10.25923/t4s5-6d10

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

Refer to NMFS Consultation No.:
WCRO-2019-00124

October 18, 2019

Angela Elam
Forest Supervisor
United States Forest Service
Gifford Pinchot National Forest
501 E. 5th St, Bldg. 404
Vancouver, Washington 98661

Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the Middle Wind Vegetation Project, Mt. Adams Ranger District, Gifford Pinchot National Forest (HUC 1707010510)

Dear Ms. Elam:

Thank you for your letter of March 25, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Middle Wind Vegetation Project.

We have determined that the proposed actions are not likely to jeopardize Lower Columbia River steelhead or its designated critical habitat.

Please contact Tom Hausmann of the Oregon Washington Coastal Office at Tom.Hausmann@noaa.gov, (503) 231-2315 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Bonnie Allison
Dave Olson

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion for the

Middle Wind Vegetation Project
Mt. Adams Ranger District
Gifford Pinchot National Forest

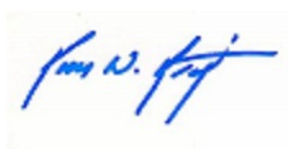
NMFS Consultation Number: WCRO-2019-00124

Action Agency: United States Forest Service, Gifford Pinchot National Forest

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region



Issued By:

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: October 18, 2019

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at Lacey, Washington.

1.2 Consultation History

The United States Forest Service (USFS), prepared the Biological Assessment (BA), and provided NMFS with a draft BA to review on January 29, 2019. The proposed action is a timber sale to take place in the Middle Wind River watershed, within the Gifford Pinchot National Forest (GPNF). The Middle Wind River is spawning, rearing, and migration critical habitat for Lower Columbia River (LCR) steelhead. NMFS provided comments on the draft BA to the USFS. The USFS addressed NMFS and USFWS comments and provided the final BA with a request to initiate consultation to NMFS on March 25, 2019. NMFS initiated consultation on March 25, 2019.

NMFS used the following information sources and documents from the action agency to make its determination: the BA provided by USFS, Status of Species summaries prepared by NMFS from papers and reports listed in the References section of this Opinion, the Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (NMFS, 2013) and scientific books, papers and reports listed in the References section of this opinion.

1.3 Proposed Federal Action

“Action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

The USFS proposes to award a contract under the Forest and Rangeland Renewable Resources Planning Act of 1974 (88 Stat 476) (16 U.S.C. 1600 et. seq.) to harvest timber on 5,297 acres of matrix[1] and late successional reserve[2] mid seral forest in the Middle Wind River watershed. The awarded contractor will construct temporary roads and landings, harvest trees, and haul logs.

[1] Large, unfragmented patches of forest designated for timber production that represent all landscape types and that are resistant, resilient and persistent over time.
[2] The network of existing old-growth forests that are retained in their natural conditions with natural processes, such as fire, allowed to function to the extent possible.

Thinning and log landings in riparian reserves

The harvest contract will call for commercial thinning in 143 units. All 143 thin units include riparian areas and riparian reserves while 43 of the units include riparian areas for streams occupied by LCR steelhead. Streams in harvest units are perennial or intermittent tributaries to the major water bodies shown in Table 1. Perennial streams may be occupied by LCR steelhead anytime. Intermittent streams may be occupied by LCR steelhead during the high flow season. Occupied or not, streams in harvest units can convey effects of the proposed action to larger water bodies. The shorter the distance between the stream and the larger water body, the more likely effects will be transported to the larger water body, where steelhead may be present.

Riparian reserves are 340 feet (two site potential tree heights) wide. Riparian reserves around perennial fish bearing streams include a 100 foot no cut buffer and a 240 foot outer riparian reserve[3]. Riparian reserves around intermittent streams include a 60 foot no cut buffer and a 280 foot outer riparian reserve. Thinning in the outer riparian reserve will leave 90 to 140 trees per acre and 40 percent to 60 percent canopy cover.

Log haul landings may be constructed in the outer portions of riparian reserves. Some earthwork will be required to clear and establish a site that is suitable to landing logs and to provide access for log trucks. Landings will be located away from perennial and intermittent stream channels to minimize sediment delivery to the stream. Erosion control measures, such as silt fences or other sediment retention methods, will be installed prior to landing construction and will remain in place and be maintained during harvest operations. The distance from the unit boundary and landings within riparian reserves to steelhead critical habitat are shown in Table 1.

Table 1. Distance from harvest unit riparian buffer and log landing to LCR steelhead streams

Harvest Unit	Stream type in Harvest Unit	Distance (river miles) from harvest unit stream to this CH water body	Distance from landing in riparian reserve to this CH water body	Distance from culvert replacement to this CH water body
802803	Intermittent	0.01 Wind River	0.40 Wind River	NA
802862	Intermittent	0.25 Falls Creek	NA	NA
802948	Intermittent	NA	NA	0.3 Ninemile Creek
802950	Intermittent	NA	NA	0.4 Ninemile Creek (2 culverts)
802971	Perennial	0.02 Wind River	0.08 Ninemile Creek	0.3 Wind River (5 culverts)
803024	Perennial	0.07 Wind River	0.07 Wind River	NA
803077	Perennial	0.50 Tenmile Creek	NA	NA
803079	Intermittent	0.25 Tenmile Creek	NA	NA
803440	Intermittent	0.50 Tenmile Creek	NA	NA

[3] The outer riparian reserve will receive the same harvest treatment as the rest of the unit. All of the trees in the matrix are of similar age and growing at the same rate. Because the density of trees is unnaturally high, the canopy is unnaturally uniform, and few trees can break out and grow tall. By thinning the stands, remaining trees will grow taller and still leave space for new trees to start growing. In the long term, thinning allows the forest to return to a more natural structure.

Harvest Unit	Stream type in Harvest Unit	Distance (river miles) from harvest unit stream to this CH water body	Distance from landing in riparian reserve to this CH water body	Distance from culvert replacement to this CH water body
803445	Intermittent	0.20 Tenmile Creek	0.20 Tenmile Creek	0.5 Tenmile Creek (2 culverts)
804083	Perennial	0.05 Panther Creek	0.05 Panther Creek	NA
804085	Perennial	0.25 Panther Creek	0.25 Panther Creek	NA
804113	Intermittent	0.14 Tenmile Creek	0.25 Tenmile Creek	NA
804142	Perennial	0.50 Panther Creek	NA	NA
804150	Intermittent	0.10 Panther Creek	0.25 Panther Creek	0.2 Panther Creek (3 culverts)
804153	Perennial	0.01 Panther Creek	NA	NA
804166	Perennial	0.01 Tenmile Creek	0.04 Tenmile Creek	NA
804183	Perennial	NA	NA	0.2 Panther Creek)
806345	Intermittent	0.01 Hollis Creek	0.35 Unnamed Trib	03 Hollis Creek and unnamed (2 culverts)
806352	Perennial	0.25 Hollis Creek	0.30 Hollis Creek	NA
806353	Perennial	0.25 Hollis Creek	NA	0.4 Hollis Creek (2 culverts)
806422	Perennial	0.25 Trib to Wind River	0.25 Trib to Wind River	NA
806435	Perennial	0.01 Eightmile Creek	NA	NA
806438	Perennial	0.01 Eightmile Creek	NA	NA
806446	Perennial	0.0 Eightmile Creek	0.20 Eightmile Creek	NA
806465	Perennial	0.25 Eightmile Creek	0.25 Eightmile Creek	NA
808228	Intermittent	0.20 Trib to Crater Creek	0.10 Trib to Crater Creek	0.2 Crater Creek (2 culverts)
808234	Perennial	0.20 Compass Creek	0.40 Compass Creek	0.5 Compass Creek
808240	Intermittent	0.04 Crater Creek	0.10 Crater Creek	NA
808242	Perennial	0.25 Crater Creek	0.25 Crater Creek	NA
808245	Perennial	0.25 Crater Creek	NA	NA
808247	Perennial	0.10 Crater Creek	NA	NA
808252	Perennial	0.50 Compass Creek	NA	NA
808255	Intermittent	0.15 Compass Creek	NA	NA
808258	Perennial	0.04 Crater Creek	0.25 Crater Creek	NA
808260	Intermittent	0.20 Compass Creek	NA	NA
808294	Perennial	0.40 Trout Creek	0.04 Trout Creek	NA
808295	Intermittent	0.20 East Fork Trout Creek	NA	NA
808297	Intermittent	0.25 East Fork Trout Creek	NA	NA
808300	Perennial	0.04 East Fork Trout Creek	0.10 East Fork Trout Creek	0.2 East Fork Trout Creek
808318	Perennial	0.01 Trout Creek	NA	NA
808324	Intermittent	0.50 Trout Creek	NA	NA
808343	Perennial	0.04 Pass Creek	0.05 Pass Creek	0.3 Pass Creek
808343	Intermittent	0.50 East Fork Trout Creek	NA	NA

Construction of roads in the riparian reserve

The USFS will require that the awarded contractor will maintain or reconstruct system roads needed for hauling timber. Reconstruction may include culvert replacement, road surface work, and fill repair. Maintenance may include brushing, blading, drainage, and logging out. Post haul maintenance would also occur as needed after the close of the sale.

Six new permanent culverts larger than 24 inches in diameter that are located within 0.5 miles of steelhead critical habitat will be replaced on system roads during reconstruction of the primary haul routes. These culverts are older pipes that are either rusted and at the end of their life, or are undersized and need to improve flow capacity. Culvert replacement requires excavation of fill material over and around the existing pipe, removal of the pipe, and replacement with a new pipe and fill material. Four of these culverts are located on intermittent streams and two culverts are located on perennial streams (Table 2). Culvert replacement work on system roads will occur during the dry weather season (June 16 to September 30). Streams would be dry at the time of implementation or dewatered to prevent generation of sediment and minimize turbidity.

Table 2. System road culvert replacement stream and distance to LCR steelhead critical habitat

Road Number	Mile Post	Stream Type	Distance to LCR steelhead critical habitat	Stream
3062	0.30	Intermittent	0.1	Wind River
3062	0.44	Intermittent	0.1	Wind River
3062	0.89	Perennial steelhead	0.0	Ninemile Creek
3080	1.42	Intermittent	0.3	Hollis Creek
60	2.21	Intermittent	0.4	Unnamed Wind River Tributary
42	4.170	Perennial	0.10	Crater Creek

Approximately 77 miles of temporary road will be reconstructed. Of these, approximately 47 miles will follow the route of an existing road or a previously decommissioned road, with about 9 road miles within 0.5 miles of LCR steelhead habitat and 6 road miles in a riparian reserve. The other 30 miles of temporary road will be new construction to relocate a decommissioned road route around a stream or wetland with 3.5 road miles in riparian reserves (Table 3).

Table 3. Temporary roadwork in the Middle Wind River Vegetation project area.

Watershed	Reconstructed Temporary (miles)	New Temporary	Existing Temporary	Crossings on Intermittent Streams	Crossings on Perennial Streams	Crossings on Steelhead Habitat	Roads on existing alignment in Riparian Reserve	Roads on new alignments in Riparian Reserves
Panther Creek	7.1	9.3	11.4	15	3	0	1.6	0.7
Falls Creek	1.4	0.5	1.3	5	0	0	0.3	0.0
Trapper Creek-Wind River	0.0	0.8	7.0	18	6	0	2.2	1.5
Trout Creek	0.3	8.7	10.5	17	1	0	1.7	1.2
Total	8.8	19.3	30.3	55	10	0	5.8	3.4

Temporary roads will be treated to repair and improve drainage structures (e.g., re-sloping road grades and re-establishing road ditch drainage), improve the running surface of the road, and clear vegetation along roadsides. Water bars and rolling dips will be placed at frequent intervals to direct surface water onto undisturbed vegetated areas or road ditches. Straw mulch, straw bale check dams, or silt fences will be in place to catch sediment from surface water run-off. Twenty-three temporary culverts will be installed on temporary roads (Table 1). Nine of these culverts are within 0.25 mile of steelhead habitat. Two culverts are on perennial streams in unit 802971. Placement and removal of temporary culverts will require some excavation of fill material, placement and then removal of the pipe, removal of fill, sloping back of streambanks to natural angle of repose, and seeding and mulching. Some direct excavation within the channel will need to occur to provide an adequate size and condition of the culvert bed prior to laying new pipe. Culverts will be installed during the dry weather season (June 16 to September 30). All temporary roads would be weatherized and vehicle access would be blocked upon closure of the sale.

Temporary roads will be managed throughout the life of the project and then restored to their pre-project condition, except in the case of the 47 miles of historical logging roads that are being re-used for this project. The reused roads will be treated so their post-project condition will be improved in comparison to their present state (baseline condition). Temporary road post-project treatment will include: out-sloping, sub-soiling to a depth of approximately 18 inches (in areas where greater than 60 feet of continuous soil compaction or displacement as identified by 6-inch deep ruts has occurred), seeding with native grass species, and mulching with weed-free straw or wood fiber mulch. Prior to precipitation and runoff events (i.e. before the rainy fall season begins) and after timber sale activities are complete, cross drains and grade breaks will be installed on all temporary roads. In certain areas (i.e. at stream crossings, at high erosion potential areas near streams), mulch, erosion matting, or re-contouring may be used to prevent or reduce sediment delivery to streams.

If in use for more than one project implementation season (i.e. late spring to fall), new and reconstructed temporary roads will be weatherized prior to the onset of wet weather in the fall.

