8%	71%
Northwest Regional ESD	19%	122%	185%	155%	-8%	71%
Portland Community College	19%	122%	185%	155%	-8%	71%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

Table 196. BOFL Revenue Distributions to Washington County (2023–2092)—Alternative 5 (in 2019 dollars)

County Revenues	Total Revenue (% Increase Relative to the No Action Alternative) 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County	$79,045,130 (22%)	$60,813,375 (138%)	$69,143,960 (209%)	$61,145,415 (141%)	$31,542,835 (-4%)	$55,243,760 (126%)	$26,267,420 (5%)	$383,201,888 (74%)

Source: ECONorthwest's analysis of Forest Model

- sign indicates decrease in revenue relative to the no action alternative

Table 197. BOFL Revenue Distributions to Taxing Districts in Washington County (2023–2092)—Alternative 5 (in 2019 dollars)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County District	$3,119,259	$2,399,802	$2,728,541	$2,412,905	$1,244,735	$2,180,015	$1,036,558	$15,121,816
Port of Portland	$73,977	$56,914	$64,710	$57,225	$29,520	$51,701	$24,583	$358,630
Tualatin Valley FD	$2,233,756	$1,718,540	$1,953,956	$1,727,923	$891,377	$1,561,147	$742,297	$10,828,996
Forest Grove RFD	$1,347,197	$1,036,466	$1,178,448	$1,042,125	$537,597	$941,541	$447,686	$6,531,061
Tri City RFD	$2,645,534	$2,035,342	$2,314,155	$2,046,455	$1,055,696	$1,848,935	$879,135	$12,825,252
SD 511 (Gaston)	$7,411,274	$5,701,864	$6,482,940	$5,732,996	$2,957,457	$5,179,657	$2,462,834	$35,929,021
SD 13 (Banks)	$7,249,813	$5,577,644	$6,341,703	$5,608,098	$2,893,026	$5,066,814	$2,409,179	$35,146,276

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
SD 15 (Forest Grove)	$7,932,593	$6,102,940	$6,938,958	$6,136,262	$3,165,488	$5,544,001	$2,636,073	$38,456,315
SD 49 (Vernonia)	$6,944,620	$5,342,843	$6,074,738	$5,372,016	$2,771,239	$4,853,518	$2,307,760	$33,666,735
SD 1J (Hillsboro)	$7,651,355	$5,886,570	$6,692,948	$5,918,711	$3,053,261	$5,347,447	$2,542,615	$37,092,907
Northwest Regional ESD	$162,305	$124,870	$141,975	$125,551	$64,768	$113,433	$53,936	$786,838
Portland Community College	$717,394	$551,927	$627,533	$554,940	$286,275	$501,379	$238,396	$3,477,844

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

Table 198. Percentage Increase in BOFL Revenue Distributions in Washington County under Alternative 5 Relative to the No Action Alternative (2023–2092)

Taxing Districts	Time Periods 2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	Total (70 Years)
Washington County District	22%	138%	209%	141%	-4%	126%	5%	74%
Port of Portland	22%	138%	209%	141%	-4%	126%	5%	74%
Tualatin Valley FD	22%	138%	209%	141%	-4%	126%	5%	74%
Forest Grove RFD	22%	138%	209%	141%	-4%	126%	5%	74%
Tri City RFD	22%	138%	209%	141%	-4%	126%	5%	74%
SD 511 (Gaston)	22%	138%	209%	141%	-4%	126%	5%	74%
SD 13 (Banks)	22%	138%	209%	141%	-4%	126%	5%	74%
SD 15 (Forest Grove)	22%	138%	209%	141%	-4%	126%	5%	74%
SD 49 (Vernonia)	22%	138%	209%	141%	-4%	126%	5%	74%
SD 1J (Hillsboro)	22%	138%	209%	141%	-4%	126%	5%	74%
Northwest Regional ESD	22%	138%	209%	141%	-4%	126%	5%	74%

