UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Blvd., Suite 1100
PORTLAND, OREGON 97232-1274

Refer to NMFS No.: WCRO-2019-00545

August 26, 2019

Cheryl F. Probert
Forest Supervisor
Nez Perce Clearwater National Forests
903 Third Street
Kamiah, Idaho 83536

Lt. Col. Christian N. Dietz
U.S. Army Corps of Engineers
Walla Walla District
201 North Third Avenue
Walla Walla, Washington 98362-1836

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Clear Creek Integrated Restoration, Clear Creek, HUCs 170603040101, 170603040102, 170603040103, Idaho County, Idaho (One Project)

Dear Ms. Probert and Lt. Col. Dietz:

Thank you for your letter of April 17, 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 Clear Creek Integrated Restoration Project. The enclosed document contains a biological opinion (Opinion) prepared by NMFS on the effects of this project as proposed by the Nez Perce-Clearwater National Forests (NPCNF). In this Opinion, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River Basin steelhead, or result in the destruction or adverse modification of designated critical habitat for Snake River Basin steelhead.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the federal agency and any person who performs the action must comply with to carry out the RPM. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes 10 Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These Conservation Recommendations are a subset of the ESA terms and conditions, and involve reducing effects of the action on EFH components such as stream substrate condition for spawning and rearing Chinook and coho salmon. Section 305(b)(4)(B) of the MSA requires federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH Conservation Recommendations, the NPCNF must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each EFH consultation, and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of Conservation Recommendations accepted.

Please contact Aurele LaMontagne at NMFS' Boise office at 208-378-5686 or aurele.lamontagne@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Michael P. Tehan

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Enclosure

cc: J. Harris – NPCNF
K. Smith – NPCNF
K. Fitzgerald – USFWS
M. Lopez – NPT
W. Schrader – COE

Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Clear Creek Integrated Restoration
Clear Creek, HUCs 170603040101, 170603040102, 170603040103
Idaho County, Idaho

NMFS Consultation Number: WCRO-2019-00545

Action Agencies: Nez Perce-Clearwater National Forests
U.S. Army Corps of Engineers

Affected Species and Determinations:

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

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

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

Issued by: Michael P. Tehan

Michael P. Tehan
Assistant Regional Administrator

Date: August 26, 2019

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ACRONYMS

ACRONYMS	DEFINITION
µPa	micropascal
BA	Biological Assessment
BMP	Best Management Practices
CCIR	Clear Creek Integrated Restoration
cfs	Cubic Feet per Second
CE	Cobble Embeddedness
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
dB	Decibel
DPS	Distinct Population Segment
DQA	Data Quality Act
ECA	Equivalent Clearcut Area
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FMP	Fisheries Management Plan
Forest Plan	Nez Perce National Forest Plan
ft^2	Square Feet
HUC	Hydrologic Unit Code
ICTRT	Interior Columbia Basin Technical Recovery Team
IDL	Idaho Department of Lands
IFPA	Idaho Forest Practices Act
ISAB	Independent Scientific Advisory Board
ITS	Incidental Take Statement
LCC	Lower Clear Creek

ACRONYMS	DEFINITION
LWD	Large Woody Debris
MMBF	Million Board Feet
mg/L	Milligrams per liter
$MgCl_2$	Magnesium Chloride
mi/mi^2	Mile per Square Miles
mm	Millimeters
MPG	Major Population Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NFS	National Forest System
NMFS	National Marine Fisheries Service
NPCNF	Nez Perce Clearwater National Forests
NTU	Nephelometric Turbidity Unit
Opinion	Biological Opinion
PBF	Physical or Biological Features
PCE	Primary Constituent Elements
PED	Potential Ecological Damage
PFMC	Pacific Fishery Management Council
RHCA	Riparian Habitat Conservation Area
RMO	Riparian Management Objectives
ROS	Rain-on-snow
RPM	Reasonable and Prudent Measures
Skidding	Ground Based Yarding
SRB	Snake River Basin
tons/acre	Tons per acre
tons/mi^2	Tons per square mile
TSZ	Transient Snow Zone
Tribe	Nez Perce Tribe
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WEPP	Water Erosion Prediction Project

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into sections 2 and 3 below.

1.1 Background

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 USC 1531 et seq.), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

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 the NMFS Snake River Basin Office in Boise, Idaho.

1.2 Consultation History

This Opinion is based on information provided in the Nez Perce-Clearwater National Forests' (NPCNF) April 18, 2019, biological assessment (BA), various e-mail and telephone conversations, and North Idaho Level 1 Team meetings. The main exchanges in the interagency communications for this consultation, including consultation on a previous version of this project, are summarized below.

May 15, 2012: The NPCNF presented the initial proposal for the Clear Creek Integrated Restoration Project at a Level 1 meeting.

November 24, 2015: NMFS issued a biological opinion for the project (NMFS No.: WCR-2014-1844).

August 19, 2016: The NPCNF withdrew the Record of Decision for the Clear Creek Integrated Restoration Project and requests that NOAA withdraw its biological opinion and incidental take statement for the Clear Creek Integrated Restoration Project.

September 1, 2016: NMFS withdrew the November 24, 2015, biological opinion, incidental statement, and MSA consultation.

July 3, 2018: NMFS received a draft BA for a renewed action for the Clear Creek Integrated Restoration project (CCIR). On September 4, 2018, NMFS returned the draft BA with comments.

March 12, 2019: NMFS received a second draft BA including an updated proposed action (Alternative C modified) and analysis including a summary of the baseline road analysis completed by the Forest Service Rocky Mountain Research Station in Moscow, Idaho, entitled *Results of Erosion Analysis of the Clear Creek Road Network: Nez Perce-Clearwater National Forest* (Elliot et al. 2018).

April 15, 2019: NMFS sent final comments on the second draft BA.

April 18, 2019: NMFS received a final BA and request for formal consultation.

July, 17, 2019: NMFS sent the draft proposed action, terms and conditions, and conservation measures to the Nez Perce Tribe (Tribe) for comment.

On July 30, 2019, NMFS received comments and suggestions from the Tribe.

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). For EFH, the federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a federal agency (50 CFR 600.910). 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). There are no interrelated or interdependent actions associated with this action.

The NPCNF proposes the CCIR to reduce existing and potential forest fuels, create conditions that will contribute to sustaining long-lived, fire-tolerant tree species, contribute to the economic and social well-being of the local community, and improve the aquatic habitat in the upper Clear Creek watershed (Figure 1). Project activities will include timber harvest, prescribed fire treatments, and road construction, reconstruction, reconditioning, and decommissioning. Other related activities include regular road maintenance (including road gravel surfacing) and dust abatement, and weed treatments. Timber harvest is proposed for seven timber sales issued over a 6-year period from 2019 to 2024. Typical timber sale contracts last 4 years, so the harvest and road actions associated with the last sale could take until 2028 to complete. All post-harvest reforestation and site rehabilitation work will conclude in 2030. Because of the specific conditions necessary for burning, landscape burning can take up to 20 years to complete (Figure 2). Assuming burning will start before the final sale, the project is likely to take 20 years to complete (2039).