Additionally, prior to any expected seasonal period of precipitation and runoff, cross drains and grade breaks would be installed. Just as with the post-treatment of sensitive areas on temporary roads (i.e. stream crossings, sediment-contributing areas near streams), mulch, erosion matting, or re-contouring would be used, as needed, to prevent or reduce erosion and the risk of sediment delivery to streams when temporary roads are in use for more than one implementation season.

Approximately 10 miles of roads within 1.5 miles of listed fish habitat are proposed for closure at the end of the project.

<u>Log haul in the riparian reserve</u>

Logs will be hauled from the project to mills on paved arterial roads. Forest Road (FR) 54 will be used to haul logs cut from the Trout Creek 6th field subwatershed (Figure 2). FR 30, FR 3062, and FR 60 will be used to haul logs cut from the Trapper Creek, Falls Creek and Wind River watersheds (Figure 3). FR 65 will be used to haul roads from the Panther Creek subwatershed (Figure 3).

Collector (secondary) roads are used to transport logs to these arterial roads. The majority of collector roads on the Gifford Pinchot National Forest are unpaved, gravel or native surface roads. Native surface roads are not suitable for use by log trucks during wet weather conditions. Fifteen unpaved timber haul routes proposed for the Middle Wind Vegetation Project cross perennial streams that are within 0.5 RM of steelhead and steelhead Critical Habitat and 11 of these roads directly cross streams with steelhead present. FR 42 transports logs from landings in the Trout Creek watershed (Figure 2). FR 42 runs for 0.75 miles along Pass Creek & Crater Creek, tributaries to Trout Creek and crosses 6 perennial tributaries to Trout Creek within 0.02 river miles of LCR steelhead critical habitat. FR 3062, 3080, and 6060 transports logs from landings in the Wind River and Trapper Creek watershed (Figure 2). FR 65 runs for 1.5 miles along Panther Creek. FR 6513 runs for 0.25 miles along a tributary to Panther Creek and crosses 5 perennial tributaries within 0.40 miles of Panther Creek. FR 62, 68, 6801, 6513, 6052, 6057 and 6500030 transport logs from the Panther Creek and Falls Creek subwatersheds. FR 65 runs for 1.5 miles along Panther Creek. FR 6513 runs for 0.25 miles along a tributary to Panther Creek and crosses 5 perennial tributaries within 0.40 miles of Panther Creek.

Timing of the log hauling activities will be concentrated in the dry weather months (June 16 to September 30). The U.S. Forest Service Sale Administrator assigned to the Middle Wind Vegetation Project Sales will determine when log transport is appropriate based on Project Design Criteria (see below) for this project and in consultation with the project's Hydrologist, Soils Scientist, and Fisheries Biologist. After project completion, system roads will be treated to repair damage done during log haul to restore the roads to a condition that supports normal forest uses and to ensure proper road drainage and stability

Best Management Practices

1. All instream work provisions that are applicable to this project's activities would be followed, as specified in the Memorandum of Understanding (MOU), dated January 2005, between the Washington Department of Fish & Wildlife (WDFW) and US Forest Service,

Regarding Hydraulic Projects. There are several instream work activities proposed for the Middle Wind Project that would necessitate adherence to instream work windows (i.e. July 15 – August 15) such as culvert replacements in perennial fish bearing streams. Provisions of the MOU will be complied with and are listed in Appendix B of this B.A.

2. Any proposals to change the Aquatics Project Design Criteria/mitigation measures should involve consultation with an aquatics and/or soils resource specialist.

3. To minimize the amount of sediment entering the stream and possible damage to stream banks and channel bottoms, stream crossings and activities in the stream other than those prescribed in the designated road work are prohibited.

4. To minimize the amount of sediment entering the stream channel during instream work at permitted stream crossings (including intermittent streams), the operation period would be limited to low flow period. This measure will help minimize disturbance to aquatic organisms and their habitat.

5. For permitted stream crossings and work adjacent to streams: to minimize the amount of sediment reaching the stream and to accelerate the re-vegetation process, rehabilitate areas compacted during management activities, and accelerate recovery of compacted soils, subsoil the compacted areas and plant native vegetation to restore any areas used as access points by equipment. Alternatives to subsoiling should involve consultation with the appropriate resource specialist and documentation in project files to track for monitoring purposes.

6. Ground-based machinery will not operate when or where soil water content is high enough to cause rutting that exceeds 6 inches in depth (for a length of ten feet or more) in accordance with Region 6 Standards and Guidelines (Forest Service 1998). Deviation from this measure should involve consultation with the appropriate resource specialist. This measure will limit the degree of detrimental soil rutting and puddling as well as reduce the potential for sediment delivery to streams. Applicable BMP: T-13. Erosion Prevention and Control Measures During Timber Sale Operations.

7. Equipment traveling away from approved skid trails or temporary roads will operate on a slash mat of limbs and tops that is deposited directly in front of the machine wherever possible. The slash mat will be made as thick and continuous as practical as a means to reduce soil disturbance. Activity would be planned to make as few trips as possible. The objective is to limit soil compaction and displacement, to ensure that soils continue to provide water infiltration, and to protect the topsoil for vegetative growth.

8. All streams within or adjacent to units will be protected to maintain or improve riparian reserve conditions in accordance with the Aquatic Conservation Strategy of the Northwest Forest Plan and the Clean Water Act. Thinning is prescribed in the outer perimeter of the Riparian Reserves. A no harvest buffer immediately adjacent to streams within the riparian reserves prohibiting equipment operation, timber removal and temporary road construction or reconstruction is designated as 60 feet, unless otherwise identified in Table 4 of this

Fisheries BA. Skyline yarding corridors are permitted through no harvest buffers on intermittent streams, providing full suspension can be achieved within the entire no harvest buffer width and less than 10 percent of the no harvest buffer is affected by the corridor. A 100 foot no harvest buffer is prescribed for all wetlands greater than 1 acre, unless otherwise specified in Table 4. Applicable BMPs: T-6 - Protection of unstable lands; T-7. Streamside Management Unit Designation; T-13 - Erosion prevention and control measures during timber sale operations; T-17 - Meadow protection during timber harvesting.

9. Harvested trees will be felled away from streams, springs, wetlands, or other riparian reserve features, including the no harvest buffers around these hydrologic features. Exceptions would be trees which are leaning towards these features, or when conditions would not allow safe felling. Any portion of a felled tree that lands in the no harvest buffer will be left on the ground. The objective of this is to prevent damage to riparian vegetation and soils within Riparian Reserves. Applicable BMPs: T-6 - Protection of unstable lands; T-13 - Erosion prevention and control measures during timber sale operations T-17 - Meadow protection during timber harvesting.

10. One-end log suspension will be required for ground-based and cable yarding systems (except during winching or lateral yarding). Evaluate alternatives to skidding across streams. If necessary, full suspension required with 30 foot buffer width. The objective of this is to minimize erosion and potential sediment delivery to streams. Applicable BMP: T-13 - Erosion prevention and control measures during timber sale operations.

11. Areas of gouging or soil displacement resulting from suspended cable yarding systems and/or mobile yarding systems will be treated to prevent rill and gully erosion and potential sediment delivery to stream courses. Go-back trails used for equipment fueling and servicing will be rehabilitated post use. Steep slopes will not be subsoiled. Erosion control treatment may include, but is not limited to, repositioning displaced soil to restore the hillslope contour of disturbed sites, creating small ditches or diversions to redirect surface water movement, and scattering slash material to create flow disruption and surface soil stability. The objective of this measure is to prevent surface soil erosion resulting from timber related ground disturbance. Applicable BMPs: T-6 - Protection of unstable lands; T-13. Erosion Prevention and Control Measures During Timber Sale Operations.

12. Prior to the wet season (October 1-June 30) or any expected seasonal period of precipitation and runoff, cross drains and grade breaks will be installed on all temporary roads, skid trails, landings, and skyline corridors. Erosion control measures will be designed in coordination with an aquatic resource specialist or soils scientist, prior to the close of the timber sale, and implemented by the purchaser by October 1st. The objective of this measure is to reduce risk of soil displacement through rill, gully and splash erosion processes. Applicable BMP: T-13 - Erosion prevention and control measures during timber sale operations.

13. Landings, skid trails and skyline corridors will be approved by the sale administrator prior to timber felling. Skid trails must be located outside of all no harvest buffers. Skid trails will be spaced a minimum of 150 feet apart. Skid trails will be re-established at previous skid trail locations except where existing skid trails from prior entry are causing detrimental soil

or hydrologic conditions that could be further avoided with alternative skid trail location. Skid trails will be subsoiled after use where compacted, with a few exceptions as identified. Subsoiling must be to a depth of 18 inches (minimum) and accomplished immediately following logging activities. Available logging slash will be placed across the subsoiled surface. Applicable BMP: T-11. Tractor Skid Trail Location and Design. T-14 - Revegetation of area disturbed by harvesting activities; T-16. Erosion control on skid trails.

14. Temporary roads and landings will be located where past logging roads and landings were located, unless a new location would cause less resource effect or where no past logging roads or landings were used to harvest the unit. Rock will be applied only where needed ("spot rocking") to reduce erosion, puddling and compaction. Rock will be incorporated into the roadbed by ripping or scarification following harvest activities (see mitigation measure which requires subsoiling). The objective is to provide better substrate for vegetative growth and water infiltration following logging and harvest activities. Temporary road stream crossing structures will be designed to comply with standards and guidelines for permanent structures which accommodate high winter flows unless seasonal restrictions are in place. If a seasonal restriction is in place, temporary road stream crossing structures will be designed to accommodate a range of summer flows and removed prior to the fall wet season. The objective of this is to provide channel transport function and hydrologic connectivity, and to reduce the risk of sediment delivery to streams from culvert failures.

15. Landings will be located outside of all no harvest buffers and outside the Riparian Reserves boundaries, where possible. Landings will be limited to the area needed for safe and efficient yarding and loading operations and have proper drainage. Certified weed free straw bale catchments or silt fences will be used to avoid sediment transport to road ditches or streams. The catchments will be located to intercept runoff from the landing prior to reaching any road ditch or stream. Any sediment that is captured and deposited behind sediment catchments will be cleaned prior to the wet season and deposited out on the forest floor to ensure it does not have a direct flow path to a system road ditch or stream and will be captured by vegetation on the forest floor. These catchments will be removed following one wet season. Applicable BMP: T-13. Erosion Prevention and Control Measures During Timber Sale Operations.

16. All permanent culverts installed on system roads, and all temporary road drainage structures (e.g. culverts) that will be left in place into the wet season (October 1-June 30), will be designed to accommodate 100-year flow events to be consistent with Gifford Pinchot Land Resource Management Plan Standards and Guidelines (USDA 1995). Temporary drainage structures will be designed to meet the base flow condition (approximately 36 inches) if utilized only during the dry season (July 1-Sept 30) and removed prior to the fall wet season. If new structures are to weather through fall and winter, they must comply with standards and guidelines as if a permanent structure. Road improvement will be designed to effectively allow water to be conveyed through the road prism without causing erosion or loss of slope stability. The objective of this design feature is to ensure channel transport function and hydrologic connectivity. Applicable BMP: T-13. Erosion prevention and control measures during timber sale operations.

17. A Spill Prevention and Response Plan will be developed and pre-approved prior to project implementation. The plan will include appropriate operational measures for handling hazardous materials. A Hazardous Material kit will be on site, and would contain materials to control/contain a spill of fuel, oils, and/or hydraulic fluid. Fueling equipment will be located outside of riparian reserves. All service work on heavy machinery and refueling will be done on an established (preferably paved) system road at a site approved by the Forest Service. The objective of this measure is to reduce the potential for damage to the stream and flood plain as a result of a hazardous material spill (eg., hydraulic fluid, lubricants, gasoline, oils), reduce the potential for soil contamination (which may then erode into a waterbody), as well as to make access to the spill site faster should a spill occur and other vehicles are called in to aid in containment and clean-up efforts. Applicable BMPs: T-4 - Use of sale area maps for designating water quality protection needs; T-7 - Streamside management unit designation; T-17. Meadow protection during timber harvesting; T-22 - Modification of the TSC (Timber Sale Contract); R-12 - Control of construction in streamside management units.

18. After activities are complete, temporary roads and landings will be closed and restored. Restoration will include having all stream crossings structures removed which were installed for the timber sale, including any road fill and road surfacing (rock) from within bankfull width of the stream course. Temporary roads and landings which were established for the timber sale will be ripped, de-compacted, or subsoiled to a depth of 18 inches (minimum). The result will be an uneven, rough surface without furrows, and be accomplished immediately following logging activities. De-compaction will encompass the entire landing and the sight distance (to discourage a bypass) from the beginning of the road, no less than 200 feet. The rest of the road will have drainage reestablished. Available logging slash will be placed across the de-compacted surface. No ground-based equipment will be operated on subsoiled portions of roads and landings after de-compaction is completed to prevent re-compacting treated roadways and landings. Post harvest motorized access to temporary roads will also be prevented by construction of an approved closure device (e.g., construction of a 4-foot high earth berm or other suitable material at the road entrance). Closure to vehicles is required to prevent subsoiled areas from being re-compacted, prevent erosion and sediment delivery, and to allow vegetation to develop. The objective of this measure is to rehabilitate areas compacted during management activities, accelerate recovery of compacted soils, and facilitate water infiltration and re-vegetation on those disturbed areas. These measures will also provide ground cover for exposed soils in order to reduce the potential for offsite erosion and maintain soil organic matter to prevent nutrient and carbon cycle deficits. Applicable BMPs: T-13 - Erosion prevention and control measures during timber sale operations; T-14 - Revegetation of area disturbed by harvesting activities.