Taxing Districts	Time Periods							Total (70 Years)
	2023–2032	2033–2042	2043–2052	2053–2062	2063–2072	2073–2082	2083–2092	
Portland Community College	22%	138%	209%	141%	-4%	126%	5%	74%

Source: ECONorthwest's analysis of Forest Model

ESD = Education Service District; RFD = Rural Fire Department; SD = School District; FD = Fire Department

- sign indicates decrease in revenue relative to the no action alternative

Yamhill County

Yamhill County does not contain BOFL and, thus, does not receive revenue from timber sales on BOFL.

Timber Sale Revenue from Common School Fund Lands

Tables 199 through 203 show the timber revenue from CSFL provided by decade (total and average annual) under each alternative.

Table 199. Timber Revenue from CSFL under the No Action Alternative (2023–2092) (in 2019 dollars)

Time Period	Total Revenue	Annual Revenue
2023–2032	$12,219,876	$1,221,988
2033–2042	$21,108,995	$2,110,900
2043–2052	$16,734,340	$1,673,434
2053–2062	$17,192,742	$1,719,274
2063–2072	$19,984,275	$1,998,428
2073–2082	$25,862,141	$2,586,214
2083–2092	$13,861,865	$1,386,186
Total (70 Year)	$126,964,234	$1,813,775

Source: ECONorthwest's analysis of Forest Model

Table 200. Timber Revenue from CSFL under the Proposed Action (2023–2092) (in 2019 dollars)

	Total Revenue	% Difference Relative to the No Action Alternative	Annual Revenue
2023–2032	$19,506,552	60%	$1,950,655
2033–2042	$25,857,528	22%	$2,585,753
2043–2052	$26,251,459	57%	$2,625,146
2053–2062	$21,149,120	23%	$2,114,912
2063–2072	$19,964,926	0%	$1,996,493
2073-–2082	$22,870,974	-12%	$2,287,097
2083–2092	$21,025,172	52%	$2,102,517
Total (70 Year)	$156,625,731	23%	$2,237,510

Source: ECONorthwest's analysis of Forest Model

Table 201. Timber Revenue from CSFL under Alternative 3 (2023–2092) (in 2019 dollars)

Time Periods	Total Revenue	% Difference Relative to the No Action Alternative	Annual Revenue
2023–2032	$19,205,688	57%	$1,920,569
2033–2042	$26,262,417	24%	$2,626,242
2043–2052	$26,107,947	56%	$2,610,795
2053–2062	$22,312,340	30%	$2,231,234
2063–2072	$18,285,884	-8%	$1,828,588
2073–2082	$21,885,317	-15%	$2,188,532
2083–-2092	$20,789,919	50%	$2,078,992
Total (70 Year)	$154,849,512	22%	$2,212,136

Source: ECONorthwest's analysis of Forest Model

Table 202. Timber Revenue from CSFL under Alternative 4 (2023–2092) (in 2019 dollars)

Time Periods	Total Revenue	% Difference Relative to the No Action Alternative	Annual Revenue
2023–2032	$19,506,552	60%	$1,950,655
2033–2042	$25,857,528	22%	$2,585,753
2043–2052	$26,251,459	57%	$2,625,146
2053–2062	$21,149,120	23%	$2,114,912
2063–2072	$19,964,926	0%	$1,996,493
Total (50 Year)	$112,729,585	29%	$1,610,423

Source: ECONorthwest's analysis of Forest Model

Table 203. Timber Revenue from CSFL under Alternative 5 (2023–2092) (in 2019 dollars)

Time Periods	Total Revenue	% Difference Relative to the No Action Alternative	Annual Revenue
2023–2032	$19,818,886	62%	$1,981,889
2033–2042	$27,924,536	32%	$2,792,454
2043–2052	$26,025,634	56%	$2,602,563
2053–2062	$23,351,277	36%	$2,335,128
2063–2072	$21,486,850	8%	$2,148,685
2073–2082	$23,285,339	-10%	$2,328,534
2083–2092	$22,974,118	66%	$2,297,412
Total (70 Year)	$164,866,640	30%	$2,355,238

Source: ECONorthwest's analysis of Forest Model

Forest Products Harvest Tax

Table 204 shows the total funding for each Forest Products Harvest Tax recipient over the analysis period under the proposed action compared to the no action alternative.