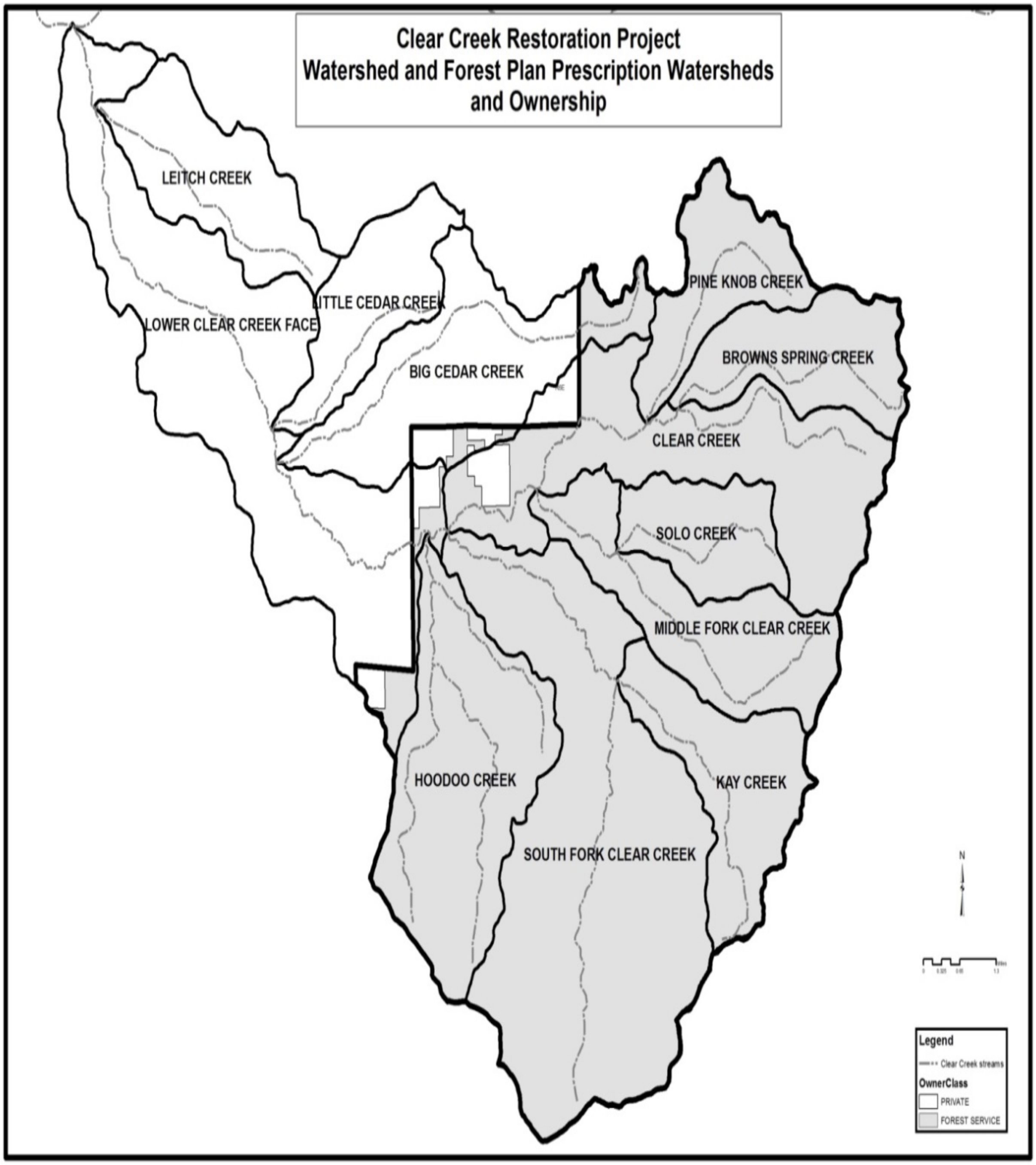

Figure 1. Clear Creek Hydraulic Unit Code (HUC) 5 watershed and NPCNF Plan prescription watershed boundaries and ownership.

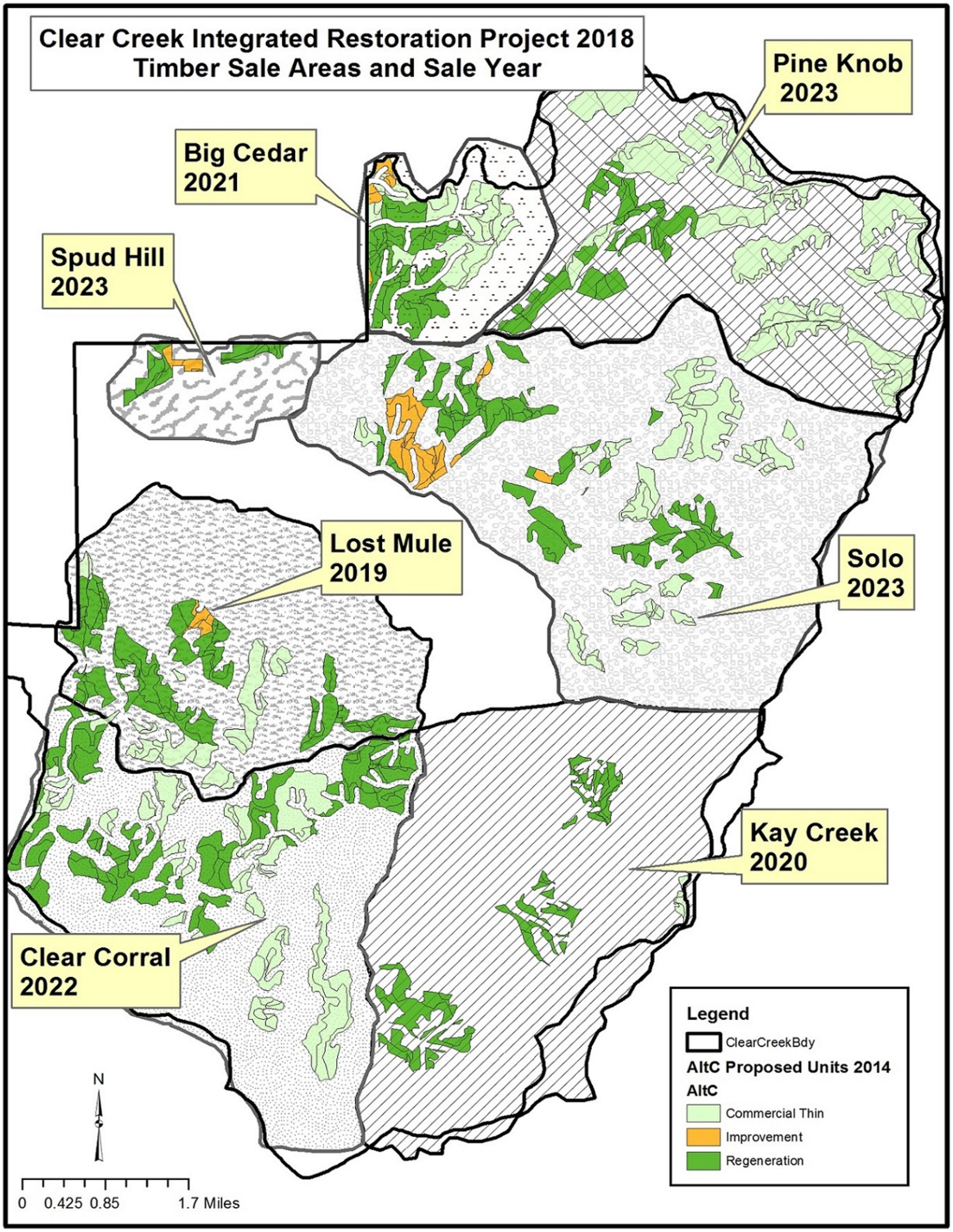

Figure 2. Proposed Clear Creek Project Timber Sale Boundaries by Sale Year.

The Nez Perce National Forest Plan (Forest Plan) allows timber management activities to occur in sediment-limited watersheds, concurrent with improvement efforts, as long as a positive, upward trend in habitat carrying capacity is indicated (Gerhardt et al. 1991). Although the Forest Plan requires that a watershed will move toward the objective over time, in the Clear Creek watershed, an upward trend is likely due to recent and ongoing road decommissioning. In the Clear Creek watershed, the West Fork South Fork Road Decommissioning Project and the Clear Ridge Road Decommissioning Project are ongoing and have already undergone consultation. These two projects have completed decommissioning 69 miles of roads and will complete decommissioning 100 more miles during implementation of CCIR. The NPCNF also included, as part of this action, a series of best management practices (BMPs)/minimization measures, as well as road decommissioning and reconstruction activities to support an upward trend in fish habitat and water quality. In addition, the NPCNFs' Monitoring Plan, as described below, is intended to help ascertain if the proposed restoration activities, in combination with the BMPs described below as part of the proposed action, will lead to the objective of achieving upward trend.

1.3.1 Proposed Timber Harvest Activities

The NPCNF is proposing 7,817 acres of timber harvest (up to 83 million board feet [MMBF]) in 10 Clear Creek prescription watersheds over a 9-year period (Figures 2 and Table 1). Harvest methods will include the following, as described in the BA.

Table 1. Summary of timber harvest treatments and yarding methods.

Watershed Information		Proposed Treatment (acres)				Yarding Method	
Subwatershed	Forest Service Land	Precomm. Thin - No harvest	Regen	Comm. Thin	Improvement	Ground-based	Skyline
Clear Creek	6,583	393	394	708	22	512	610
Hoodoo Creek	6,446	422	1,323	435	0	1,015	752
South Fork Clear Creek	12,941	319	550	644	0	603	592
Kay Creek	3,537	271	65	27	0	67	26
Middle Fork Clear Creek	4,025	97	220	237	178	355	271
Pine Knob Creek	2,622	90	75	600	0	566	112
Brown Springs Creek	3,057	56	288	745	0	571	462
Solo Creek	2,226	135	385	232	31	389	261
Big Cedar Creek	720	0	195	309	72	321	249
Lower Clear Cr Face	568	11	82	0	0	67	15
Total	42,725	1,794	3,577	3,937	303	4,467	3,350
Total Harvest		No Harvest	7,817			7,817	

1.3.1.1 Harvest

Regeneration harvest removes the majority (up to 85 percent) of trees from a harvest unit while leaving other trees for wildlife habitat and future soil productivity. Variable retention prescriptions for the leave trees are used depending on the habitat type with moister sites retaining more trees and drier sites generally retaining less (as would occur under a natural fire regime). Clumps of trees and individual trees are left throughout the unit at a rate of 14 to 28 trees per acre. Downed woody material is also left within the unit for soil productivity at a rate of 7 to 33 tons per acre (tons/acre). There are 3,577 acres of regeneration proposed (Table 1).

Precommercial thinning is the removal of trees not for immediate financial return, but to reduce stocking and promote growth of the more desirable trees for eventual commercial harvest. These trees are cut and left on site and not hauled away as indicated in Table 1. There are 1,794 acres of precommercial thinning proposed (Table 1).