19. Monitoring of feller buncher activity will be performed by the sale administrator in order to prevent/rectify resource damage that may occur as a result of ground disturbing activities. Resource damage includes forming of ponds, ruts, or rills; culvert blockages, stream channel instability, and the occurrence of scour or sediment transport and deposition downstream of cross drains. Project activities will be curtailed and corrective action taken, before work is allowed to resume, if resource damage is occurring. Implementation and effectiveness

monitoring of BMPs will be documented by the sale administrator and made available to the line officer in order to determine when adjustments need to be made to prevent excessive resource damage. The objective of this is to minimize erosion and potential sediment delivery to streams, and oversee the harvest methods introduced by the project Forest Plan Amendment of the Middle Wind Project.

20. Pre- bunching will be approved on a unit by unit basis on slopes up to 45% prior to start of operation. Feller bunchers will not operate over erosive soils on slopes greater than 35%. The rationale for the Middle Wind Project – Gifford Pinchot National Forest Plan Amendment for pre-bunching on steep slopes allows ground based equipment to travel on slopes greater than 35 percent and away from designated landings, temporary roads, or skid trails for the purpose of pre-bunching. The mechanical harvester will:
    a. Enter the harvest unit on planned trails and be limited to slopes less than 45 percent, including short, steep pitches.
    b. Avoid traveling across the slope and turning on steep slopes.
    c. Operate on a slash mat of limbs and tops that is deposited directly in front of the machine, as described previously.
    d. Not enter into riparian no harvest buffers and unstable slopes.
    e. Excavation of road prism for feller buncher access, upon verification with a cultural resource specialist, will be minimized and restored when pre-bunching activities are complete.

21. Go-back trails used for equipment fueling and servicing will be approved by the Forest Service and be located where suitable grade and minimal impacts to soils and water quality exist, and be rehabilitated post use. The objective of this is to prevent surface soil erosion resulting from timber related ground disturbance and compliance with the project-specific Forest Plan Amendment.

22. Hazard trees within a site potential tree height distance from a stream, also known as the RMZ, will be felled towards the stream and left on the ground. In the case that the felled tree would be at risk of interfering with surface flow into a culvert or culvert inlet area, they can be felled away from the stream.

23. Although not a requirement, if possible (i.e. non-timber contract funding becomes available) and deemed necessary by a Soils and/or Aquatics Specialist, burned areas greater than 100 square feet will be mulched and seeded subsequent to burning piled slash. This measure does not apply to permanent roads. This measure will mitigate the effects of burning on the soil (i.e. increased surface water run-off, laden with sediment and nutrients, to streams due to the hydrophobic quality of severely burned soil).

24. Burning of slash piles will occur at harvest units identified in the Soil Resources section of the Environmental Assessment for the Middle Wind Vegetation Project. Slash piles will be burned along 50-100 ft. sections of road within these previously-identified harvest units, and slash pile burning will not occur within 50 ft. of any perennial or intermittent stream or stream crossing. This will ensure that any sediment- or nutrient-laden water run-off from

these burned slash-pile sites has an opportunity to percolate into the forest floor before reaching any stream.

25. The silvicultural treatment in the riparian reserve will follow a prescription to optimize structural development and plant species diversity to benefit water quality and old growth dependent fauna including native salmonids. The riparian treatment will prescribe down wood level and riparian reserve buffer widths based on topographic relief and other inherent channel stability indicators. For more information see Middle Wind Vegetation Project Riparian Reserve Silvilcultural Prescription (project record). The objective is to optimize plant structural development species diversity to benefit water quality and old growth dependent fauna including native salmonids. Applicable BMPs: T-4 - Use of sale area maps for designating water quality protection needs; T-7. Streamside Management Unit Designation; T-17. Meadow Protection during Timber Harvesting; T-22. Modification of the TSC (Timber Sale Contract); R-12. Control of Construction in Streamside Management Units; W-3 - Protection of wetlands.

26. All timber sale activities (eg., felling, yarding, haul, road-related work) will be restricted to a limited operating season, defined as June 1 to October 15, with the additional requirement that any aspect of operations may be suspended during anomalous rain events during this period. Restoration work will be completed by October 15. Exceptions for any harvest activity outside this period will require concurrence by the project Hydrologist, Soils Scientist, and/or Fish Biologist, with periodic review and daily diary reports, and extra mitigation applied (eg., sediment catchments at landings and road worksites, as needed). The objective of this measure is limit ground disturbing activities to the dry season thereby minimizing soil rutting, compaction, surface erosion and sediment delivery. Applicable BMPs: T-4. Use of Sale Area Maps for Designating Water Quality Protection Needs; T-6. Protection of Unstable Lands; T-7. Streamside Management Unit Designation; T-13. Erosion Prevention and Control Measures During Timber Sale Operations; T-17. Meadow Protection during Timber Harvesting; T-22. Modification of the TSC (Timber Sale Contract); R-12. Control of Construction in Streamside Management Units.

    Any pre-approved project activities occurring outside of the limited operating season, defined as June 1 to October 15, will require monitoring of daily conditions as follows:

    a. Implementation and effectiveness monitoring of BMPs will be documented in daily diaries and made available to the aquatic resource specialist to assess conditions of haul routes, landings, and skid trails.
    b. Project activities will be curtailed and corrective action taken when ponding, rutting, rilling, culvert blockages, stream channel instability, and the occurrence of scour or sediment transport and deposition downstream of cross drains are encountered on adjacent system roads, temporary roads, skid trails, landings, stream crossings, riparian reserves or within harvest units where ground disturbance has occurred.
    c. Reconstructing the temporary roads will require the use of straw mulch or silt fences as a precaution to trap any surface water runoff that may contain sediment. Temporary road surfaces will be graded in a manner (i.e. outsloping) that will reduce the potential for surface water runoff to enter streams. Surface water

runoff from these temporary roads will be directed onto undisturbed vegetated areas or road ditches, where straw mulch, wood fiber mulch, straw bale check dams, or silt fences will be in place to catch any sediment from surface water run-off. Water bars, rolling dips, etc. will be placed at frequent intervals to direct the surface water off of the temporary roads and to prevent concentrated water flow. The goal of surface soil erosion control measures is to always keep the soil in place and not rely on straw bale check dams or silt fences to catch sediment down slope or in road drainage ditches.

d. After project activities are complete, temporary road surfaces will be seeded and covered with straw or wood fiber mulch to prevent surface run-off in between water bars. In addition, all road work at units 2971, 4166, and 8294 will be completed within the dry season (i.e. July 1 – September 30). These timing restrictions will be strictly adhered to due to proximity to listed fish and critical habitat.

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). No actions are interrelated to, or interdependent upon the Middle Wind River vegetation project described above.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which “means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features” (81 FR 7214).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an “exposure-response-risk” approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a RPA to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species’ likelihood of both survival and recovery. The species status section also helps to inform the description of the species’ current “reproduction, numbers, or distribution” as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely (Tague et al., 2013) to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014, Mote et al 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Mote et al., 2014; Tague et al., 2013).

During the last century, average regional air temperatures in the Pacific Northwest increased by 0.55-0.78 degrees Celsius as an annual average, and up to 2 degrees Fahrenheit in some seasons (based on average linear increase per decade; (Abatzoglou et al., 2014; Kunkel et al., 2013)). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al., 2014). Warming is likely to continue during the next century as average temperatures are projected to increase another 1.7 to 5.55 degrees Celsius, with the largest increases predicted to occur in the summer (Mote et al., 2014).

Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al., 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB, 2007; Mote et al., 2013). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB, 2007; Mote et al., 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al., 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al., 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3 degree Celsius increases in Columbia Basin streams and a peak temperature of 26 degree Celsius in the Willamette (NWFSC, 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al., 2009).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB, 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available (Mantua et al., 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al., 2008; Tillmann and Siemann, 2011; Winder and Schindler, 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al., 1999; Raymondi et al., 2013; Winder and Schindler, 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al., 2008; Raymondi et al., 2013; Wainwright and Weitkamp, 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al., 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (Lawson et al., 2004; Mcmahon and Hartman, 1989).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al., 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7 degree Celsius by the end of the century (IPCC, 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Reeder et al., 2013; Tillmann and Siemann, 2011).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 percent to 109 percent increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios, and is essentially irreversible over a time scale of centuries (IPCC, 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al., 2012; Feely et al., 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al., 2012; Sunda and Cai, 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC, 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Reeder et al., 2013; Tillmann and Siemann, 2011). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al., 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams, 2005; Zabel et al., 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC, 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Reeder et al., 2013; Tillmann and Siemann, 2011).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC, 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al., 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.2.1 Status of the Species

For Pacific salmon, steelhead, and certain other species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al., 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al., 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al., 2000).

The summary that follows describes the status of LCR steelhead, and its designated critical habitats, that occurs within the geographic area of this proposed action and is considered in this opinion. More detailed information on the status and trends of this listed species, and its biology and ecology, are in 70 FR 37160 and 70 FR 52630.

Status of LCR Steelhead

This species is included in the Lower Columbia River recovery plan (NMFS, 2013). For this species, threats in all categories must be reduced, but the most crucial elements are protecting favorable tributary habitat and restoring habitat in the Upper Cowlitz, Cispus, North Fork Toutle, Kalama and Sandy subbasins (for winter steelhead), and the East Fork Lewis, and Hood, subbasins (for summer steelhead). Protection and improvement is also needed among the South Fork Toutle and Clackamas winter steelhead populations.

Spatial Structure and Diversity. The DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive), and the Willamette and Hood Rivers, Oregon (inclusive), as well as multiple artificial propagation programs. There are 4 MPGs comprised of 23 DIPs, including 6 summer-run steelhead populations and 17 winter-run populations that comprise (NWFSC, 2015). Summer steelhead return to freshwater long before spawning. Winter steelhead, in contrast, return from the ocean much closer to maturity and spawn within a few weeks. Summer steelhead spawning areas in the Lower Columbia River are found above waterfalls and other features that create seasonal barriers to migration. Where no temporal barriers exist, the winter-run life history dominates.

There have been a number of large-scale efforts to improve accessibility (one of the primary metrics for spatial structure) in this ESU. Trap and haul operations were begun on the Lewis River in 2012 for winter-run steelhead, reestablishing access to historically-occupied habitat above Swift Dam. In 2014, 1033 adult winter steelhead (integrated program fish) were transported to the upper Lewis River; however, juvenile collection efficiency is still below target levels. In addition, there have been a number of recovery actions throughout the ESU to remove or improve culverts and other small-scale passage barriers. Many of these actions (including the removal of Condit Dam on the White Salmon River) have occurred too recently to be fully evaluated.

Total steelhead hatchery releases in the Lower Columbia River Steelhead DPS have decreased since the last status review, declining from n total (summer and winter run) release of approximately 3.5 million to 3 million from 2008 to 2014. Some populations continue to have relatively high fractions of hatchery-origin spawners, whereas others (e.g., Wind River) have relatively few hatchery origin spawners.

Abundance and Productivity. The Winter-run Western Cascade MPG includes native winter-run steelhead in 14 DIPs from the Cowlitz River to the Washougal River. Abundances have remained fairly stable and have remained low, averaging in the hundreds of fish. Notable exceptions to this were the Clackamas and Sandy River winter-run steelhead populations, that are exhibiting recent rises in NOR abundance and maintaining low levels of hatchery-origin steelhead on the spawning grounds (Jacobsen et al., 2014). In the Summer-run Cascade MPG, there are four summer-run steelhead populations. Absolute abundances have been in the hundreds of fish. Long and short term trends for three DIPs (Kalama, East Fork Lewis and Washougal) are positive; though the 2014 surveys indicate a drop in abundance for all three. The Winter-run Gorge MPG has three DIPs. In both the Lower and Upper Gorge population surveys for winter steelhead are very limited. Abundance levels have been low, but relatively stable, in the Hood River. In recent years, spawners from the integrated hatchery program have constituted the majority of the naturally spawning fish. The Wind River and Hood River are the two DIPs in the Summer-run Gorge MPG. Hood River summer-run steelhead have not been monitored since the last status review. Adult abundance in the Wind River remains stable, but at a low level (hundreds of fish). The overall status of the MPG is uncertain.

Limiting factors. Factors limiting the productivity and abundance of this species include (NMFS, 2013):

- Degraded estuarine and nearshore marine habitat
- Degraded freshwater habitat
- Reduced access to spawning and rearing habitat
- Avian and marine mammal predation
- Hatchery-related effects
- An altered flow regime and Columbia River plume
- Reduced access to off-channel rearing habitat in the lower Columbia River
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary
- Juvenile fish wake strandings
- Contaminants

2.2.2 Status of the Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features throughout the designated areas. These features are essential to the conservation of the listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

For salmon and steelhead, including LCR steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each listed species they support.4 The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NMFS, 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were

[4] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" NOAA Fisheries. 2005. Assessment of NOAA Fisheries' critical habitat analytical review teams for 12 evolutionarily significant units of West Coast salmon and steelhead. National Marine Fisheries Service, Protected Resources Division, editor, Portland, Oregon..

essential due to factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution of the population it served (e.g., a population at the extreme end of geographic distribution), or if it serves another important role (e.g., obligate area for migration to upstream spawning areas).

The physical or biological features of freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (see Table 4),. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

Table 4. Primary constituent elements (PCEs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion (except SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, and SONCC coho salmon), and corresponding species life history events.