Table 204. Forest Products Harvest Tax Revenues by Recipient under the Proposed Action Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Forest Products Harvest Tax Revenue Distributions	No Action Alternative	Proposed Action	Difference
Oregon Forest Land Protection Fund (ODF)	$7,566,645	$9,777,201	$2,210,556
Forest Practices Act (ODF)	$16,719,844	$21,604,460	$4,884,616
OSU College of Forestry	$1,220,427	$1,576,968	$356,541
Forestry Research (OSU)	$10,861,797	$14,035,014	$3,173,217
Forest Resources Institute	$13,546,735	$17,504,344	$3,957,609
Total	$49,915,448	$64,497,984	$14,582,536

Table 205 shows the funding for each Forest Products Harvest Tax recipient by decade under Alternative 3 compared to the no action alternative. Table 206 shows the total funding for each Forest Products Harvest Tax recipient over the analysis period under Alternative 3 compared to the no action alternative.

Table 205. Forest Products Harvest Tax Revenue by Decade under Alternative 3 Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Time Period	No Action Alternative	Alternative 3	Difference	Percentage
Average Annual Revenue				
2023-2032	$788,506	$1,014,424	$225,918	29%
2033-2042	$691,148	$992,781	$301,633	44%
2043-2052	$702,110	$972,841	$270,730	39%
2053-2062	$720,896	$904,083	$183,187	25%
2063-2072	$708,058	$857,087	$149,029	21%
2073-2082	$683,218	$828,665	$145,447	21%
2083-2092	$697,609	$823,186	$125,577	18%
Total Revenue				
2023-2092	$50,430,468	$64,590,280	$14,159,812	28%

Table 206. Forest Products Harvest Tax Revenues by Recipient under Alternative 3 Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Forest Products Harvest Tax Revenue Distributions	No Action Alternative	Alternative 3	Difference
Oregon Forest Land Protection Fund (ODF)	$7,566,645	$9,691,200	$2,124,555
Forest Practices Act (ODF)	$16,719,844	$21,414,424	$4,694,580
OSU College of Forestry	$1,220,427	$1,563,097	$342,670
Forestry Research (OSU)	$10,861,797	$13,911,560	$3,049,763
Forest Resources Institute	$13,546,735	$17,350,374	$3,803,639
Total	$49,915,448	$63,930,656	$14,015,208

Table 207 shows the funding for each Forest Products Harvest Tax recipient by decade under Alternative 4 compared to the no action alternative. Table 208 shows the total funding for each Forest Products Harvest Tax recipient over the analysis period under Alternative 4 compared to the no action alternative.

Table 207. Forest Products Harvest Tax Revenue by Decade under Alternative 4 Compared to the No Action Alternative (2023–2072) (in 2019 dollars)

Time Period	No Action Alternative	Alternative 4	Difference	Percentage
Average Annual Revenue				
2023–2032	$788,506	$1,023,162	$234,656	29.76%
2033–2042	$691,148	$1,001,135	$309,987	44.85%
2043–2052	$702,110	$978,815	$276,704	39.41%
2053–2062	$720,896	$912,699	$191,802	26.61%
2063–2072	$708,058	$866,955	$158,897	22.44%
Total Revenue				
2023–2092	$36,107,188	$47,827,648	$11,720,460	32.46%

Table 208. Forest Products Harvest Tax Revenues by Recipient under Alternative 4 Compared to the No Action Alternative (2023–2072) (in 2019 dollars)