Commercial thinning generally removes up to 60 percent of a stand while leaving the healthiest, more insect and disease or fire resistant trees in the stand. Tree spacing is generally 20 to 30 feet between tree crowns, and is dependent on the habitat type. There are 3,937 acres of commercial thinning proposed (Table 1).

Improvement harvest involves the removal of ladder fuels from around existing large ponderosa pine and other legacy trees left as a result of the last fire disturbance in the area. Remnant legacy trees are being encroached upon by less fire resistant trees creating ladder fuels. In the event of a fire, the ladder fuels could cause the mortality of the legacy trees. The intent of this treatment is to retain the legacy trees on the landscape and improve their chances for survival in the event of a fire. There are 303 acres of improvement proposed (Table 1).

Yarding is the movement of felled trees or logs from the area where they are felled to the landing by ground based vehicles (skidding) or by a skyline yarding. In ground-based logging or skidding, the trees or logs will be dragged across the ground by a cable (3,350 acres). In skyline yarding, logs are suspended from a cable when brought to a landing (4,467 acres). To reduce ground disturbance, no skidding will be allowed on slopes over 35 percent, unless mitigating measures, such as operating on adequate compacted snow or only skidding over short distances, are approved by the soil specialist.

Landslide prone areas were identified (250 acres) and field verified in harvest units. As a BMP, landslide prone areas will be further identified during unit layout, excluded from harvest, and given a 100-foot PACFISH no harvest buffer.

The design features or BMPs listed below are proposed to restrict activity in Riparian Habitat Conservation Areas (RHCAs), and minimize soil disturbance and erosion, and minimize sediment delivery to streams.

- No timber harvest will occur within PACFISH streamside RHCAs (i.e., within 300 feet of fish-bearing streams, 150 feet of perennial non-fish bearing water and wetlands larger than one acre, 100 feet of intermittent streams, landslide prone areas, and wetlands one acre or smaller).

- No ground based skidding will be allowed on slopes over 35 percent, unless mitigating measures, such as operating on adequate compacted snow or only over short distances, are approved by the soil specialist.

- Activities will be restricted when soils are wet to prevent soil damage (indicators include excessive rutting, soil displacement, and erosion).

- Skid trails, landings, and yarding corridors will be located and designated to minimize the area of increased detrimental soil effects.

- Existing skid trails and landings will be used to the extent possible and all will be decommissioned after use. Decommissioning includes de-compaction of the trail and the placement of large woody material on the surface.

- Equipment used for machine piling or mastication of activity slash will remain on designated skid trail or will be required to rehabilitate (decompact or recontour) any detrimental disturbance they cause.

- Decompaction will span the width of the compacted areas and extend to a depth of 10–18 inches, to effectively loosen the ground to allow water penetration and revegetation and to prevent the rocky sub-surface soils from mixing with the topsoil. The depth of decompaction will be adjusted to avoid turning up large rocks, roots, or stumps. Equipment will not be permitted to operate outside the clearing limits of the skid trail.

- Decompaction will be done during from June 15 to October 15, unless otherwise approved. No decompaction work will be done during wet weather or when the ground is frozen or otherwise unsuitable.

- All erosion control barriers and cross ditches removed or otherwise rendered ineffective by the decompaction treatment will be reinstalled as they were prior to the decompaction.

- Non-channelized sediment delivery from harvest units to streams will be prevented using BMPs found in Rules Pertaining to the Idaho Forest Practices Act Title 38, Chapter 13, Idaho Code, and Soil and Water Conservation Practices Handbook, FSH 2509.22.

- When machine piling, existing duff/litter will be retained as much as possible and not included in the activity slash piling.

- Coarse woody material will be retained within harvest units for nutrient cycling, maintaining soil moisture, soil stability, and other soil physical and biological properties. Drier habitat types have wood retention requirements of 7–15 tons/acre for Douglas-fir, grand fir, and ponderosa pine types. Moister habitat types require 17–33 tons/acre.

- For units with high subsurface erosion potential, the amount of excavated skid trails and landings will be limited to the extent possible, decommissioned (full recontour), and receive an application of large woody material for soil stabilization.

- In regeneration harvest areas, approximately 14–28 standing trees per acre will be retained for future down wood recruitment. Snags or other designated retention trees felled for safety reasons will be left in the unit.

1.3.1.2 Prescribed Fire

Fuel treatment includes broadcast burning (used in open canopy grass and shrub lands), jackpot burning (a type of broadcast burning to reduce high fuel areas and promote a mosaic burn pattern following harvest), and machine and hand fuels piling. Machine piling only occurs on ground-based harvest units and broadcast burning usually occurs on skyline yarded units. Jackpot burning can occur on either harvest type. The total acres for each treatment type are based on slash concentrations after harvest activities are complete but will be similar to the total acres of regeneration or improvement harvest. No burning will occur within commercial thin units. Burning of harvest activity generated slash will be designed in the project burn plan to provide a low-severity mosaic burn with little-to-no detrimental disturbance of soil resources. Slash will be allowed to overwinter prior to burning.

For legacy trees, burning objectives will strive for variable tree survival with almost all legacy trees surviving prescribed fire. Fuel reduction measures would be implemented where needed to insure survival of the legacy larch, ponderosa pine, and Douglas-fir.

For non-legacy trees, expected survival is 50 percent. For areas requiring 100 percent live canopy retention, the burn objective will be to prevent fire entry into these areas. Low-intensity fire may be allowed to back into the edges of some of these sensitive areas and would result in no less than 90 percent live-canopy retention for the area.

The design features or BMPs listed below are proposed to restrict activity in RHCAs, and minimize the risk of unintentional high severity burns.

- No ignition will occur in PACFISH buffers but prescribed fire will be allowed to back burn into these areas.

- Burning will be done under moderate conditions that minimize the risk of a high severity burn including: air temperature less than 85 degrees, wind speed less than 10 miles per hour, and a relative humidity range between 17 percent and 57 percent.

- Burn units will be divided into smaller units than those appearing on the map and ignition will occur on ridge tops first and continue in the downhill direction in order to prevent heat buildup and reduce fire severity.

- Prescribed fire would not be ignited in areas requiring 100 percent live canopy retention.

Water drafting (pumping) in the action area streams may be necessary for providing water for prescribed burning. The procedures and BMPs for water pumping from streams is described below in the Water Pumping Section.

1.3.1.3 Weed Treatment

Areas most susceptible to weed introduction include roadways, landings, and skid trails. To minimize the spread of noxious weeds and invasive plants, all equipment will be cleaned of loose debris prior to entering the action area. The use of herbicides is not proposed. Following activities, project-related exposed soils (i.e., landings, skid trails, road sides, etc.) will be re-vegetated using certified noxious weed free native seed mix and fertilizer (as necessary) upon project completion.

1.3.1.4 Haul

There will be 83 MMBF of logs hauled from the action area over a period of 5 to 9 years. Because timber contracts will be awarded over a 6-year period and typically takes 4 years to complete a contract, the total time for harvest and haul is likely to occur over a 9-year period until 2028. Roads proposed for haul that are currently open or closed will continue their open or closed status following haul. Many roads will service a single timber sale while the primary routes, routes with haul over 1 MMBF, will service more than one location or sale. Table 2 outlines the amount of miles, round trips, and expected years of use for primary haul routes; Figure 3 shows these primary routes in the action area. For the three main haul routes leaving the NFS boundary, the Kooskia Road 286 is estimated to be used to haul 40 MMBF or 48 percent of the haul, the Clearwater Road 650 estimated at 9 MMBF or 11 percent, and the Lighting Creek Road 1106 estimated at 34 MMBF or 41 percent of the haul. Log haul would occur during dry or frozen conditions with most occurring between the months of June and September. About 16 miles of all haul roads on Forest managed lands occur within RHCAs and cross streams.

Table 2. Primary haul routes and estimated use.