Primary Constituent Elements Site Type	**Primary Constituent Elements Site Attribute**	**Species Life History Event**
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and “reverse smoltification” Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing

CHART Salmon and Steelhead Critical Habitat Assessments

The CHART for each recovery domain assessed biological information pertaining to occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0 to 3 point score for the PCEs in each HUC5 watershed for:

Quantity,
Quality – Current Condition,
Quality – Potential Condition,
Support of Rarity Importance,
Support of Abundant Populations, and
Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality – current condition), which considers the existing condition of the quality of PCEs in the HUC5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

LCR Steelhead Critical Habitat/Willamette-Lower Columbia Recovery Domain.
Critical habitat was designated in the WLC recovery domain for UWR Chinook salmon, LCR Chinook salmon, LCR steelhead, UWR steelhead, CR chum salmon, southern green sturgeon, and eulachon, and has been proposed for LCR coho salmon. In addition to the Willamette and Columbia River mainstems, important tributaries on the Oregon side of the WLC include Youngs Bay, Big Creek, Clatskanie River, and Scappoose River in the Oregon Coast subbasin; Hood River in the Gorge; and the Sandy, Clackamas, Molalla, North and South Santiam, Calapooia, McKenzie, and Middle Fork Willamette rivers in the West Cascades subbasin.

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011; NMFS, 2013). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011; NMFS, 2013). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the USACE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals — such as arsenic and polycyclic aromatic hydrocarbons — have been identified in Lower Columbia River watersheds in the vicinity of the (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011; NMFS, 2013)ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems. Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2013). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80 percent reduction in emergent vegetation production and a 15 percent decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom et al., 2005; NMFS, 2013). Diking and filling have reduced the tidal prism and eliminated emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxins that are harmful to aquatic resources (Lower Columbia River Estuary Partnership, 2007). Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's capacity to support salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of estuarine habitats.

The CHART for the WLC recovery domain determined that most HUC5 watersheds with PCEs for salmon or steelhead are in fair-to-poor or fair-to-good condition (NMFS, 2005). However, most of these watersheds have some or a high potential for improvement. Only watersheds in the upper McKenzie River and its tributaries are in good to excellent condition with no potential for improvement.

Table 5. Willamette-Lower Columbia Recovery Domain: Current and potential quality of HUC5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK), chum salmon (CM), and steelhead (ST) (NMFS, 2005). [5] Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Columbia Gorge #1707010xxx			
Wind River (511)	CK/ST	2/2	2/2
East Fork Hood (506), & Upper (404) & Lower Cispus (405) rivers	CK/ST	2/2	2/2
Plympton Creek (306)	CK	2	2
Little White Salmon River (510)	CK	2	0
Grays Creek (512) & Eagle Creek (513)	CK/CM/ST	2/1/2	1/1/2
White Salmon River (509)	CK/CM	2/1	1/2
West Fork Hood River (507)	CK/ST	1/2	2/2
Hood River (508)	CK/ST	1/1	2/2
Unoccupied habitat: Wind River (511)	Chum conservation value "Possibly High"		
Cascade and Coast Range #1708000xxx			
Lower Gorge Tributaries (107)	CK/CM/ST	2/2/2	2/3/2

[5] On January 14, 2013, NMFS published a proposed rule for the designation of critical habitat for LCR coho salmon and PS steelhead USDC. 2013. Endangered and threatened species; Designation of critical habitat for Lower Columbia River coho salmon and Puget Sound steelhead; Proposed rule. *U.S Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register*. 78:2726-2796.. A draft biological report, which includes a CHART assessment for PS steelhead, was also completed (NMFS 2012). Habitat quality assessments for LCR coho salmon are out for review; therefore, they are not included on this table.

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Lower Lewis (206) & North Fork Toutle (504) rivers	CK/CM/ST	1/3/1	2/1/2
Salmon (101), Zigzag (102), & Upper Sandy (103) rivers	CK/ST	2/2	2/2
Big Creek (602)	CK/CM	2/2	2/2
Coweeman River (508)	CK/CM/ST	2/2/1	2/1/2
Kalama River (301)	CK/CM/ST	1/2/2	2/1/2
Cowlitz Headwaters (401)	CK/ST	2/2	1/1
Skamokawa/Elochoman (305)	CK/CM	2/1	2
Salmon Creek (109)	CK/CM/ST	1/2/1	2/3/2
Green (505) & South Fork Toutle (506) rivers	CK/CM/ST	1/1/2	2/1/2
Jackson Prairie (503) & East Willapa (507)	CK/CM/ST	1/2/1	1/1/2
Grays Bay (603)	CK/CM	1/2	2/3
Upper Middle Fork Willamette River (101)	CK	2	1
Germany/Abernathy creeks (304)	CK/CM	1/2	2
Mid-Sandy (104), Bull Run (105), & Lower Sandy (108) rivers	CK/ST	1/1	2/2
Washougal (106) & East Fork Lewis (205) rivers	CK/CM/ST	1/1/1	2/1/2
Upper Cowlitz (402) & Tilton rivers (501) & Cowlitz Valley Frontal (403)	CK/ST	1/1	2/1
Clatskanie (303) & Young rivers (601)	CK	1	2
Rifle Reservoir (502)	CK/ST	1	1
Beaver Creek (302)	CK	0	1
Unoccupied Habitat: Upper Lewis (201) & Muddy (202) rivers; Swift (203) & Yale (204) reservoirs	CK & ST Conservation Value "Possibly High"		
Willamette River #1709000xxx			

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Upper (401) & South Fork (403) McKenzie rivers; Horse Creek (402); & McKenzie River/Quartz Creek (405)	CK	3	3
Lower McKenzie River (407)	CK	2	3
South Santiam River (606)	CK/ST	2/2	1/3
South Santiam River/Foster Reservoir (607)	CK/ST	2/2	1/2
North Fork of Middle Fork Willamette (106) & Blue (404) rivers	CK	2	1
Upper South Yamhill River (801)	ST	2	1
Little North Santiam River (505)	CK/ST	1/2	3/3
Upper Molalla River (905)	CK/ST	1/2	1/1
Abernethy Creek (704)	CK/ST	1/1	1/2
Luckiamute River (306) & Yamhill (807) Lower Molalla (906) rivers; Middle (504) & Lower (506) North Santiam rivers; Hamilton Creek/South Santiam River (601); Wiley Creek (608); Mill Creek/Willamette River (701); & Willamette River/Chehalem Creek (703); Lower South (804) & North (806) Yamhill rivers; & Salt Creek/South Yamhill River (805)	CK/ST	1	1
Hills (102) & Salmon (104) creeks; Salt Creek/Willamette River (103), Hills Creek Reservoir (105), Middle Fork Willamette/Lookout Point (107); Little Fall (108) & Fall (109) creeks; Lower Middle Fork of Willamette (110), Long Tom (301), Marys (305) & Mohawk (406) rivers	CK	1	1
Willamina Creek (802) & Mill Creek/South Yamhill River (803)	ST	1	1
Calapooia River (303); Oak (304) Crabtree (602), Thomas (603) & Rickreall (702) creeks; Abiqua (901), Butte (902) & Rock (903) creeks/Pudding River; & Senecal Creek/Mill Creek (904)	CK/ST	1/1	0/1
Row River (201), Mosby (202) & Muddy (302) creeks, Upper (203) & Lower (205) Coast Fork Willamette River	CK	1	0
Unoccupied habitat in North Santiam (501) & North Fork Breitenbush (502) rivers; Quartzville Creek (604) and Middle Santiam River (605)	CK & ST Conservation Value "Possibly High"		

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Unoccupied habitat in Detroit Reservoir/Blowout Divide Creek (503)	Conservation Value: CK "Possibly Medium"; ST Possibly High"		
Lower Willamette #1709001xxx			
Collawash (101), Upper Clackamas (102), & Oak Grove Fork (103) Clackamas rivers	CK/ST	2/2	3/2
Middle Clackamas River (104)	CK/ST	2/1	3/2
Eagle Creek (105)	CK/ST	2/2	1/2
Gales Creek (002)	ST	2	1
Lower Clackamas River (106) & Scappoose Creek (202)	CK/ST	1	2
Dairy (001) & Scoggins (003) creeks; Rock Creek/Tualatin River (004); & Tualatin River (005)	ST	1	1
Johnson Creek (201)	CK/ST	0/1	2/2
Lower Willamette/Columbia Slough (203)	CK/ST	0	2

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The Proposed Action of the Middle Wind Project would take place within four sub-watersheds of the Wind River; Trout Creek (Figure 2) and Falls Creek, Trapper Creek, Wind River; and Panther Creek (Figure 3). The effects of the proposed action largely focus on pathways by which sediment is eroded into the watershed channels. The action area includes all areas to be harvested, all streams that are likely to be crossed and/or receive sediment inputs, and since this sediment is ultimately transported to the mouth of the Wind River, the action area extends from the Middle Wind River to the mouth of the Wind River.

Figure 1. Relationship between harvest units and roads and the Trout Creek and Trapper Creek subwatershed. Green denotes LCR steelhead spawning habitat.

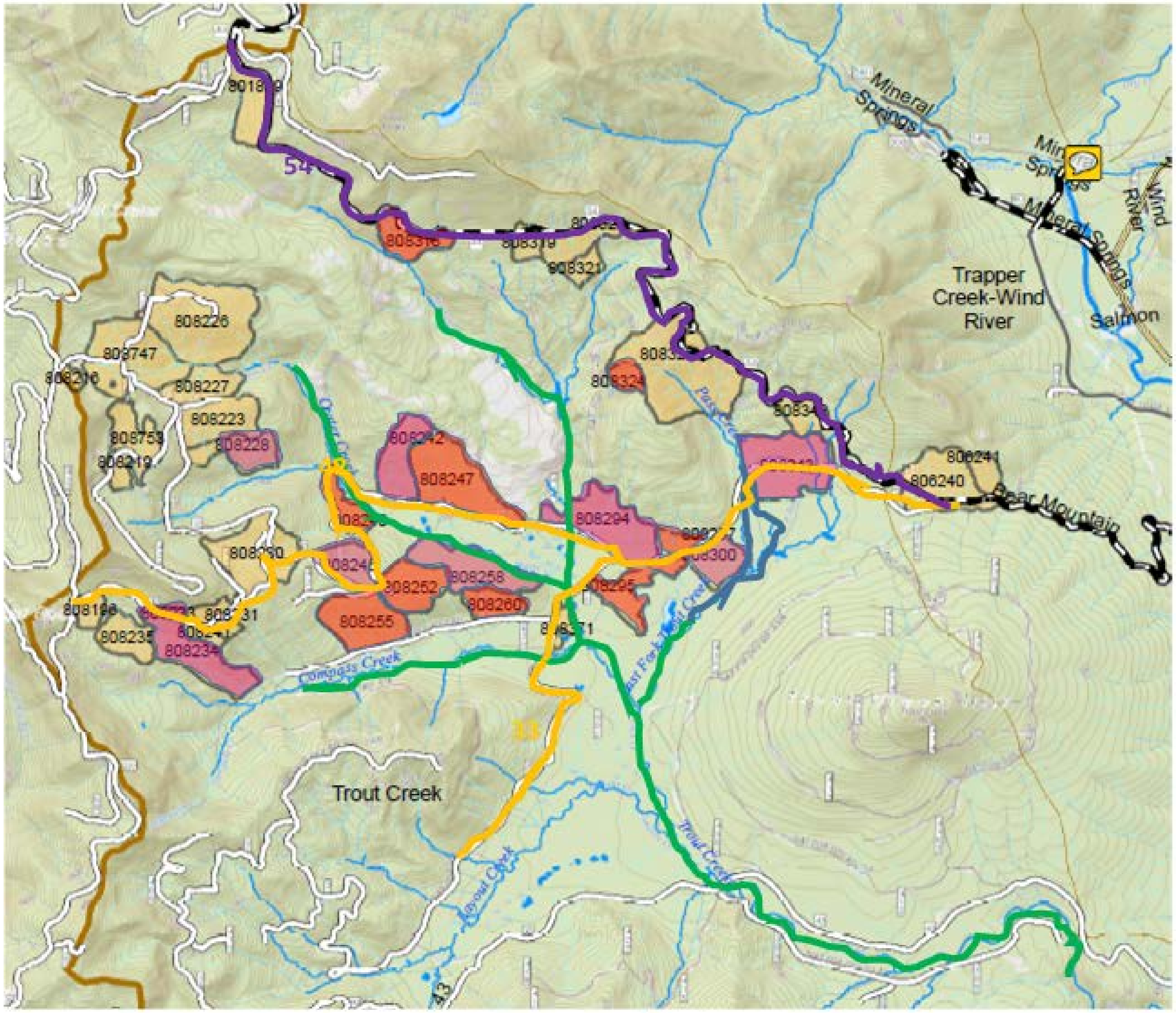
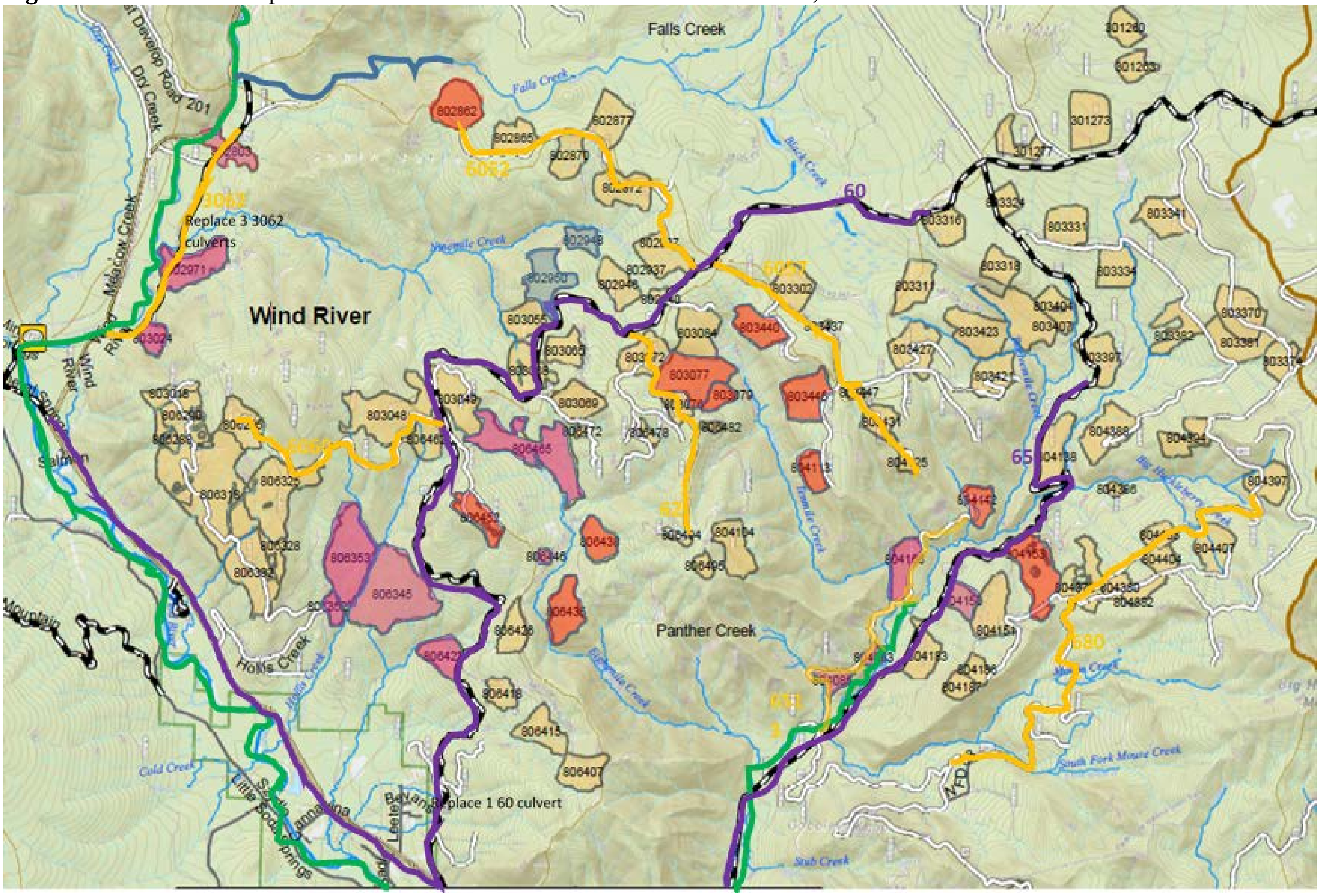