Forest Products Harvest Tax Revenue Distributions	No Action Alternative	Alternative 4	Difference
Oregon Forest Land Protection Fund (ODF)	$5,473,461	$7,250,157	$1,776,696
Forest Practices Act (ODF)	$12,094,583	$16,020,508	$3,925,925
OSU College of Forestry	$882,816	$1,169,380	$286,564
Forestry Research (OSU)	$7,857,065	$10,407,483	$2,550,418
Forest Resources Institute	$9,799,261	$12,980,120	$3,180,859
Total	**$36,107,186**	**$47,827,648**	**$11,720,462**

Table 209 shows the funding for each Forest Products Harvest Tax recipient by decade under Alternative 4 compared to the no action alternative. Table 210 shows the total funding for each Forest Products Harvest Tax recipient over the analysis period under Alternative 4 compared to the no action alternative.

Table 209. Forest Products Harvest Tax Revenue by Decade under Alternative 5 Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Time Period	No Action Alternative	Alternative 5	Difference	Percentage
Average Annual Revenue				
2023–2032	$788,506	$1,062,569	$274,063	35%
2033–2042	$691,148	$1,042,200	$351,052	51%
2043–2052	$702,110	$1,020,603	$318,493	45%
2053–2062	$720,896	$926,875	$205,979	29%
2063–2072	$708,058	$896,537	$188,478	27%
2073–2082	$683,218	$874,119	$190,902	28%
2083–2092	$697,609	$857,718	$160,110	23%
Total Revenue				
2023–2092	$49,915,448	$66,806,212	$16,890,764	34%

Table 210. Forest Products Harvest Tax Revenues by Recipient under Alternative 5 Compared to the No Action Alternative (2023–2092) (in 2019 dollars)

Forest Products Harvest Tax Revenue Distributions	No Action Alternative	Alternative 5	Difference
Oregon Forest Land Protection Fund (ODF)	$7,566,645	$10,127,103	$2,560,458
Forest Practices Act (ODF)	$16,719,844	$22,377,632	$5,657,788
OSU College of Forestry	$1,220,427	$1,633,404	$412,977
Forestry Research (OSU)	$10,861,797	$14,537,293	$3,675,496
Forest Resources Institute	$13,546,735	$18,130,782	$4,584,047
Total	**$49,915,448**	**$66,806,212**	**$16,890,764**

References

Ambuehl, Jenn. Senior Financial Analyst. Benton County, Oregon. August 12, 2021—Email.

Arce, Eve. Treasurer/Tax Collector. Josephine County, Oregon. July 8, 2021—Meeting.

Blanchard, Shawn. County Treasurer. Tillamook County, Oregon. October 15, 2021—Email.

Clatsop County. 2019. Adopted Budget: Fiscal Year 2019–2020. Available: https://www.co.clatsop.or.us/finance/page/fiscal-year-2019-20-budget.

Guess, Mary Ann. Treasurer/Tax Collector. Columbia County, Oregon. June 25, 2021—Meeting.

Hansen, Greg. Administrative Officer. Polk County, Oregon. July 15, 2021—Email.

IMPLAN Group, LLC. 2019a. 2019 Data Year. Huntersville, NC. Available: https://www.IMPLAN.com.

IMPLAN Group, LLC. 2019b. *Understanding Output*. Huntersville, NC. Available: https://support.implan.com/hc/en-us/articles/360035998833-Understanding-Output

Johnson, Suzanne. Director of Assessment and Taxation. Clatsop County, Oregon. June 11, 2021 —Meeting.

Lynn, Judy. Budget Officer. Washington County, Oregon. July 6, 2021—Meeting.

Nava, Brian. Treasurer. Clackamas County, Oregon. June 29, 2021—Meeting.

ODF (Oregon Department of Forestry). 2016. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2016. Prepared for the Association of Oregon Counties.