Haul Road # (HUC 12s)	Haul Road Miles	MMBF Hauled	Maximum Estimated No. of Trips1	Loads Per Day June-Sept	Assumed Time Period of Use (# Years)
Kooskia-Road 286 Route Total	45.6	40	7600	-	-
286 Upper Clear Creek Lower Clear Creek	23	20	3800	10	5
1114 Upper Clear Creek	6.2	8	1500	17	1
9730 Upper Clear Creek	6.5	9	1700	20	1
1855 South Fork Clear Creek	9.9	3	600	8	1
Clearwater-Road 650 Route Total	7.8	9	1800	-	-
650-North Lower Clear Creek Rabbit Cr- SF Clearwater River	7.8	9	1800	11	2
Lightening Creek-Road 1106 Route Total	19.1	34	6800	-	-
650-South Lower Clear Creek	1.8	3	600	15	0.5
1106 –Clear-Cr Lower Clear Creek	5.9	10	2000	10	2.5
1160 Lower Clear Creek	1.5	1	200	5	0.5
1106 –South-Fork Rabbit Cr- SF Clearwater R Lightning Cr- SF Clearwater R	9.9	20	4000	16	3
Total for all primary haul routes	73	83	16200	-	10

1. Round trips are based on a haul truck carrying capacity of approximately 5,000 board feet.

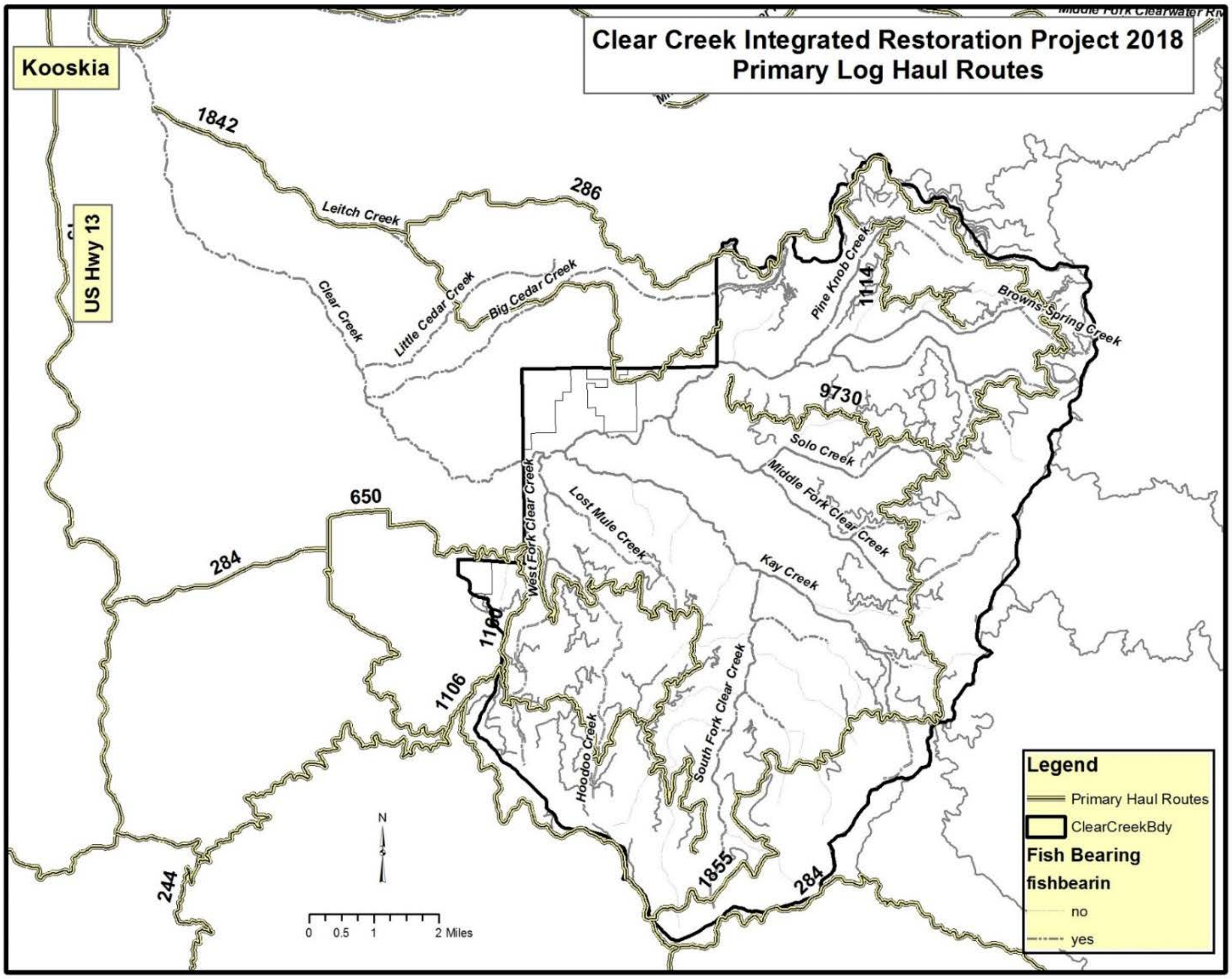

Figure 3. Map of primary haul routes. The Forest Service land boundary is in outlined in black.

Haul routes exiting National Forest System (NFS) lands are generally paved with a few exceptions. The paved roads include the Roads 1842, 286, 284, and US Highways 12 and 13 (Figure 3) and Road 515 (Clear Creek Road; not in Figure 3). Portions of haul roads that leave the NFS boundary and are gravel include 4.3 miles of Road 1842 with one crossing over Big Cedar Creek and another over a small tributary to Big Smith Creek, 4.4 miles of Road 650 with three crossings, 9.9 miles of Road 1106 with seven stream crossings. Road 1106 is adjacent to Green Creek for the lower 1.4 miles; this section of Green Creek is steelhead critical habitat and drains in the South Fork of the Clearwater River.

Dust abatement will be applied to haul routes in any year the road is used for haul. Dust abatement is applied to maintain visibility for drivers and minimize sediment delivery to streams. Typically, magnesium chloride is used for dust abatement on graveled haul routes where harvest volumes exceed one million board feet (Roads 286, 650, 1106, 1114, 1160, 1855, and 9730). When applied to the road surface, a 1-foot no-spray buffer is left on the edges of the road, if road width allows, to minimize overspray into ditches which could contaminate streams. Because the application of magnesium chloride is expensive and water is effective for dust abatement for short durations, haul routes that will be used for short durations with less traffic may receive water for dust abatement. These include most of the 40 miles of graveled and 34 miles of native surfaced roads.

Water drafting (pumping) in the action area streams may be necessary for providing water for dust abatement. The procedures and BMPs for water pumping from streams are described below in the Water Pumping Section.

1.3.1.5 Water Pumping

Water drafting needed for dust abatement and project related burning activities would occur. There are no predesignated sites; however when water is used, any drafting sites will be approved by a fisheries biologist or hydrologist. Typical locations are small, non-fish bearing headwater streams with relatively low flow. A typical technique is for culverts to be partially blocked with boards and visqueen in order to create small pools for pumping water. Culverts are not blocked in their entirety allowing water to flow over the top of the boards. Water is pumped into tank trucks for use on roads and during burning operations. Filling firefighting engines would often occur at the Ranger Station; however sites near treatment areas may also be used. The equipment used to remove water from streams will meet NMFS screening criteria (NMFS 2011). All materials are removed upon completion of the withdrawal activities.

Guidelines found in NMFS' Anadromous Salmonid Passage Facility Design (NMFS 2011) will be utilized for all water pumping activities associated with dust abatement and fire safety. A qualified fisheries biologist will inspect all pumping locations. In addition to the guidelines (NMFS 2011), BMPs for pumping are as follows:

- Undercut banks will not be exposed, and connected flow at and below pump sites will be maintained.
- Upstream and downstream juvenile and adult passage will be maintained.
- No more than 20 percent of streamflow shall be pumped.
- Instream withdrawal sites will be constructed such that they minimize streambed alteration.
- Pump intakes will be screened with 3/32-inch plate screen or equivalent to avoid entrainment and/or intake of juvenile fish and amphibians as prescribed in NMFS (2011).
- Spill containment materials for portable pumps, such as absorbent diapers, spill kits, or physical containment, will be required on site.
- Individual gas can capacity will not exceed 5 gallons, with no more than 10 gallons total, when stored in riparian areas to facilitate refueling of portable pumps.

1.3.1.6 Petroleum Fuels

Machinery is used in harvest and road work activities and will require fuel and maintenance to operate. The BMPs to reduce the chance of petroleum products entering the water and causing harm to ESA-listed fish from harvest and road machinery are listed at end of the Proposed Road Work section (Section 1.3.2).

1.3.2 Proposed Road Work

The NPCNF proposes to recondition, reconstruct, and decommission roads, and construct new, temporary roads (Table 3). Primary components of these activities are described below.

Table 3. Proposed road work by subwatershed (HUC 12). Road columns are in miles and culvert columns are in number of culverts.

Subwatershed	Reconditioning and Reconstruction			Temporary	Decomissioning	
	Recondition	Reconstruction	Stream Culvert Replacements	Road Construction	Decommission	Culvert Removals
Clear Creek	3.9	4.8	9	6.3	0.6	0
Hoodoo Creek	9.4	16.1	14	9.2	0.8	0
South Fork Clear Creek	5.2	17.3	24	5.4	0	0
Kay Creek	0.5	4.9	6	0.7	0.9	0
Middle Fork Clear Creek	1.5	3.9	3	3.5	0.9	1
Pine Knob Creek	4.4	5.7	2	0.3	2.6	0
Brown Springs Creek	5.7	12.3	4	3.1	4.5	5
Solo Creek	1.9	6.7	4	1.9	1.4	1
Big Cedar Creek	1.5	3.6	0	2.9	1.5	6
Lower Clear Cr Face - Forest	0	0	0	0.3	0	0
Private	1.6	1.5	0	0	0	0
Total	**35.6**	**76.8**	**66**	**33.6**	**13.2**	**13**

1.3.2.1 New Temporary Roads

The NPCNF proposes 33.6 miles of temporary roads to access timber harvest units. Four miles of these temporary roads will be built on existing road templates. These existing roads have been opened, will be used for haul as “temporary roads,” and decommissioned after use. The decommissioning of these existing roads has already undergone consultation. New temporary roads will be built on or near ridge-tops and will not cross streams, so stream crossing construction is not required. New roads will be narrower than existing system roads to reduce the size of the footprint on the landscape. All temporary roads, including any non-system roads used, would be constructed, or reconstructed, and obliterated within 4 years. Obliteration includes de-compaction, re-contouring where needed and the application of woody material onto the de-compacted surfaces to provide for soil productivity and limit erosion potential. Temporary roads built on existing templates will be stabilized using recontouring or decompaction. If overwintered, roads would be placed in a hydrologically stable condition to limit erosion and motorized access would be prevented.