Figure 2. Relationship between harvest units and roads and the Wind River, Falls Creek and Panther



2.4 Environmental Baseline

The “environmental baseline” includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The Wind River begins in McClellan Meadows at an elevation of approximately 3,000 feet. The gradient drops from over 15 percent near the headwaters to 2 percent at the mouth of Falls Creek. As the river flows through the Middle Wind project area from Trapper Creek to the community of Stabler, the valley width increases and channel gradients continue to drop. Near Stabler, the river enters a bedrock-confined channel and gradients increase as the river begins a steep descent of over 10 miles to the mouth on the Columbia River. Trout Creek enters the Wind River near the upper end of this canyon and Panther Creek enters midway down the canyon. At the lower end of the canyon, the Wind River again broadens out as it approaches the Columbia River and becomes influenced by backwater from the Bonneville pool.

The Wind River watershed has a temperate marine climate with cool, moist winters and dry summers. Mean annual precipitation is 110 inches. Approximately 75 percent of the annual precipitation falls between November and March. With elevations ranging from less than 100 feet at the mouth of the Wind River to nearly 4,000 feet, both rain and snow are common in the watershed during the winter months.

Ninety percent of the Wind River watershed lies within the Gifford Pinchot National Forest. The GPNF is operated under the regulations of the Northwest Forest Plan. Private timberland in the watershed is regulated by the Washington State Forest Practice Rules. These regulations require timber harvests planners to retain trees around streams to provide natural riparian buffers, avoid harvests on unstable slopes, construct fish passage through road stream crossings, minimize road sediment delivered to streams and manage timber stands for hydrologic maturity to controls peak flows.

Wind River flows are unregulated and range from 250 cubic feet per second in the summer to 2,000 cubic feet per second in the winter. The major tributaries include the Little Wind River, Bear Creek, Panther Creek, Trout Creek, Trapper Creek, Dry Creek, Falls Creek, and Paradise Creek.

Baseline water quality - suspended sediment

Eroded sediment that reaches the channel starts out suspended in the flow and ends up mixed into the substrate. Suspended sediment levels throughout the Wind River watershed are highly variable over time. During the summer months, suspended sediment is low across the watershed but during the winter months, suspended sediment levels are higher and correlated with stream discharge, increasing in the downstream direction. The Upper Wind River and Dry Creek have greater than 15 percent fine sediment in the substrate. The Little Wind River, Lower Trout Creek, Upper Trout Creek, Trapper Creek, Paradise Creek, Falls Creek and Lower Panther Creek, are all moderately impaired for sediment supply due to high road densities, steep topography and naturally unstable soils. Sediment in channels in the Lower Wind River and Little Wind River comes from road initiated landslides, utility corridors, timber harvests, and naturally unstable slopes. Sediment accumulates in the mouth of the Wind River.

Increased peak flows from road construction, logging, and removal of instream large woody material have accelerated bank erosion and increased sedimentation in the Wind River watershed. Excessive amounts of fine sediment destabilize natural stream function, degrade fish habitat, suffocate salmonid eggs in spawning beds, and harm fish gills. Sediment in the Wind River watershed appears to come from a variety of sources. The road network delivers sand-size and smaller sediment during runoff events occurring during the late spring and late fall when the watershed is still accessible to motor vehicles. The February 1996 flood initiated a number of road system failures that delivered substantial volumes of stream crossing and cross slope fill sediment to the stream network. Roads that are no longer maintained may be at higher risk of episodic, and potentially catastrophic, failure due to inadequately maintained drainage structures. Channel meander through the Trout Creek Flats is a source of alluvial sediments.

McNeil Core Sediment samples were taken in 1998 from the Wind River and seven tributaries to evaluate the quality of steelhead spawning habitat. Table 6 shows the spawning substrate composition in nine spawning reaches. The fines (less than1.6 millimeters) averaged 12 percent throughout the sampled area and ranged from 7 to 16 percent. The smalls (1.7-6.3mm) averaged 17.4 percent and ranged from 13-20 percent.

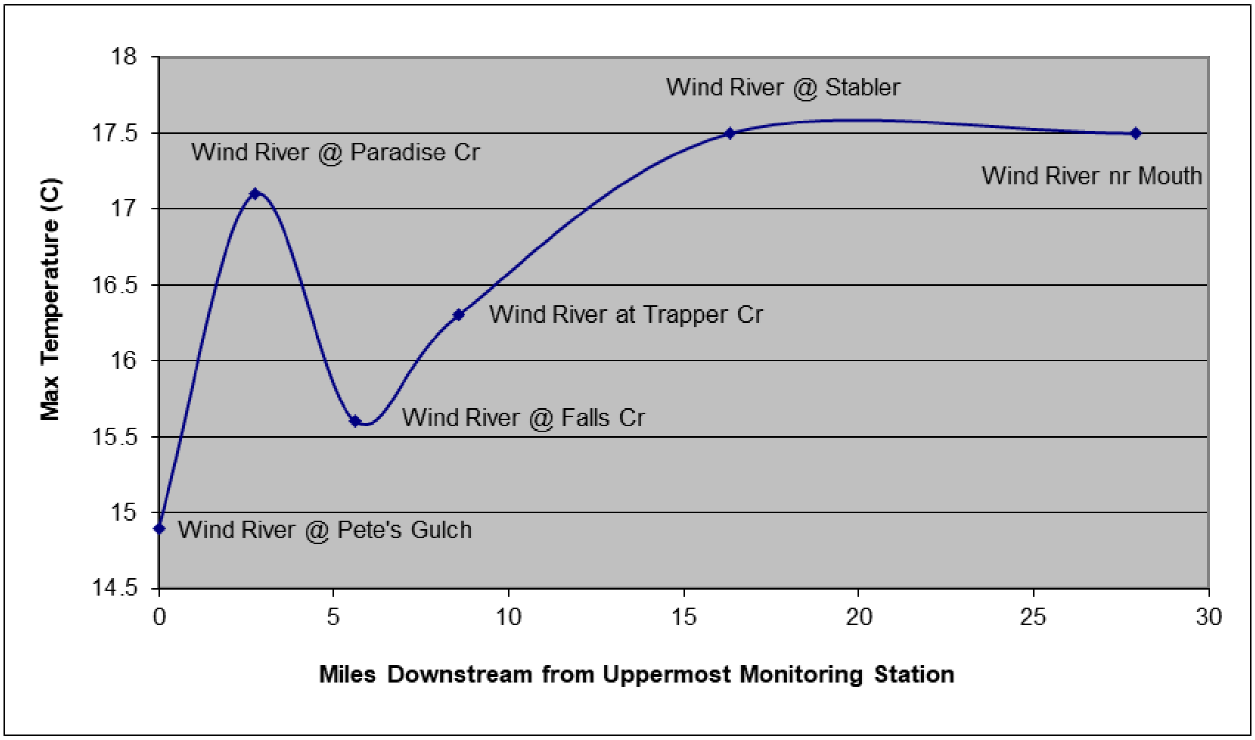
Table 6. 1998 spawning substrate composition for the Wind River and its tributaries

Tributary	Fines (less than 1.6 millimeters)	Smalls (less than 6.3 millimeters)	Rating
Dry Creek	14	19	Functioning at Risk
Middle Wind River	14	17	Functioning at Risk
Panther Creek	14	14	Functioning at Risk
Trout Creek	14	15	Functioning at Risk
Martha Creek	11	17	Functioning at Risk
Upper Wind River	16	22	Not Properly Functioning
Layout Creek	7	12	Properly Functioning
Trapper Creek	7	19	Functioning at Risk
Paradise Creek	11	18	Functioning at Risk
average	12	17	Functioning at Risk

<u>Baseline water quality - temperature</u>

Water temperature is a limiting factor for steelhead survival in the Middle Wind project area. Eightmile Creek was listed on the State's 1998 303(d) list for exceedance of the 16 degree Celsius temperature standard. Thirty-two other temperature monitoring sites have reported temperatures greater than 16 degrees Celsius and 15 sites have reported temperatures greater than 18 degrees Celsius. High summer temperature is attributed to loss of riparian cover, channel widening and reduced summer base flows. Warmer temperatures significantly increase stress, disease outbreaks and mortality rates. Water temperatures in the Wind River generally increases from upstream to downstream direction. Figure 5 illustrates water temperatures increased 1.7 degrees Celsius during the summer of 2000. Steelhead typically migrate upstream or downstream in search of cooler temperatures.

Figure 3. Maximum water temperatures at monitoring stations along the Wind River (WR), year 2000. Data are arranged in a downstream direction from left to right.



The Wind River originates from cold springs and seeps in the saddle between the Wind River watershed and the Lewis River watershed. As the Wind River flows downslope it is fed by warmer water from Trout Creek and cooler water from Panther Creek. Trout Creek originates from cold seeps and springs along the West Crater lava flow but removal of old-growth riparian conifers, high width-to-depth ratios, and a lack of large woody material allows solar radiation to increase Trout Creek temperature 6 degrees Celsius per river mile. Below Trout Creek Flats, Trout Creek is supplied by tributaries that are also poorly shaded from past logging. Trout Creek water temperature commonly exceeds 20 degrees Celsius, and exceeds 17 degrees Celsius for up to two months of the year. The Wind River and Trout Creek do not meet either the NMFS criteria or the Washington State summer water quality standard of 16 degrees Celsius. Riparian Reserve areas within the proposed harvest units were harvested during the past half-century but have grown back and currently contain a dense component of conifers providing shade. Riparian buffers are beginning to experience inter-tree competition for water, nutrients, and light limiting their growth rate.

Baseline migration barriers

Roads and culverts block upstream migration of anadromous fish. Priority culverts include: FR 42 (MP 4.3), FR 4300, several locations on FR 3300, and FR 5401.

Baseline large woody debris (LWD)

Intensive harvest of riparian timber in the 1940s and 1950s followed by stream clean outs during the 1970s left a legacy of immature and overstocked stands that provide low levels of LWD recruitment and reduced volumes of instream LWD. LWD contributes channel roughness to slow stream velocities creating pools and flood side channels. Pools that provide habitat for fish to rest, feed and hide from predators have a low surface area to depth ratio and develop from the interaction of large wood, streamflows, substrate, and channel slope. Side channels and braids provide protective habitat for juvenile steelhead during winter peak flow events. As the volume of LWD decreased, stream velocities have increased, the stream channels in the Wind River watershed have become straighter and entrenched with less pool habitat and reduced floodplain side channel connectivity. Table 7 shows the pool quality and pools per mile in the Wind River watershed.