ODF (Oregon Department of Forestry). 2017. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2017. Prepared for the Association of Oregon Counties.

ODF (Oregon Department of Forestry). 2018. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2018. Prepared for the Association of Oregon Counties.

ODF (Oregon Department of Forestry). 2019a. 2019–2021 Legislatively Adopted Budget Narrative.

ODF (Oregon Department of Forestry). 2019b. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2019. Prepared for the Association of Oregon Counties.

ODF (Oregon Department of Forestry). 2020a. Timber Harvest Data 1962–2019. Oregon Open Data Portal. Available: https://data.oregon.gov/Natural-Resources/Timber-Harvest-Data-1962-2019/c3sg-dt24.

ODF (Oregon Department of Forestry). 2020b. Council of Forest Trust Land Counties Annual Report: Fiscal Year 2020. Prepared for the Association of Oregon Counties.

ODF (Oregon Department of Forestry). 2021. Logflow by Origin and Destination County Data, 2018 to 2021.

Oregon Department of Forestry Emergency Fire Cost Committee. 2020. FY20 Estimated OFLPF Account Balance. Available: https://www.oregon.gov/odf/board/Documents/efcc/3_%20OFLPF%20Fund%20Balance%20FY20_013120.pdf. Accessed: August 12, 2021.

Oregon Department of Revenue Research Section. 2020. State of Oregon Tax Expenditure Report: 2021-2023 Biennium. Oregon Department of Administrative Services: Salem, OR.

Oregon Forest Resources Institute. 2020. Approved Fiscal Year 2019-20 Budget. Available: https://oregonforests.org/sites/default/files/2019-11/FY%202019-20%20APPROVED%20Budget.pdf.

Oregon State University. 2020. 2020 Annual Financial Report. Available:https://fa.oregonstate.edu/annual-financial-reports-audited. Accessed: August 12, 2021.

Portland State University. 2021. Population Forecasts. Available: https://www.pdx.edu/population-research/population-forecasts.

Shearer, Christina; Welch, Jayne. Finance Director; Treasurer/Tax Collector. Lincoln County, Oregon. July 1, 2021—Meeting.

Simms, Megan. Treasurer. Coos County, Oregon. June 25, 2021—Meeting.

Steele, Laurie. Treasurer. Marion County, Oregon. July 20, 2021—Meeting.

Tintle, Robert. County Treasurer/Financial Services Manager. Lane County, Oregon. June 25, 2021—Meeting.

University of Montana. 2021. “Timber Harvest for Oregon”. Dataset available at: http://www.bber.umt.edu/fir/HarvestOR.aspx. Accessed: August 12, 2021.

U.S. Bureau of Labor Statistics. No Date. Employer Costs for Employee Compensation for the Regions – March 2021. Table 1. Employer Costs for Employee Compensation for private industry workers by census region and division. Available: https://www.bls.gov/regions/southwest/news-release/employercostsforemployeecompensation_regions.htm.

U.S. Census Bureau. 2010. Table 12. Available: https://data.census.gov/cedsci/table?text=sex%20by%20age&g=0500000US41003.150000,41005.150000,41007.150000,41009.150000,41011.150000,41015.150000,41019.150000,41027.150000,41033.150000,41039.150000,41041.150000,41043.150000,41047.150000,41051.150000,41053.150000,41057.150000,41067.150000,41071.150000&tid=DECENNIALSF12010.P12&hidePreview=true. Accessed: July 14, 2021.

U.S. Census Bureau. 2021. Table S0101: Age and Sex. *2015–2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/table?q=ACSST1Y2019.S0101&text=s0101&g=0400000US41_0500000US41003,41005,41007,41009,41011,41015,41019,41029,41033,41039,41041,41043,41047,41051,41053,41057,41067,41071&y=2019&tid=ACSST5Y2019.S0101&hidePreview=true. Accessed: July 14, 2021.