1.3.2.2 Road Reconditioning and Reconstruction

Road reconstruction and reconditioning will occur on roads proposed for haul. The amount of road preparation needed for haul can vary. System roads currently maintained for haul may require none or very little maintenance. Proposed haul roads that have been closed for decades may be overgrown with trees and require full reconstruction. Road preparation can be partial or discontinuous, and every element of reconditioning or reconstruction will not be needed for the full length of every mile of proposed haul road. There are seven timber sales proposed and road preparation will occur the year before, or year of, the timber sale. Ongoing maintenance of haul routes is commensurate with use.

Up to 35.6 miles of road will be reconditioned and involves general road maintenance on existing roads that are used for log hauling. It includes roadside brushing, blading, ditch cleaning and spot placement of aggregate where currently absent and is designed to provide for safe passage of vehicles and road surface erosion control.

Up to 76.8 miles of road will be reconstructed and can include culvert replacements or upgrades, the addition of cross drain structures near stream crossings, application of surface aggregate gravel materials, and road realignment or reshaping. Adding crossdrains minimizes sediment delivery to streams by diverting water to the forest floor where sediment is filtered out. New crossdrains will be placed within 200 feet of stream crossings to minimize the length of road surface draining to stream crossings. Other crossdrains may be added as needed to reduce cumulative ditch flow. On reconstructed road segments, cross drains would be installed prior to road prism shaping and ditch reconstruction activities that are upslope of the new cross drain sites, such that sediment generated from these activities would not drain to the stream. None of the 66 stream crossing culvert replacements occur on fish-bearing streams and will not require fish salvage. Although only one culvert replacement is within 600 feet of critical habitat (South Fork Clear Creek), six culvert replacements will be monitored for turbidity. Turbidity monitoring is part of the monitoring plan to help characterize effects from the project and to reduce sediment transport to critical habitat. Steelhead have not been observed at these six sites over the past 4 years. These six culvert replacements will be monitored for turbidity during replacement and will occur after July 15 to take advantage of the lower flows and reduced potential for sediment transport. The BMPs for road reconditioning, reconstruction, decommissioning, and culvert work are similar and described below.

1.3.2.3 Road Decommissioning

The NPCNF proposes to decommission 13.2 miles of unneeded roads. Decommissioning improves hydrologic and soil function and can range from full recontouring to match the adjacent hillslope to abandonment. Proposed decommissioning will include the removal of 13 culverts and reshaping, to match the surrounding terrain, of any stream, seep, or wetland crossing where they occur.

Road decommissioning includes activities that result in improved hydrologic and soil function in the watershed. It includes the removal and reshaping of any stream, seep, or wetland crossing where they occur on roads that are decommissioned. The NPCNF will decommission 13.2 miles of road, and each road will receive a site specific prescription depending on characteristics such as the size of cuts and fills, hill slopes, and erosion risks. Prescriptions may include the following:

- Removing any metal culverts and other drainage structures and associated fills.
- Pulling up fill material where there are existing or potential failures, or where the fill is determined to be unstable. Treatments along stream crossings require a complete recontour of all fill material and with stream channels restored to natural grade and dimensions.
- Laying entire or selected portions of the road to original contours or the angle of repose of the fill material.
- Out-sloping the road surface.
- Diverting streams via temporary culvert or non-eroding, water-tight diversion. Settling basins or other methods will be used to ensure that muddy water does not return to the streams. Diversions will be installed, operated, and removed such that erosion and sedimentation are minimized.
- Removing gates after applying wood and rock debris across the de-compacted road surface to prevent vehicle usage.

1.3.2.4 Culvert Replacement and Removal

The NPCNF will replace 66 stream crossing culverts on haul routes and remove 13 culverts during road decommissioning. The NPCNF and its contractors will integrate the following conservation measures/BMP during all road work near and in streams (including culvert removals and the culvert replacements noted above), to minimize potential adverse effects on ESA-listed species and their critical habitat:

Culverts and Bare Soils

- Instream work will occur after July 15 for the six culvert replacements monitored for turbidity.
- Removable sediment traps will be placed below work areas to trap fines.
- When working instream, all fill around pipes will be removed prior to bypass and pipe removal.
- Install and operate stream diversions such that erosion and sedimentation is minimized.

- Work sites will be dewatered prior to culvert removal and rewatered slowly following completion of culvert work.

- Erosion control mats will be used on stream channel slopes and slides.

- Decommissioned stream crossings will be recontoured and banks reinforced with onsite materials.

- Replacement culvert inlets and outlets will be stabilized using log or rock weirs or armoring.

- Construct erosion control features, such as ditch relief culverts and sediment detention basins, and perform erosion control measures such as rocking ditches.

- Halt construction during heavy precipitation events to reduce potential sediment.

- Dispose of removed culverts, fill material, and other structural materials off NFS ground and away from live water.

- Disturbed soils will be re-vegetated with weed-free grasses for short-term erosion protection and with shrubs and trees for long-term soil stability.

- Bare soils will receive mulching with native materials, where available, or using weed-free straw to ensure coverage of exposed soils.

Fuels

- Fuels will be stored outside of RHCAs.

- All motorized equipment (including chainsaws and other hand power tools) will be fueled and serviced at least 100 feet away from streams in an area that will not deliver fuel, oil, etc. to riparian areas and streams.

- All equipment used in the stream and in riparian areas will be cleaned of external oil, dirt and mud; and repair abnormal leaks prior to arriving at the project site.

- Equipment with leaking fluids will not be used and fluid leaks will be repaired immediately.

- For road work, absorbent material manufactured for containment and cleanup of hazardous material will be kept on the job site.

- The Contracting Officer will be notified of hazardous spills.

The NPCNF will obtain any required permits for disturbance of water or wetlands prior to initiating work (Army Corps of Engineers 404 permit, Idaho Department of Water Resources Stream Alteration

Permit). All related permit mitigation measures/BMP practices will be incorporated into project plans and contractor specifications.

1.3.3 Monitoring

The following implementation and effectiveness monitoring plan, as taken from the BA, has been incorporated into the proposed action:

The purpose of the monitoring plan is to determine if harvest and/or road improvement activities are contributing enough sediment to the stream to cause changes to channel morphology and/or degradation of habitat quality for steelhead. For the transect station at the NFS boundary, this plan evaluates potential changes to the physical habitat (e.g., spawning gravels), the physical processes (e.g., channel aggradation) and stream temperature and turbidity. The transect monitoring station is located where intrinsic potential for steelhead is very high. This station, and all other monitoring stations, are pictured in Figure 4.