Table 7. Wind River average pools per mile and pool quality

	Trout	**Middle Wind**	**Falls**	**Panther**
Pool Surface/ Volume Ratio	52	38	54	46
Pools/Mile	25	23	31	56

Baseline drainage network

Roads intercept precipitation and shallow sub surface flow and transport it as surface flow in ditches. This effectively increases drainage density in the watershed. Where roads cross streams they route the captured water flows to streams acting as extensions of the stream channels. This decreases the time it takes water transporting fine sediment to reach streams. Road densities greater than 2.0 miles per square mile threaten LCR steelhead and their stream habitat. The road density of the Middle Wind River project area is 2.4 miles of road per square mile which increases the drainage network from 23 percent to 35 percent. Increased road density increases peak flows. Peak flows are sorted into flows with a lower than one year return interval (intra-annual) and flows with a higher than one year return interval (inter-annual). Inter-annual peak flows move bedload and scour salmon and steelhead redds. Intra-annual peak flows generally do not move bedload. Roads abruptly increase the magnitude of intra-annual peak flows that move bedload and scour redds each year until the channel substrate particle size distribution equilibrates to the new flow regime (Grant et al., 2008). This transient period temporarily decreases the productivity of salmon and steelhead populations.

Baseline previously-analyzed actions

ESA consultations in the Wind River Watershed include the Maintenance Dredge of the Wind River Confluence in 1997, the Limbo Timber Sale in 1999, the Wind River Highway Realignment in 2004, and the Bear Creek Timber Sale in 2016.

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

We identified critical habitat physical and biological features (PBF, i.e. water quality) that could be affected by the stressors (i.e. sediment) resulting from the proposed action. We rated the likelihood that each PBF would be exposed to the stressor and then we estimated the magnitude of each PBF response to each stressor. We assigned the likelihood of exposure and the magnitude of response a rating of low, moderate or high based on logic summarized in the description of each PBF stressor. Then we combined the PBF exposure and response magnitude ratings into a consequence of PBF exposure and response according to the rules shown in Table 8. The PBF stressor ratings are used to make a determination whether the proposed action is likely to adversely modify critical habitat.

Table 8. Rules to determine consequences to individual fitness/PBF of combining likelihoods of exposure and response: Green denotes low, Yellow denotes moderate, Red denotes high

Likelihood of Response	**Likelihood of Exposure**		
	Low	Moderate	High
Low	Low	Low	Low
Moderate	Low	Moderate	High
High	Low	High	High

We than considered the likelihood that each steelhead life history stage (egg, juveniles, adults) would be exposed to the PBF stressor from the critical habitat analysis, the magnitude of response of each life history stage and the consequences of exposure and response to individual fitness at each life history stage using the same logic shown in Table 8. We also estimated the likelihood of individual exposure, magnitude of individual response, and consequence of individual exposure and response to fitness for the direct effect pathways. NMFS combined all the stressors for each PBF and each direct effect pathway at the individual fish scale and assigned a low, moderate, or high rating to the PBF. The results of this analysis are summarized in Table 8.

Table 9. Habitat and species effects pathways from proposed action activities. NA denotes not applicable. Green =low; yellow=moderate; red=high.

PBF/ Direct	Activity	Stressor	Habitat Analysis by PBFs			Species Analysis by Life Stage												
			Likelihood of exposure	Magnitude of response	Consequence of exposure and response to PBF	Life Stage	Likelihood of exposure	Magnitude of response	Consequence at the individual fitness level	Life stage	Likelihood of exposure	Magnitude of response	Consequence at the individual fitness level	Life stage	Likelihood of exposure	Magnitude of response	Consequence at the individual fitness level
Water quality	Thinning, roads and haul in riparian reserves	Suspended sediment	Mod	Low	Low	Eggs, embryos, fry	Mod	Low	Low	Juvenile	High	Low	Low	Adult	Mod	Low	Low
Water quality	Thinning in riparian reserve	Temperature	Low	Low	Low	Eggs	NA	NA	NA	Juveniles	High	Low	Low	Adult	NA	NA	NA
Substrate quality	Thinning, roads and haul in riparian reserves	Suspended sediment	Mod	Low	Low	Eggs	Low	Mod	Low	Juveniles	NA	NA	NA	Adult	NA	NA	NA
Natural cover	Thinning in riparian reserve	LWD	Low	Low	Low	Eggs, embryos, fry	NA	NA	NA	Juveniles	Mod	Low	Low	Adult	NA	NA	NA
Direct	Culvert replacement	Fish Salvage	NA	NA	NA	Eggs, embryos, fry	NA	NA	NA	Juveniles	Low	Mod	Low	Adult	NA	NA	NA

2.5.1 Effects to Water Quality

Stressor: Suspended Sediment

Effects to PBF

LCR steelhead critical habitat PBF of water quality may be degraded by proposed actions that cut trees and that construct roads, landings and stream crossings in the outer riparian buffer. Cutting and transporting trees to landings on 937 outer riparian reserve acres exposes 234 acres of sediment to erosion. Constructing 235 ground based landings and 255 skyline landings in riparian reserves expose an additional 90 acres of ground to erosion. Approximately 10 miles of new and reconstructed roads and 12 culvert replacements in riparian reserves will expose another 18 acres of ground to erosion. Log haul over 3.5 miles of roads within 0.25 miles of streams exposes 6 acres of sediment to erosion into streams.

Likelihood of exposure to suspended sediment that degrades water quality: **Moderate** Proposed actions expose 348 acres of ground in riparian reserves to erosion. However, exposed sediment primarily reaches the stream by being transported through the no cut, inner riparian reserve buffer. Any sediment entrained in stormwater overland flow will likely be deposited in the no cut buffer before it reaches the stream. The proposed action includes BMP engineering controls that should prevent sediment from becoming eroded and transported as stormwater[6]. Six new permanent culverts in or within 0.5 miles of steelhead critical habitat can potentially convey road runoff sediment directly to the streams during storms. BMP 16 calls for permanent roads to be constructed to shunt stormwater and sediment down the slope before it reaches the culvert. BMP 5 calls for revegetation of areas disturbed by culvert installation to catch runoff from the road.

Magnitude of response of water quality to suspended sediment from riparian reserve thinning: **Low**

If all of the newly exposed ground supplied sediment to the stream during a rainstorm, the suspended sediment concentration could reach 70 milligrams per liter per riparian acre thinned for 10 hours. The concentration and duration of suspended sediment will be substantially less than this estimate due to the no cut buffers and BMPs[7]. Therefore, the magnitude of response to water quality is Low.

Consequence of exposure and response to suspended sediment from riparian reserve thinning on water quality: **Low**

[6] PDC 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 26.

[7] For example, if overland flow from a large rainstorm eroded all the underlying sediment 0.01 meters deep from 1000 square meters (1/4 acre) per acre exposed by outer riparian reserve thinning and yarding into a channel discharging 8 cubic meters per second over 10 hours, the average concentration of suspended sediment in the plume would be 70 milligrams per liter per acre thinned.

Proposed actions in riparian reserves may supply some sediment to stream channels that will cause periodic, short term, local degradation of water quality. Proposed actions are unlikely to cause long-term or permanent changes to water quality.

Effects to eggs and embryos

The proposed actions includes BMPs to protect water quality. These BMPs include limiting timing of the work; considering ground stability when constructing roads; using erosion controls; and managing stormwater runoff by using road drainage and ditch designs from the USFS Road Construction and Maintenance Handbooks. Our effects analysis is based on our confidence (Copstead et al., 1998; Gomi et al., 2005; Lakel et al., 2010; Madej et al., 2006; Wemple and Jones, 2003) that erosion control BMPs will effectively minimize the amount of sediment delivered to streams. The maximum concentration of suspended sediment from erosion without the use of BMPs is 70 milligrams per liter for 10 hours.

Likelihood of exposure to suspended sediment that reduces fitness by affecting eggs and embryos: **Low**
The likelihood that some LCR steelhead eggs and embryos in redds will be exposed to 70 milligrams per liter suspended sediment concentrations for 10 hours is low because road construction and maintenance BMPs were shown to be 93% effective in minimizing sediment loading to streams (Luce and Black, 1999) and riparian buffers were shown to trap sediment preventing it from reaching streams (Copstead et al., 1998). Roads that are well-graded and graveled did not show signs of surface runoff during storm events (Copstead and Johansen 1998). Cross drains allow a small portion of the road to route water and sediment through the ditch lines to streams. Retaining ground cover in ditch lines trap and stores the majority of sediment and minimizes the amount of sediment reaching streams. The summer in-water work window minimizes the amount of sediment mobilized in the stream.

Magnitude of egg and embryo response to suspended sediment: **High**
The response of eggs or embryos exposed to 70 milligrams per liter suspended sediment for 10 hours would be 0 to 20 percent mortality (Newcombe et al., 1996).

Consequence of exposure and response to suspended sediment at the fitness level: **Low**
BMPs and riparian buffers should make it extremely unlikely that eroded sediment from roads and landings will reach the stream during the time steelhead redds are present.

Effects to juveniles and adults

Juvenile and adult salmon and steelhead may be exposed to suspended sediment plumes from the response site with an average concentration of between 0 milligrams per liter and 70 milligrams per liter for less than 24 hours.

Likelihood of exposure to 70 milligrams per liter suspended sediment for less than 24 hours: **Moderate**

The likelihood that juveniles and adults will be exposed to suspended sediment eroded from the response site is moderate because the area of ground cover removed from the riparian zone could be extensive.

Magnitude of response to 70 milligrams per liter suspended sediment for 24 hours: **Low**
The response of juvenile and adult salmon and steelhead to suspended sediment concentrations of less than 70 milligrams per liter for less than 24 hours is sublethal, moderate physiological stress (Newcombe et al., 1996).

Consequence of exposure and response to suspended sediment at the fitness level: **Low**
The number of individual fish that experience moderate physiological stress from suspended sediment resulting from outer riparian reserve erosion is likely to be very small, directly proportional to the acres of harvest, landing and road construction in the outer riparian reserves and inversely proportional to the effectiveness of BMPs to minimize the amount of erosion.

Stressor: Temperature

Effects to PBF

LCR steelhead rearing and migration critical habitat PBF of water temperature may be degraded by actions that remove riparian shade. Proposed actions that can remove shade are outer riparian reserve thinning.

Likelihood of exposure to solar heating that degrades water quality: **Low**
Thinning outer riparian reserve trees may reduce the shade that blocks solar heating of the rivers and streams. The Environmental Protection Agency (EPA) used Boyd and Kasper (2003) to analyze the effects of thinning prescriptions on stream temperature (EPA, 2013) as a function of the total width of the riparian buffer, the width and canopy cover of the no-cut buffer and the canopy cover of the outer buffer after thinning. Their analysis showed an increase in stream temperature for streams that had a shade loss of greater than 6 percent. For every stream channel orientation, a 120 foot no cut buffer with 80 percent canopy cover and a thinned outer riparian buffer with greater than 40 percent canopy cover kept the decrease in stream shade less than 3 percent. Likewise, a 60 foot no cut buffer with 80 percent canopy cover and a thinned 90 foot outer riparian buffer with 50 percent canopy cover kept the decrease in stream shade less than 3 percent. The proposed 60 to 100 foot no cut buffers combined with 280 or 240 outer riparian buffers thinned to 40 to 50 percent canopy cover should likewise keep the decrease in stream shade less than 6 percent.

Magnitude of response of water quality to solar heating: **Low**
The amount of reduced stream shade may be between 0 percent and 6 percent. The response of water temperature to 3 percent reduced shade is likely less than a 0.072 degree Celsius increase.[8]

Consequence of exposure and response to solar heating that degrades water quality: **Low**
Although some Middle Wind streams are temperature limited, the slight increase in water temperature resulting from the outer riparian reserve thinning is, for all practical purposes, unmeasurable.

Effects to eggs and embryos (not applicable, not present in summer)

Effects to Juveniles and adults

Likelihood of exposure to 0.072 degree Celsius increase in summer water temperature: **High**
Steelhead rear in streams for several years. Adults enter the Wind River in the summer. Steelhead in the Wind River are anticipated to be exposed to any increase in summer water temperature.

Magnitude of response to a 0.072 degree Celsius increase in summer water temperature: **Low**
The slight increase in solar heating from reduced outer riparian reserve canopy cover may be offset by other variables that determine water temperature such as groundwater mixing, air temperature, and discharge rate. The small, worst case temperature increase is unlikley to alter steelhead health or behavior. The response of juvenile steelhead to a 0.072 degrees Celsius increase in summer water temperature is likely indistinguishable from their behavior in the baseline water temperature.

Consequence of exposure and response to water temperature at the fitness level: **Low**
The small change in water temperature from the reduction of outer riparian reserve canopy cover is too small to have any effect on fish health or behavior.

---

[8] Unshaded streams receive approximately 1000 Watts per square meter (240 calories per square meter-second) from the overhead sun. If outer riparian reserve thinning decreased shade by 3 percent over a 1000 meter reach of a wide, shallow stream, the rate of temperature increase would be 0.00024 degrees Celsius per second. If the stream flow velocity is 0.1 meters per second, the increase in temperature would be 0.0024 degrees Celsius per meter so the total change in temperature in the 1000 meter reach would be 0.072 degrees Celsius.

2.5.2 Effects to Substrate Quality

Stressor: Suspended sediment

Effects to PBF

As described in the Environmental Baseline, spawning substrate in Middle Wind River streams generally has a high fraction of fine sediment because in the past, mass wastings[9] have delivered large amounts of sediment to the streams. We anticipate that erosion of sediment exposed by the Middle Wind project will be much better controlled by BMPs than historical logging operations. However, because the substrate fine sediment fraction is already high, any increase would be a serious effect to LCR steelhead eggs and embryos in redds constructed from substrate.