Appendix 3.14

Greenhouse Gas Emission and Carbon Sequestration Quantification Methods and Results

Methods

The National Marine Fisheries Service (NMFS) used available data to quantify greenhouse gas (GHG) emissions and carbon sequestration under each alternative analyzed in the environmental impact statement for the following covered activities: timber harvest activities, reforestation and young stand management, and road system management. The following details the quantification methodologies for each of these covered activities.

Timber harvest activities and reforestation and young stand management would affect the amount of carbon stored in trees and would result in GHG emissions.

- **Carbon sequestration.** The analysis involved evaluating forest model outputs for carbon stock by alternative for the years 2023, 2048, 2073, and 2093. The estimated carbon stock based on bole wood (main trunk) provides a means to compare the relative loss of carbon from harvested stands among the alternatives.[1]
- **Greenhouse gas emissions.** Because ODF was not able to provide project-specific estimates for equipment use and vehicle activity, this analysis calculated GHG emissions from forest operations using the following.
    - The forest model outputs the volume of timber harvested per year by alternative for the years 2023, 2048, 2073, and 2093.
    - A study conducted in the Oregon Coast Range (Sonne 2006:9) modeled emission rates from forestry operations under a range of scenarios. To construct a worst-case emissions estimate, this analysis selected the study's scenario with the highest emissions rate (i.e., precommercial thinning, commercial thinning, herbicide, fertilization, and transport to mill with a 30-year rotation), yielding an emissions rate of 108 metric tons of carbon dioxide equivalent (MT CO_2e) per million board feet (MMBF) harvested or thinned.[2],[3]

Road system management would result in GHG emissions from equipment use and vehicle activity. Because estimates for equipment use and vehicle activity were not readily available, this analysis calculates GHG emissions from road construction using the following.

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[1] The carbon stock does not include carbon stored in the soil, standing and downed woody debris, understory plants, the forest floor, or harvested stands. The exclusion of these contributors to carbon storage results in a conservative underestimate of the size of the net carbon sink.

[2] The study's GHG inventory boundary, which accounts for the emissions from specific ODF activities within the permit area, excluded emissions associated with production at sawmills and construction of facilities and equipment.

[3] The emission factors used in the study to model emissions from offroad equipment and vehicles are based on year 2006 and prior engines. Vehicle and equipment engine emission factors improve over time due to improvements in emission control technologies and more stringent regulations. Therefore, use of this study is conservative in that it results in an overestimate of emissions expected during the future analysis years of 2023 and beyond.

- Modeled road miles constructed per year by alternative for the years 2023, 2048, 2073, and 2093.[4]
- A U.S. Forest Service study (Loeffler et al. 2009:5) measured fuel consumption during forest road construction to estimate the amount of diesel fuel consumed per length of road constructed at various slopes. The forest model outputs that road slopes would be less than 50 percent for all new roads in the permit area. Based on this study, cut-fill construction on the roads with less than 50 percent slopes would result in 588 gallons of diesel fuel per mile of road constructed.[5]
- The GHG emissions factors (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O] per gallon) for diesel fuel mobile equipment recommended by the most recent U.S. Environmental Protection Agency guidance (EPA 2021:2-3). The emissions factor was converted to CO_2e per gallon using the 100-year global warming potential values from the *Intergovernmental Panel on Climate Change Fourth Assessment Report* (IPCC 2007:44), yielding an emissions factor of 23 pounds CO_2e per gallon.

Results

Using the data described above, NMFS quantified the estimated change in GHG emissions and carbon sequestration from quantified covered activities in the analyzed years 2023, 2048, 2073, and 2093 for all alternatives, as shown in Table 1. Under all alternatives for all analyzed years, the plan area would sequester much more carbon than covered activities would emit. Annual carbon emitted would be, on average, 6.5 percent of the average annual sequestration for each year and alternative. And while there would be differences in the size of the average annual sequestration between alternatives, these changes represent, on average, only 0.4 percent of the total carbon stock for each year and alternative.