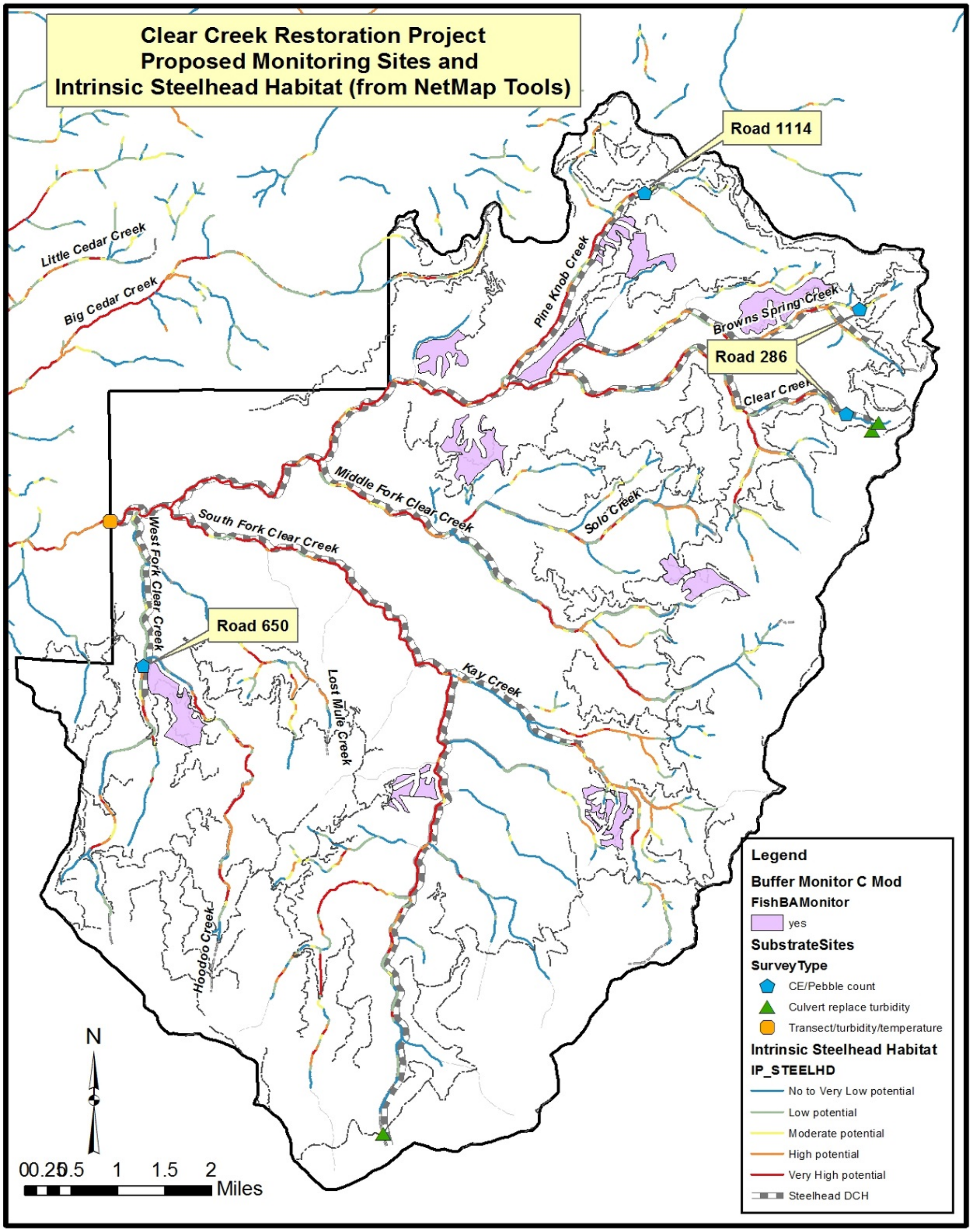

Figure 4. All monitoring stations. The orange dot at the Forest boundary will have comprehensive transect monitoring to detect changes in physical stream characteristics. Blue pentagon symbols are cobble embeddedness monitoring sites. Green triangles are culvert replacement sites with turbidity monitoring.

1.3.3.1 Transect Monitoring Station at the Forest Boundary

The variables that will be monitored at the NFS boundary station (Figure 4) are stream channel physiography, water temperature, stream bed surface substrate, cobble embeddedness, and fish presence and abundance.

- Stream channel physiography: The bases for these measurements are described in Harrelson, et al. (1994).
    - This monitoring station has three (3) monumented cross-sections. The cross-sections are spaced 100 feet apart (measured at the thalweg).
    - The monitoring station has one thalweg/longitudinal profile, starting at the downstream monumented cross-section, and extending upstream for a distance of 500 feet. The endpoint of the thalweg/longitudinal profile is monumented.
    - Stream discharge will be measured each year that channel physiography is measured (this is necessary for calibrating Manning's roughness coefficient; needed for calculating sediment transport capacity).
- Stream bed surface substrate
    - Bed surface substrate is measured using a modified Wolman Pebble Count procedure described in Harrelson, et al. (1994). The modifications are as follows:
        - Pebbles are measured in a zig-zag pattern, starting at the downstream monumented cross-section, and continuing to the upstream end of the monumented thalweg/longitudinal profile.
        - Measurements of the medial axis are measured and recorded to the nearest millimeter (mm); not tallied into Wentworth phi-classes.
        - A minimum of 300 particles will be measured at each station.
- Cobble embeddedness
    - Three measurements are conducted at each of the stream channel cross section locations (described above); taken at 25 percent, 50 percent, and 75 percent locations within the cross-section width. A total of nine (9) measurements will be taken at each station.
    - Measurements would be taken as described in Skille and King (1989).

- Temperature/Turbidity
    - Stream temperature and turbidity monitoring will occur in coordination with the U.S. Geological Survey. A cableway and temperature and turbidity monitoring instrument will be installed and data collected from April through October for a minimum of 5 years.
- Fish Presence and Abundance
    - Single pass snorkel surveys would be conducted in the same year that the stream channel physiography measurements are made.
    - The number and species observed would be recorded. The length and width of the snorkeled area would also be measured in order to determine area and calculate fish densities.
- Monitoring Frequency: this plan proposes both pre- and post-project monitoring timeframes.
    - Pre-project
        - The boundary transect site was measured and monitored in 2015 and 2016.
        - The site will be re-measured at least one additional time prior to the commencement of operations.
        - The temperature and turbidity instrument will be installed at the NFS boundary in 2019. Data collection will begin in the summer of 2019.
    - Post-project
        - Monitoring would occur on the following schedule: year-1 after project activities begin, every 5 years until all harvest is complete.
        - Temperature and turbidity monitoring at the NFS boundary will occur every year from April through October for a minimum of 5 years.

If the monitoring as described above indicates that a statistically significant change in cobble embeddedness, stream channel physiography, and/or streambed surface substrate has occurred, the change will be assessed by examination of anomalies in climate and/or precipitation that may have caused a bankfull or near bankfull flow event.

If this assessment indicates that changes may have occurred from implementation of project activities, the following would be conducted as soon as practicable (e.g. if snow conditions preclude access), in the order listed:

1. Field assessment of all implemented, ground disturbing activities to determine the source of any erosion and delivery of sediment to streams.

2. Compilation of a report to be submitted to NMFS and U.S. Fish and Wildlife Service (USFWS) within a month following the field assessment containing the results of this field assessment; and

3. Re-initiation of consultation for some or all of the remaining, unimplemented activities if consensus opinion of the Central Idaho Level 1 Team deems it necessary, prior to implementation of these activities.

1.3.3.2 Implementation/Effectiveness Monitoring

1. PACFISH implementation monitoring would be conducted annually by the NPCNF fisheries biologist in conjunction with BMP audits. Monitoring would be conducted on randomly selected treatment units throughout the NPCNF. Results would be made publicly available on the NPCNF's website. Both implementation and effectiveness of treatments would be monitored. Additional monitoring of sediment movement through RHCAs would be conducted in Clear Creek. The focus of the monitoring would be measuring whether or not sediment travels from harvested and burned units into RHCAs and also how far the sediment travels, and whether or not it reaches a stream. This monitoring would be conducted on portions of the following regeneration harvest units after burning of the units has occurred: #103, 109, 141, 142, 145,155, 160, 214, 218, and 315.

2. Implementation monitoring of road reconstruction and reconditioning activities would occur on all reconstructed segments on which log haul occurs or is planned to occur, to verify that timing of reconstruction activities adheres to times shown in Figure 2 in the BA, and that implementation of proposed activities and design features has corrected current sources of sediment and reduced it. Haul roads are surveyed prior to haul to identify safety and sediment issues. These issues are corrected prior to haul using road design features such as installation of crossdrains, culvert replacements, and surface gravelling. A complete list of these design features can be found in the BA under the Proposed Road Work section.

3. Steelhead and turbidity monitoring at six culvert replacement sites, one of which is in steelhead designated critical habitat, would occur during implementation. Of these six culverts, three are on Clear Creek and three are on the South Fork Clear Creek. These are shown on Figure 4 in the BA. Prior to work, a background turbidity will be taken above the culvert replacement site. During dewatering and rewatering, turbidity will be monitored within 600 feet downstream of the culvert replacement. If turbidity exceeds 50 nephelometric turbidity unit (NTU), work or rewatering will be slowed until turbidity is reduced to below 50 NTU.

4. Monitoring and inspections of haul road preparation, road conditions during haul and after wet weather, and harvest areas would be continuous throughout implementation

of the Project. Specific and more regular inspections would occur on Roads 286, 650, 1106, and 1114. Haul inspections would occur regularly (approximately every few days) while active haul is occurring. The roads would be regularly inspected by a Sales Administrator during haul to ensure erosion is not occurring in an amount and location that would result in sediment delivery to streams. The contractors or a Sales Administrator would decide whether to cease haul during wet periods when haul trucks create ruts greater than 3 inches deep for 50 feet. Following the wet periods when haul is ceased, all active haul roads would be inspected for signs of potential environmental damage (PED) within 2 working days of roads becoming drivable and before haul resumes. Signs of PED are those with the potential to deliver sediment and are of a scale that requires repair by mechanical equipment. The PEDs include, but are not limited to, sediment delivery to a perennial stream, excessive ditch scour, or ditch or culvert blockage. Within the 2 working days of inspection, the contractor would be directed to correct the cause of the PED condition within 4 days following notification. A log that identifies all PEDs and documents NPCNF and contractor compliance during the corrective 4-day time frame would be kept.

5. Instream substrate monitoring associated with log haul would occur at a total of four sites, on Roads 1114 (Pine Knob), 286 (Brown Springs and Clear Creek), and 650 (West Fork Clear Creek) where these main haul routes cross on or upstream of steelhead designated critical habitat (Figure 4, above). Intrinsic steelhead habitat potential is moderate to low at the stream crossings to be monitored. The objective is to measure changes in cobble embeddedness and substrate composition using Wolman pebble counts (particularly fines <6 mm) that may be associated with log haul activities. If negative changes are occurring, actions would be taken to assess the entry location and address the haul or road design criteria if necessary. All sampling sites occur in designated critical habitat in a response reach ranging from 3 percent to 4 percent stream gradient. Monitoring would be conducted once per year in the early summer when hauling occurs on the road. This would allow time for data analysis and resolution of identified problems prior to the fall rains and next hauling season. Monitoring would be conducted for 5 years. Monitoring at any of these stations will be discontinued if a natural sedimentation event, such as a landslide, precludes detection of project related sediment effects. If project related sediment effects are detected, the source will be determined and corrective actions taken to limit the sediment source. Results and information on any corrective actions would be provided to NMFS and USFWS annually.