Likelihood of exposure to suspended sediment that degrades substrate quality: **Moderate**
The likelihood that sediment from the project actions that reaches and enters the stream will increase the fine sediment fraction is moderate because erosion and overland sediment transport take place during large rain events that also likely increase stream discharge enough to move bedload. During peak flow events that move substrate, suspended sediment in the water column mixes with the substrate and increases the fraction of sand and fine sediment in the substrate (Cui et al., 2003; Parker and Toro-Escobar, 2002).

Magnitude of response of substrate to suspended sediment: **Low**
We expect that no cut buffers and the other BMPs will substantially minimize the amount of eroded sediment that reaches and enters stream channels[10]. A small amount of suspended sediment will mix with and become part of bedload and substrate but as long as the amount of sediment that reaches the stream is controlled by BMPs, the increase in fine sediment fraction will likely be minimal.

Consequence of exposure and response to suspended sediment on sustrate quality: **Low**
The fraction of fine sediment in substrate downstream from the thinned riparian reserves is not likely to change from any suspended sediment eroded from proposed action in the outer riparian reserve.

Effects to eggs and embryos

Peak flows are sorted into flows with a lower than one year return interval (intrannual) and flows with a higher than one year return interval (interannual). Interannual peak flows move substrate but intraannual peak flows generally do not move substrate. The likelihood that response actions create suspended sediment just before an interannual peak flow is moderate. A large rain event resulting in an interannual peak flow could supply sufficient sediment to increase the fine sediment fraction of downstream substrate by 0.6 percent during an interannual peak flow. We anticipate that proposed BMPs will prevent proposed actions from increasing the fine sediment

[9] The downslope movement of soil, sand and rock as a solid, continuous **mass** under the force of gravity.
[10] Ten percent of 60 cubic meters of eroded sediment equals 6 cubic meters of fine sediment. 6 cubic meters of fine sediment will increase the fine sediment fraction of 1000 meter by 10 meter reach of the stream by 0.6 percent.

fraction in substrate. The midpoint between these two estimates is a 0.3 percent increase in substrate fine sediment fraction- a minimal amount.

Likelihood of exposure to a 0.3 percent increase in fine sediment fraction that reduces fitness of eggs and embryos: **Low**.

As described earlier, the probability of the combination of conditions for sediment from the response site to increase the fine sediment fraction in the substrate is moderate.

Magnitude of egg and embryo response to 0.3 percent increase in fine sediment fraction: **Low**
The increase in the fine sediment fraction by 0.3 percent in substrate that is 5 percent sand and 1 percent fines could decrease the fraction of eggs that hatch up to 10 percent[11]. (Lapointe et al., 2004).

Consequence of exposure and response to fine sediment at the fitness level: **Low**
Suspended sediment from the response site could result in the death of 10 percent of the eggs in the redds downstream. The number of eggs killed is most likely inversely proportional to the effectiveness of BMPs that prevent response site sediment from entering the channel.

Effect to juveniles and adults (not applicable, only relevant to eggs in redds)

2.5.3 Effects to Natural Cover

Stressor: Reduced large woody debris

Effects to PBF

Outer riparian reserve thinning will remove trees that could otherwise supply LWD to the stream.

Likelihood of exposure to removed LWD that will reduce natural cover: **Moderate**
Although the no cut buffer would likely block outer riparian reserve trees from ever reaching the channel, there may be some reaches where a tall tree 60 to 100 feet from the channel would fall toward and be pulled into the channel by high flow.

Magnitude of response to riparian reserve thinning that reduces the recruitment of LWD natural cover: **Low**
Any stochastic supply of LWD to the channels by natural forces is more than offset by GPNF restoration projects that create pool habitat by strategically constructing log jams in the streams and rivers.
Consequence of exposure and response to removal of LWD that reduces natural cover: **Low**

Any LWD removal will temporarily reduce any already scarce PBF in the action areas but restoration replaces lost wood with engineered log jams that create more valuable habitat.

[11] For silt<0.062 mm diameter and 0.63<sand<2 mm diameter, percent egg survival =83-2.3(% sand)-6(%sand x %silt).

Effects to eggs and embryos (not applicable, are not found in pool habitat)

Effects to juveniles

Juvenile steelhead rely on pool habitat created by LWD to rest and forage. The low density of LWD in Middle Wind River tributaries increases the energy expenditure and decreases the growth rate of rearing juveniles.

Likelihood of exposure to removed LWD that reduces pool habitat: **Moderate**
The likelihood that juvenile steelhead will be exposed to a reduction in pool habitat because outer riparian reserve thinning will remove trees that would otherwise have fallen into the stream is Low.

Magnitude of response to removed LWD that reduces pool habitat: **Low**
Because LWD in the Middle Wind River watershed is already scarce, any reduction or failure to resupply wood to the streams causes juveniles to expend energy that would otherwise go to growth and improved survival.

Consequence of exposure and response to reduced pool habitat at the fitness level: **Low**
The number of individual fish that may experience reduced growth and energy from the reduction of natural cover and pool habitat is small and proportional to the time between the thinning and the restoration projects funded by this timber sale.

Effect to adults (not applicable, not dependent on pool habitat)

2.5.4 Direct Effect to Fish During Fish Salvage

For the two perennial stream culvert replacements, contractors will divert flow around the construction site and block the channel with nets below the diversion and above the return to keep fish out of the construction site. Once the site is blocked, biologists will capture and transport fish, including juvenile LCR steelhead,that are trapped between the nets. Isolation, capture and relocation at release exposes fish to stress and short term vulnerability to predation.

Effect to eggs and embryos (not applicable, not present at culvert crossing locations)

Effects to juveniles

Likelihood that fish will be exposed to stream isolation and fish salvage: **Low**
Juvenile steelhead rear near natal streams for approximately 2 years so they are present throughout the watershed at all times of the year. Culverts will be replaced in two perennial streams requiring fish salvage. Very few steelhead are likely to be near the culvert replacement project and require salvage and relocation.

Magnitude of response to stream isolation and fish salvage: **Moderate**
Exposed juveniles may be stressed and receive some degree of mechanical injury during capture, holding, or release. Dip netting, time out of water, and data collection (e.g., measuring fish

length), are stressful and can lead to immediate or delayed mortality (Murphy et al., 1996). Electrofishing causes physiological stress and can cause physical injury or death in rare cases, including cardiac or respiratory failure (Snyder, 2003). There is also potential that some fish would be missed or stranded in substrate interstices after a site is dewatered.

Consequence of exposure and response to fish salvage at the fitness level: **Low**
Although some listed salmonids may die during dewatering and relocation, fish will only be exposed to the stress caused by these activities once and the procedure is only expected to last a few hours. If construction took place without work area isolation, more fish would be injured or killed.

Critical Habitat Summary of Effects - Having evaluated the likelihood of features of habitat experiencing degrading conditions as a result of the proposed action, and the intensity of response to such exposure, we have determined that multiple PBFs (water quality, substrate, riparian conditions, and natural cover) will all be modified to varying degrees, with some effects rapidly ameliorating to baseline levels (eg water quality) and some effects persisting for month (substrate condition) to years (large wood, riparian conditions).

Species Summary of Effects – All life stages of LCR Steelhead are likely to be exposed to some effects of the proposed action. There may be small declines in egg to emergence survival, juvenile survival, and spawning success in each location where suspended sediment reaches spawning areas and where thinned outer riparian reserves could provide shade or large wood to streams. We expect a very small number of juvenile steelhead to be harmed or killed during fish salvage of two streams prior to culvert replacement. Because all effects of the proposed action will occur among the Wind River populations we expect that exposed eggs and individuals will experience compromised fitness, however we do not anticipate substantial effects to Wind River steelhead population's abundance, productivity, spatial structure, or genetic diversity.

Wind River summer steelhead is a primary population of LCR steelhead. The viability of Wind River summer steelhead is currently high. No increase in productivity is needed to attain the recovery goal abundance of 1000 spawners as the current abundance of Wind River summer steelhead is approximately 1000. Upper Gorge winter steelhead that spawn in the Wind River are a stabilizing population of LCR steelhead. The viability of Upper Gorge winter steelhead is low, yet no increase in productivity is needed to attain the recovery goal abundance of 200 spawners. Given these abundance data the anticipated small effects of the proposed action on Wind River summer steelhead's abundance and productivity parameters, we find it unlikely that the viability of either population will be reduced substantially from the effects of the proposed action.

We discuss the implications of these minimal population level effects on the species as a whole in the Integration and Synthesis section.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

The NMFS reviewed Skamania County and Washington State Department of Ecology permit databases to identify potential projects that would add cumulative effects to the proposed action. No such projects were identified. Because the entire action area is in the GPNF, state and private activities in the action area would require a Federal permit creating a Federal nexus for ESA consultation.

Skamania County population grew an average 1.5 percent per year between 1990 and 2015 and this trend is expected to continue. Lower Wind River land has been converted from forest to residential use regulated by and consistent with provisions of the Skamania County Critical Areas Ordinance, with the Underwood Conservation District providing technical assistance. Unlike Federal and private timberland, private property owners can remove riparian vegetation and construct levees to control flooding, which impair natural river processes and habitat values for fish. Residential development also adds upland impervious surface that impacts hillslope processes, water runoff and sediment supply rates and ultimately Wind River water quality. Landslides have contributed large quantities of sediment to the lower Wind River, disrupting channel structure and stability. Several Wind River stream reaches and tributaries are State 303(d) listed for high average temperature from the absence of riparian cover and fecal coliform bacteria from leaking septic systems contribute to bacteria levels in some areas. A Washington Department of Environmental Quality (WDEQ) Water Quality Clean-up Plan depends on State Forest Practices Rules, a Carson Stormwater Ordinance, and a Stabler Water Quantity and Quality Study to meet the Clean-up plans targets.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

LCR steelhead are a threatened species, comprised of 23 populations. LCR steelhead survival and recovery are limited by degraded environmental baseline in fresh water, estuarine, and marine critical habitats. PBFs i that are potentially worsened by the proposed action include water quality degraded by suspended sediment and temperature, fine sediment in spawning gravel, short term decrease in LWD and short term decrease in fish passage. The proposed action is likely to affect LCR steelhead because they migrate and breed in the action area and juveniles continuously occupy the action area before they migrate as smolts.

The proposed action may further worsen PBFs of designated critical habitat by causing riparian area and streambank erosion that increases the fine sediment fraction in spawning gravel, degrading water quality with suspended sediment and increased temperature, and impeding fish passage during culvert replacements. LCR steelhead survival and recovery is also affected by these PBF changes because LCR steelhead are always present to be exposed and LCR steelhead rely on PBFs.

For LCR steelhead, the results of the effects analysis are summarized in the Table 25 and Table 29. As shown in Table 25, although some PBF stressors have a moderate or high likelihood of PBF exposure or magnitude of PBF response rating, no stressor has a combination of moderate or high likelihood of PBF exposure and magnitude of PBF response rating that leads to a moderate or high consequence of PBF exposure and response rating. Likewise, no PBF response magnitude or direct effect stressor has a moderate or high likelihood of individual exposure and magnitude or individual response rating leading to a moderate or high consequence of exposure and response to individual fitness rating. As shown in Table 29, when all of the stressor effects to each PBF are combined, the consequence to the conservation value of designated critical habitat rating is low. Likewise, when the effects of PBF and direct effects to individuals are combined, the consequence of the PBF and direct effects at the population level rating is low.

In conclusion, although response actions may temporarily worsen critical habitat PBFs, NMFS did not identify any effect pathway where PBF degradation rises to the level that critical habitat is adversely modified. Likewise, the proposed action may kill or harm some individual fish from the Wind River LCR steelhead population, however NMFS did not identify any pathway where deaths or harm rise to a level where population abundance or productivity , would be substantially decreased from the combination of the environmental baseline, cumulative effects and the proposed action. NMFS did not identify any pathways whereby response actions would affect the spatial structure or diversity of LCR steelhead. Because the combination of the environmental baseline, response actions and cumulative effects does not decrease the viability of any LCR steelhead population, NMFS concluded that the proposed actions would not jeopardize survival or recovery of the LCR steelhead species.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR steelhead or destroy or adversely modify the designated critical habitat of any of these species.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

<u>2.9.1 Amount or Extent of Take</u>

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur in the form of harm when eggs, embryos, juveniles or adults are exposed to effects of the proposed action. Exposure is likely because the proposed actions take place over a large, distributed area and over the course of several years. However, predicting a number of fish that is likely to be exposed to these effects over the space and time of the work is extremely difficult, because fish presence is highly variable, and influenced by a number of factors that are remain difficult to accurately predict, such as rainfall timing and intensity, streamflow discharge, etc. We anticipate that take in the form of harm will occur when:

1. Steelhead eggs and embryos in redds are exposed to water quality degraded by suspended sediment caused when tree thinning removes ground cover and leads to erosion, and when the sediments occlude spawning substrates, injuring or killing eggs and embryos.
2. Juvenile and adult salmon and steelhead experience physiological stress from water quality degraded by suspended sediment caused when actions in outer riparian reserves remove ground cover. Stress may limit growth among juvenile fish, making them more susceptible to piscivores. Stress can also reduce fitness in pre-spawn adults.
3. Salmon and steelhead juveniles experience slightly reduced growth and energy from the reduction in pool habitat from the reduced supply of LWD in thinned outer riparian reserves, leading to greater susceptibility to piscivores.