[4] The forest model outputs the distance of new forest roads constructed but does not output the distance of roads vacated or maintained. For the purpose of this analysis, we assumed the contribution of emissions from activities related to maintaining and vacating roads would be negligible because of the limited frequency, duration, and intensity of this type of activity.

[5] Fuel consumption estimates are based on historical vehicle and equipment engines with less fuel-efficient engines than would be generally expected over the future years of the 70-year permit term. Use of these values is, therefore, conservative in that it overestimates fuel consumption and, thus, GHG emissions.

Table 1. Estimated Change in Carbon Sequestration and Emissions (MT CO_2e per year) by Alternative from Modeled Activities[a,b]

Covered Activity	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
2023					
Carbon Sequestration	499,188	218,435	234,172	218,435	159,354
Timber Harvest Emissions	-21,811	-26,876	-26,742	-26,876	-28,088
Road Construction Emissions	-48	-52	-52	-52	-52
Net Carbon Sequestration[c]	**477,328**	**191,507**	**207,377**	**191,507**	**131,214**
2048					
Carbon Sequestration	676,477	518,423	524,824	518,423	501,350
Timber Harvest Emissions	-18,758	-25,570	-25,453	-25,570	-26,082
Road Construction Emissions	-48	-52	-52	-52	-52
Net Carbon Sequestration[c]	**657,671**	**492,801**	**499,319**	**492,801**	**475,215**
2073					
Carbon Sequestration	617,014	685,904	681,061	685,904	680,785
Timber Harvest Emissions	-17,897	-22,467	-22,310	-22,467	-23,486
Road Construction Emissions	-7	-7	-6	-7	-7
Net Carbon Sequestration[c]	**599,109**	**663,430**	**658,744**	**663,430**	**657,293**
2093					
Carbon Sequestration	568,855	542,180	548,714	N/A[d]	521,943
Timber Harvest Emissions	-18,581	-21,851	-21,820	N/A[d]	-22,545
Road Construction Emissions	-1	-1	-1	N/A[d]	-1
Net Carbon Sequestration[c]	**550,273**	**520,328**	**526,894**	**N/A[d]**	**499,398**

[a] Emissions from quantified covered activities are presented as negative values (i.e., subtracting from the carbon pool); carbon sequestration is presented as positive values (i.e., adding to the carbon pool).

[b] Only modeled activities were quantified. Non-quantified covered activities include minor forest-product harvest, quarries, fire management, and recreation infrastructure and maintenance. All non-quantified covered activities emit GHGs and, therefore, would subtract from the carbon pool.

[c] Net only includes the quantified covered activities. All values are positive, denoting a carbon sink and not a carbon source.

[d] Alternative 4 would have a 50-year permit term. Therefore, data were not modeled for 2093.

MT CO_2e = metric tons carbon dioxide-equivalent; timber harvest = modeled timber harvest, reforestation, and young stand management; N/A = not applicable

References

EPA (U.S. Environmental Protection Agency). 2021. Emission Factors for Greenhouse Gas Inventories. Available: https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf. Accessed: August 2021.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Avery, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available: https://www.ipcc.ch/report/ar4/wg1/. Accessed: August 2021.

Loeffler, Dan, Greg Jones, Nikolaus Vonessen, Sean Healey, and Woodam Chung. 2009. Estimating Diesel Fuel Consumption and Carbon Dioxide Emissions from Forest Road Construction. USDA Forest Service Proceedings. Available: https://www.fs.fed.us/rm/pubs/rmrs_p056/rmrs_p056_25_loeffler.pdf. Accessed: August 2021.

Sonne, Edie. 2006. Greenhouse Gas Emissions from Forestry Operations. Available: https://acsess.onlinelibrary.wiley.com/doi/abs/10.2134/jeq2005.0159. Accessed: August 2021.