6. Cross drain culvert monitoring would occur on Forest Roads 650 and 286, the two primary routes used for harvest hauling and access activities. The intent of the monitoring is to demonstrate the effectiveness of the cross drains in directing road related sediment away from live stream crossings. Monitoring would include identification of all cross drains on these two roads, measurement of the width and length of any sediment track leading from the cross drain downhill, and whether or not the sediment track reached a live stream. Where delivery was observed, additional measures would be taken to alleviate the delivery. Initial measurements were collected in 2018 and would be repeated on the segments of road where haul is

occurring 2 years after hauling activities begin. Measurements would be taken in late spring/early summer in order to determine if drainage improvements are needed prior to fall season rains. If sediment is found to reach a stream, drainage improvements would be implemented to alleviate further delivery. There are over 200 cross drains on Road 286 and over 150 on Road 650. Initial measurements in 2018 found no detectable delivery to streams.

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 RPMs and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This 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 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 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 reasonable and prudent alternatives 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.

This opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds that make up the designated area, and discusses the current function of the essential PBF that help to form that conservation value. The designation of critical habitat for steelhead (70 FR 52630) use the phrase PCE to identify features essential to the conservation of the species. New critical habitat regulations (81 FR 7214) replace this with PBF, the current terminology used to define critical habitat under the ESA. In this opinion, we use the term PBF to mean PCE.

Table 4. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register decision notices for ESA-listed species considered in this Opinion.

Species	Listing Status	Critical Habitat	Protective Regulations
Steelhead (*O. mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Note: Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered.

2.2.1 Status of the Species

This section describes the present condition of the Snake River Basin steelhead distinct population segment (DPS). NMFS expresses the status of a salmonid evolutionarily significant units (ESU) or DPS in terms of likelihood of persistence over 100 years (or risk of extinction over 100 years). NMFS uses McElhaney et al.'s (2000) description of a viable salmonid population (VSP) that defines "viable" as less than a 5 percent risk of extinction within 100 years and "highly viable" as less than a 1 percent risk of extinction within 100 years. A third category, "maintained," represents a less than 25 percent risk within 100 years (moderate risk of extinction). To be considered viable a DPS should have multiple viable populations so that a single catastrophic event is less likely to cause the DPS to become extinct, and so that the DPS may function as a metapopulation that can sustain population-level extinction and recolonization processes (ICTRT 2007). The risk level of the DPS is built up from the aggregate risk levels of the individual populations and major population groups (MPGs) that make up the DPS.

Attributes associated with a VSP are: (1) abundance (number of adult spawners in natural production areas), (2) productivity (adult progeny per parent), (3) spatial structure, and (4) diversity. A VSP needs sufficient levels of these four population attributes in order to: safeguard the genetic diversity of the listed ESU or DPS; enhance its capacity to adapt to various environmental conditions; and allow it to become self-sustaining in the natural environment (ICTRT 2007). These viability attributes are influenced by survival, behavior, and experiences throughout the entire salmonid life cycle, characteristics that are influenced in turn by habitat and other environmental and anthropogenic conditions. The present risk faced by the DPS informs NMFS' determination of whether additional risk will appreciably reduce the likelihood that the DPS will survive or recover in the wild.

2.2.1.1 Snake River Basin Steelhead

The Snake River Basin steelhead was listed as a threatened ESU on August 18, 1997 (62 FR 43937), with a revised listing as a DPS on January 5, 2006 (71 FR 834). This DPS occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Reasons for the decline of this species include substantial modification of the seaward migration corridor by hydroelectric power development on the mainstem Snake and Columbia Rivers, and widespread habitat degradation and reduced streamflows throughout the Snake River basin (Good et al. 2005). Another major concern for the species is the threat to genetic integrity from past and present hatchery practices, and the high proportion of hatchery fish in the aggregate run of Snake River Basin steelhead over Lower Granite Dam (Good et al.

2005; Ford 2011). On May 26, 2016, in the agency's most recent 5-year review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as threatened (81 FR 33468).

Life History. Adult Snake River Basin steelhead enter the Columbia River from late June to October to begin their migration inland. After holding over the winter in larger rivers in the Snake River basin, steelhead disperse into smaller tributaries to spawn from March through May. Earlier dispersal occurs at lower elevations and later dispersal occurs at higher elevations. Juveniles emerge from the gravels in 4 to 8 weeks, and move into shallow, low-velocity areas in side channels and along channel margins to escape high velocities and predators (Everest and Chapman 1972). Juvenile steelhead then progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juveniles typically reside in fresh water for 1 to 3 years, although this species displays a wide diversity of life histories. Smolts migrate downstream during spring runoff, which occurs from March to mid-June depending on elevation, and typically spend 1 to 2 years in the ocean.

Spatial Structure and Diversity. This species includes all naturally-spawning steelhead populations below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho, as well as the progeny of six artificial propagation programs (71FR834). The hatchery programs include Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater River, East Fork Salmon River, Tucannon River, and the Little Sheep Creek/Imnaha River steelhead hatchery programs. The Snake River Basin steelhead listing does not include resident forms of *O. mykiss* (rainbow trout) co-occurring with steelhead.

The Interior Columbia Technical Recovery Team (ICTRT) identified 24 extant populations within this DPS, organized into five MPGs (ICTRT 2003). The ICTRT also identified a number of potential historical populations associated with watersheds above the Hells Canyon Dam complex on the mainstem Snake River, a barrier to anadromous fish migration. The five MPGs with extant populations are the Clearwater River, Salmon River, Grande Ronde River, Imnaha River, and Lower Snake River. In the Clearwater River, the historic North Fork population was blocked from accessing spawning and rearing habitat by Dworshak Dam. Current steelhead distribution extends throughout the DPS, such that spatial structure risk is generally low. For each population in the DPS, Table 5 shows the current risk ratings for the parameters of a viable salmonid population (spatial structure, diversity, abundance, and productivity).

Table 5. Summary of viable salmonid population parameter risks and overall current status for each population in the Snake River Basin steelhead DPS (NWFSC 2015). Risk ratings with "?" are based on limited or provisional data series.

MPG	Population	VSP Risk Parameter: Abundance/ Productivity	VSP Risk Parameter: Spatial Structure/ Diversity	Overall Viability Rating
Lower Snake River	Tucannon River	High?	Moderate	High Risk?
	Asotin Creek	Moderate?	Moderate	Maintained?
Grande Ronde River	Lower Grande Ronde	N/A	Moderate	Maintained?
	Joseph Creek	Very Low	Low	**Highly Viable**
	Wallowa River	N/A	Low	Maintained?
	Upper Grande Ronde	Low	Moderate	**Viable**
Imnaha River	Imnaha River	Moderate?	Moderate	Maintained?
Clearwater River (Idaho)	Lower Mainstem Clearwater River*	Moderate?	Low	Maintained?
	South Fork Clearwater River	High?	Moderate	High Risk?
	Lolo Creek	High?	Moderate	High Risk?
	Selway River	Moderate?	Low	Maintained?
	Lochsa River	Moderate?	Low	Maintained?
	North Fork Clearwater River			*Extirpated*
Salmon River (Idaho)	Little Salmon River	Moderate?	Moderate	Maintained?
	South Fork Salmon River	Moderate?	Low	Maintained?
	Secesh River	Moderate?	Low	Maintained?
	Chamberlain Creek	Moderate?	Low	Maintained?
	Lower Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Upper Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Panther Creek	Moderate?	High	High Risk?
	North Fork Salmon River	Moderate?	Moderate	Maintained?
	Lemhi River	Moderate?	Moderate	Maintained?
	Pahsimeroi River	Moderate?	Moderate	Maintained?
	East Fork Salmon River	Moderate?	Moderate	Maintained?
	Upper Mainstem Salmon R.	Moderate?	Moderate	Maintained?
Hells Canyon	Hells Canyon Tributaries			*Extirpated*

*Current abundance/productivity estimates for the Lower Clearwater Mainstem population exceed minimum thresholds for viability, but the population is assigned moderate risk for abundance/productivity due to the high uncertainty associated with the estimate.

The Snake River Basin DPS steelhead exhibit a diversity of life-history strategies, including variations in fresh water and ocean residence times. Traditionally, fisheries managers have classified Snake River Basin steelhead into two groups, A-run and B-run, based on ocean age at return, adult size at return, and migration timing. A-run steelhead predominantly spend 1-year in the ocean; B-run steelhead are larger with most individuals returning after 2 years in the ocean. New information shows that most Snake River populations support a mixture of the two run types, with the highest percentage of B-run fish in the upper Clearwater River and the South Fork Salmon River; moderate percentages of B-run fish in the Middle Fork Salmon River; and very low percentages of B-run fish in the Upper Salmon River, Grande Ronde River, and Lower Snake River (NWFSC 2015). Maintaining life history diversity is important for the recovery of the species.