When quantifying take with the number of individuals harmed or killed is not practicable, NMFS identifies a surrogate that serves the same role as a reinitiation trigger, by being both observable, and causally related to the harm that will occur. In this case the surrogate is the 937acres of outer riparian reserve acres to be managed. The take is a function of the number of outer riparian reserve acres thinned because it encompasses all the sediment sources (landings, roads, road crossings) that can deliver sediment to the stream and it encompasses the pathway by which large wood may be delivered to the stream. The number of outer riparian reserve acres thinned is an effective reinitiation trigger because it is easily tracked by the GPNF.

Take is also likely to occur in the form of capture, injury, and death when juvenile salmon and steelhead are handled during work site isolation and fish salvage activities at the two culvert replacements on perennial streams. The USFWS and NOAA-Restoration Center had an average capture of approximately 132 ESA-listed salmon and steelhead per project, where isolation and dewatering was required. Less than 5 percent of captured fish are likely to be injured or killed, including by delayed mortality, and the remainder is likely to survive with no long-term adverse effects. Based on these numbers, NMFS anticipates that up to 264 juvenile steelhead could be captured and up to 13 juvenile individuals could be injured or killed as a result of fish capture necessary to isolate in-water culvert replacement.

Consultation must be reinitiated if either thinning in outer riparian reserves exceeds 937 acres or the amount of take (264 fish handled/13 injured or killed) is exceeded.

2.9.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The USFS and/or its contractors shall:

1. Minimize incidental take from sediment loading of streams.
2. Minimize incidental take from reduced natural cover.
3. Minimize incidental take from isolation and fish salvage before culvert replacement work.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USFS or any contractor must comply with them in order to implement the RPMs (50 CFR 402.14). The USFS or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1: In order to hasten revegetation and re-stabilize soils, do not engage in "grubbing" to remove brushy or shrubby vegetative root structures in areas where thinning occurs, and restrict grubbing to tree stumps only.

2. The following terms and conditions implement reasonable and prudent measure 2:

a. Minimize incidental take from reduced recruitment of large wood to streams from outer riparian reserve thinning by using BMPs 22 and 25.
b. Offset incidental take from reduced recruitment of large wood to streams from outer riparian reserve thinning by felling and leaving trees within the riparian area of stands in units 804337, 806465, 808240, 808258, 808295, 808300, 808371, 803079.

3. The following terms and conditions implement reasonable and prudent measure 3: Minimize incidental take from stream isolation and fish salvage by
    a. ensuring a fish biologist oversees implementation of worksite isolation measures and fish handling,
    b. ensuring that the number of fish handled is documented and a record of observed fish injuries and deaths is created,
    c. sending the report of fish handled/injured/killed is provided to Projectreports.wcr@noaa.gov.

2.10 Reinitiation of Consultation

This concludes formal consultation for the Middle Wind River Vegetation Project.

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion is the United States Forest Service. Individual copies of this opinion were provided to the United States Forest Service. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq..

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analysis in this opinion contains more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

Abatzoglou, J.T., D.E. Rupp, and P.W. Mote. 2014. Seasonal Climate Variability and Change in the Pacific Northwest of the United States. *J Climate*. 27:2125-2142.

Barton, A., B. Hales, G.G. Waldbusser, C. Langdon, and R.A. Feely. 2012. The Pacific oyster, Crassostrea gigas, shows negative correlation to naturally elevated carbon dioxide levels: Implications for near-term ocean acidification effects. *Limnol Oceanogr*. 57:698-710.

Bottom, D.L., C.A. Simenstad, J. Burke, A.M. Baptista, D.A. Jay, K.K. Jones, and E.C.H. Schiewe. 2005. Salmon at river's end: The role of the estuary in the decline and recovery of Columbia River salmon. U.S. Department of Commerce. 246.

Boyd, M., and B. Kasper. 2003. Analytical methods for dynamic open channel heat and mass transfer: Methodology for heat source model Version 7.0.

Copstead, R.L., D.K. Johansen, and J. Moll. 1998. Water/Road Interaction: Introduction to surface cross drains. U.S. Department of Agriculture, Forest Service, Technology and Development Program., San Dimas, CA. 15.

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. *Evol Appl*. 1:252-270.

Cui, Y.T., G. Parker, T.E. Lisle, J. Gott, M.E. Hansler-Ball, J.E. Pizzuto, N.E. Allmendinger, and J.M. Reed. 2003. Sediment pulses in mountain rivers: 1. Experiments. *Water Resour Res*. 39.

Dominguez, F., E. 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. *Geophysical Research Letters*. 39.

Doney, S.C., M. Ruckelshaus, J.E. Duffy, J.P. Barry, F. Chan, C.A. English, H.M. Galindo, J.M. Grebmeier, A.B. Hollowed, N. Knowlton, J. Polovina, N.N. Rabalais, W.J. Sydeman, and L.D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. *Annu Rev Mar Sci*. 4:11-37.

EPA. 2013. Potential Modeling Approach to Evaluate the Effects of Thinning Activities on Stream Shade. EPA Comment to BLM 11/19/2013. United States Environmental Protection Agency, Portland, OR.

Feely, R.A., T. Klinger, J.A. Newton, and M. Chadsey. 2012. Scientific summary of ocean acidification in Washington state marine waters. *In* NOAA Office of Oceanic and Atmospheric Research Special Report.

Fresh, K.L., E. Casillas, L.L. Johnson, and D.L. Bottom. 2005. Role of the estuary in the recovery of Columbia River Basin salmon and steelhead: An evaluation of the effects of selected factors on salmonid population viability. U.S. Department of Commerce. 105.

Glick, P., J. Clough, and B. Nunley. 2007. Sea-Level Rise and Coastal Habitats in the Pacific Northwest: An analysis for Puget Sound, southwestern Washington, and northwestern Oregon. National Wildlife Federation, Seattle, WA.

Gomi, T., R.D. Moore, and M.A. Hassan. 2005. Suspended sediment dynamics in small forest streams of the Pacific Northwest. *J Am Water Resour As*. 41:877-898.

Goode, J.R., J.M. Buffington, D. Tonina, D.J. Isaak, R.F. Thurow, S. Wenger, D. Nagel, C. Luce, D. Tetzlaff, and C. Soulsby. 2013. Potential effects of climate change on streambed scour and risks to salmonid survival in snow-dominated mountain basins. *Hydrol Process*. 27:750-765.

Grant, G.E., S.L. Lewis, F.J. Swanson, J.H. Cissel, and J.J. McDonnell. 2008. Effects of forest Practices on Peak Flows and Consequent channel response: A State of Science Report for Western Oregon and Washington. United States Department of Agriculture Forest Service Pacific Northwest Research Station, Portland, OR. 76.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. R.K.P.a.L.A. Meyer, editor. Intergovernmental Panel on Climate Change, Geneva, switzerland. 151.

ISAB. 2007. Climate change impacts on Columbia River Basin fish and wildlife *In* Climate Change Report. Northwest Power and Conservation Council Independent Scientific Advisory Board, Portland, Oregon.

Jacobsen, R., N. Nott, E. Brown, M. Weeber, and M. Lewis. 2014. Assessment of western Oregon adult winter steelhead – Redd surveys 2014. 27.

Kunkel, K.E., L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, K.T. Redmond, and J.G. Dobson. 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6. Climate of the Northwest U.S. *In* NOAA Technical Report. Vol. 142-6. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Washington, D.C. 83.

Lakel, W.A., W.M. Aust, M.C. Bolding, C.A. Dolloff, P. Keyser, and R. Feldt. 2010. Sediment Trapping by Streamside Management Zones of Various Widths after Forest Harvest and Site Preparation. *Forest Sci*. 56:541-551.

Lapointe, M., N. Bergeron, F. Berube, M. Pouliot, and P. Johnston. 2004. 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). *Can J Fish Aquat Sci*. 61:2271-2277.

Lawson, P.W., E.A. Logerwell, N.J. Mantua, R.C. Francis, and V.N. Agostini. 2004. Environmental factors influencing freshwater survival and smolt production in Pacific Northwest coho salmon (Oncorhynchus kisutch). *Can J Fish Aquat Sci*. 61:360-373.

Lower Columbia River Estuary Partnership. 2007. Lower Columbia River and estuary ecosystem monitoring: Water quality and salmon sampling report, Portland, Oregon.

Luce, C.H., and T.A. Black. 1999. Sediment production from forest roads in western Oregon. *Water Resour Res*. 35:2561-2570.

Madej, M.A., E.A. Eschenbach, C. Diaz, R. Teasley, and K. Baker. 2006. Optimization strategies for sediment reduction practices on roads in steep, forested terrain. *Earth Surf Proc Land*. 31:1643-1656.

Mantua, N., I. Tohver, and A. Hamlet. 2009. Impacts of Climate Change on Key Aspects of Freshwater Salmon Habitat in Washington State. The Climate Impacts Group, University of Washington, Seattle, Washington.

Mantua, N., I. Tohver, and A. Hamlet. 2010. Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. *Climatic Change*. 102:187-223.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce. 156.

Mcmahon, T.E., and G.F. Hartman. 1989. Influence of Cover Complexity and Current Velocity on Winter Habitat Use by Juvenile Coho Salmon (Oncorhynchus-Kisutch). *Can J Fish Aquat Sci*. 46:1551-1557.

Meyer, J.L., M.J. Sale, P.J. Mulholland, and N.L. Poff. 1999. Impacts of climate change on aquatic ecosystem functioning and health. *J Am Water Resour As*. 35:1373-1386.

Mote, P.W., J.T. Abatzglou, and K.E. Kunkel. 2013. Climate: Variability and Change in the Past and the Future. Island Press, Washington D.C.

Mote, P.W., A.K. Snover, S. Capalbo, S.D. Eigenbrode, P. Glick, J. Littell, R.R. Rayomdi, and W.S. Reeder. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

Murphy, B.R., D.W. Willis, and American Fisheries Society. 1996. Fisheries techniques. American Fisheries Society, Bethesda, Md., USA. xx, 732 p. pp.

Newcombe, C.P., J.O.T. Jensen, and BC Environment. Habitat Protection Branch. 1996. Channel suspended sediment and fisheries : a synthesis for quantitative assessment of risk and impact. Ministry of Environment, Lands, and Parks, Habitat Protection Branch, Victoria, B.C. ii, 90, 25 p. pp.

NMFS. 2005. Assessment of NOAA Fisheries' critical habitat analytical review teams for 12 evolutionarily significant units of West Coast salmon and steelhead. NMFS Protected Resources Division, Portland, Oregon.

NMFS. 2011. Anadromous Salmonid Passage Facility Design. National Marine Fisheries Service, Northwest Region, Portland, Oregon.

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. National Marine Fisheries Service, Northwest Region, Seattle, WA.

NOAA Fisheries. 2005. Assessment of NOAA Fisheries' critical habitat analytical review teams for 12 evolutionarily significant units of West Coast salmon and steelhead. National Marine Fisheries Service, Protected Resources Division, editor, Portland, Oregon.

NWFSC. 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. Northwest Fisheries Science Center.

Parker, G., and C.M. Toro-Escobar. 2002. Equal mobility of gravel in streams: The remains of the day. *Water Resour Res*. 38.

Raymondi, R.R., J.E. Cuhaciyan, P. Glick, S.M. Capalbo, L.L. Houston, S.L. Shafer, and O. Grah. 2013. Water Resources: Implications of Changes in Temperature and Precipitation. Island Press, Washington D.C.

Reeder, W.S., P.R. Ruggiero, S.L. Shafer, A.K. Snover, L.L. Houston, P. Glick, J.A. Newton, and S.M. Capalbo. 2013. Coasts: Complex Changes Affecting the Northwest's Diverse Shorelines.

Scheuerell, M.D., and J.G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (Oncorhynchus tshawytscha). *Fish Oceanogr*. 14:448-457.

Sherwood, C.R., D.A. Jay, R.B. Harvey, P. Hamilton, and C.A. Simenstad. 1990. Historical Changes in the Columbia River Estuary. *Prog Oceanogr*. 25:299-352.

Snyder, D.E. 2003. Electrofishing and its harmful effects on fish. . U.S. Government Printing Office. Denver, Colorado. 149.

Sunda, W.G., and W.J. Cai. 2012. Eutrophication induced CO2-acidification of subsurface coastal waters: interactive effects of temperature, salinity, and atmospheric p CO2. *Environ Sci Technol*. 46:8.

Tague, C.L., J.S. Choate, and G. Grant. 2013. Parameterizing sub-surface drainage with geology to improve modeling streamflow responses to climate in data limited environments. *Hydrology and Earth System Sciences*. 17:341-354.

Tillmann, P., and D. Siemann. 2011. Climate Change Effects and Adaptation Approaches in Marine and Coastal Ecosystems of the North Pacific Landscape Conservation Cooperative Region. National Wildlife Federation.

USDC. 2013. Endangered and threatened species; Designation of critical habitat for Lower Columbia River coho salmon and Puget Sound steelhead; Proposed rule. *U.S Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register*. 78:2726-2796.

Wainwright, T.C., and L.A. Weitkamp. 2013. Effects of climate change on Oregon Coast coho salmon: habitat and life-cycle interactions. *Northwest Sci*. 87:23.

Wemple, B.C., and J.A. Jones. 2003. Runoff production on forest roads in a steep, mountain catchment. *Water Resour Res*. 39.

Winder, M., and D.E. Schindler. 2004. Climate change uncouples trophic interactions in an aquatic system (vol 85, pg 2100, 2004). *Ecology*. 85:3178-3178.

Zabel, R.W., M.D. Scheuerell, M.M. McClure, and J.G. Williams. 2006. The interplay between climate variability and density dependence in the population viability of Chinook salmon. *Conserv Biol*. 20:190-200.