Diversity risk for populations in the DPS is either moderate or low. Large numbers of hatchery steelhead are released in the Snake River, and the relative proportion of hatchery adults in natural spawning areas near major hatchery release sites remains uncertain. Moderate diversity risks for some populations are thus driven by the high proportion of hatchery fish on natural spawning grounds and the uncertainty regarding these estimates (NWFSC 2015). Reductions in hatchery-related diversity risks would increase the likelihood of these populations reaching viable status.

Abundance and Productivity. Historical estimates of steelhead production for the entire Snake River basin are not available, but the basin is believed to have supported more than half the total steelhead production from the Columbia River basin (Mallet 1974, as cited in Good et al. 2005). Historical estimates of steelhead passing Lewiston Dam (removed in 1973) on the lower Clearwater River were 40,000 to 60,000 adults (Ecovista et al. 2003), and the Salmon River basin likely supported substantial production as well (Good et al. 2005). In contrast, at the time of listing in 1997, the 5-year mean abundance for natural-origin steelhead passing Lower Granite Dam, which includes all but one population in the DPS, was 11,462 adults (Ford 2011). Counts have increased since then, with between roughly 23,000 and 44,000 adult wild steelhead passing Lower Granite Dam in the 5-year period summarized in the most recent status review (2011–2015) (NWFSC 2015). However, the average of the last 2 years for natural-origin steelhead passing Lower Granite Dam was 9,078 a precipitous drop from the previous 5-year average of 30,667 (ODFW and WDFW 2019).

Population-specific abundance estimates exist for some but not all populations. Of the populations for which we have data, three (Joseph Creek, Upper Grande Ronde, and Lower Clearwater) are meeting minimum abundance/productivity thresholds and several more have likely increased in abundance enough to reach moderate risk. Despite these recent increases in abundance, the status of many of the individual populations remains uncertain, and four out of the five MPGs are not meeting viability objectives (NWFSC 2015). In order for the species to recover, more populations will need to reach viable status through increases in abundance and productivity.

Limiting factors for recovery of the DPS include:

- Adverse effects related to the mainstem Columbia and Snake River hydropower system and modifications to the species' migration corridor.

- Genetic diversity effects from out-of-population hatchery releases. Potential effects from high proportion of hatchery fish on natural spawning grounds.

- Degraded fresh water habitat.

- Harvest related effects, particularly B-run steelhead.

- Predation in the migration corridor.

Currently, the Clearwater River steelhead MPG does not meet the MPG-level viability criteria. All five extant populations are presently at moderate risk (Lower Mainstem Clearwater, Selway, and Lochsa Rivers) or high risk (Lolo Creek, South Fork Clearwater River) of extinction within 100 years, primarily due to moderate or high abundance and productivity risk. At least three of the MPG's populations must be viable and one must be highly viable for the MPG to meet the viability criteria. The Lower Mainstem Clearwater population is the only extant large population in the MPG and must reach at least low risk status for the MPG to reach viable status. Limiting factors to the MPG are included in the population discussion below.

The proposed action will occur in the Clear Creek watershed, which is occupied by the Lower Clearwater Mainstem steelhead population.

Abundance and Productivity. Current abundance/productivity estimates for the Lower Clearwater Mainstem population exceed minimum thresholds for low risk status, but the population is assigned moderate risk for abundance/productivity due to the high uncertainty associated with the estimate (NWFSC 2015).

Spatial Structure. Clear Creek is one of six major spawning areas for the population. Current spawning is distributed widely across the population and is presumed to occur in all major and most minor spawning areas. Based on the extensive branching of currently occupied habitat, the spatial structure risk for this population is very low, which is adequate for this population to reach its proposed status (NWFSC 2015).

Diversity. Although there is no within-population hatchery program in this population, large numbers of hatchery fish share the mainstem Clearwater migration corridor with this population, and hatchery fish may stray into spawning areas such as Clear Creek. There is some diversity risk associated with the high degree of uncertainty regarding the contribution of those hatchery fish to natural spawning. The cumulative diversity risk for this population is low, but the risk rating could be increased to moderate, pending a more in-depth assessment of the potential hatchery-origin component of natural spawners and of selective impacts from recreational harvest. A low diversity risk is adequate for this population to reach its proposed status (NWFSC 2015).

Limiting Factors. Elevated summer water temperatures, low summer stream flows, and loss of habitat complexity are likely to be the most significant factors affecting steelhead production in the population area as a whole (NMFS 2017). Other potential limiting factors relevant to Clear Creek and the proposed action are degraded floodplain connectivity and function from development (NMFS 2017).

2.2.2 Status of Critical Habitat

In evaluating the condition of designated critical habitat, NMFS examines the condition and trends of physical and biological features (PBFs) which are essential to the conservation of the ESA-listed species because they support one or more life stages of the species. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish. Modification of PBFs may affect freshwater spawning, rearing or migration in the action area. Generally speaking, sites required to support one or more life stages of the ESA-listed species (i.e., sites for spawning, rearing, migration, and foraging) contain PBF essential to the conservation of the listed species (e.g., spawning gravels, water quality and quantity, side channels, or food) (Table 6).

Table 6. Types of sites, essential physical and biological features, and the species life stage each PBF supports.

Site	Essential Physical and Biological Features	Species Life Stage
Snake River Basin Steelhead[a]	**Snake River Basin Steelhead**[a]	**Snake River Basin Steelhead**[a]
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
Freshwater rearing	Water quality and forage[b]	Juvenile development
Freshwater rearing	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival

[a] Additional PBFs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River steelhead and Middle Columbia steelhead. These PBFs will not be affected by the proposed action and have therefore not been described in this Opinion.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.
[c] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Critical habitat was designated for Snake River Basin steelhead on September 2, 2005 (70 FR 52630). Specific stream reaches are designated within the Lower Snake, Salmon, and Clearwater River basins. Critical habitat includes the stream channel and water column with the lateral extent defined by the ordinary high-water line, or the bankfull elevation where the ordinary high-water line is not defined.

Spawning and rearing habitat quality in tributary streams in the Snake River varies from excellent in wilderness and roadless areas to poor in areas subject to intensive human land uses (NMFS 2015; NMFS 2017). Critical habitat throughout much of the Interior Columbia (which includes the Snake River and the Middle Columbia River) has been degraded by intensive agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer streamflows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in non-wilderness areas. Human land use practices throughout the basin have caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations.

Streamflows are substantially reduced by water diversions (NMFS 2015; NMFS 2017). Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). Reduced tributary streamflow has been identified as a major limiting factor for Snake River Basin steelhead in particular (NMFS 2017).

Many stream reaches designated as critical habitat for these species are listed on the Clean Water Act 303(d) list for impaired water quality, such as elevated water temperature (IDEQ 2011). Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures, such as some stream reaches in the Upper Grande Ronde. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Water quality in spawning and rearing areas in the Snake River has also been impaired by high levels of sedimentation and by heavy metal contamination from mine waste (e.g., IDEQ and EPA 2003; IDEQ 2001).

The construction and operation of water storage and hydropower projects in the Columbia River basin, including the run-of-river dams on the mainstem lower Snake and lower Columbia Rivers, have altered biological and physical attributes of the mainstem migration corridor. These alterations have affected juvenile migrants to a much larger extent than adult migrants. However, changing temperature patterns have created passage challenges for summer migrating adults in recent years, requiring new structural and operational solutions (i.e., cold water pumps and exit "showers" for ladders at Lower Granite and Lower Monumental dams). Actions taken since 1995 that have reduced negative effects of the hydrosystem on juvenile and adult migrants including:

- Minimizing winter drafts (for flood risk management and power generation) to increase flows during peak spring passage;
- Releasing water from storage to increase summer flows;
- Releasing water from Dworshak Dam to reduce peak summer temperatures in the lower Snake River;
- Constructing juvenile bypass systems to divert smolts, steelhead kelts, and adults that fall back over the projects away from turbine units;
- Providing spill at each of the mainstem dams for smolts, steelhead kelts, and adults that fall back over the projects;
- Constructing “surface passage” structures to improve passage for smolts, steelhead kelts, and adults falling back over the projects; and,
- Maintaining and improving adult fishway facilities to improve migration passage for adult salmon and steelhead.

The present condition of PBFs and the human activities that affect PBF trends within the action area are further described in the environmental baseline.

2.2.3 Climate Change Implications for ESA-listed Species and their Critical Habitat

Climate change is one factor affecting the rangewide status of Snake River Basin steelhead and aquatic habitat, including designated critical habitat for Snake River Basin steelhead and essential fish habitat for Pacific salmon. The United States Global Change Research Program reports average warming of about 1.3°F from 1895 to 2011, and projects an increase in average annual temperature of 3.3°F to 9.7°F by 2070 to 2099 (USGCRP 2014). Climate change has negative implications for designated critical habitats in the Pacific Northwest (Climate Impacts Group 2004; Scheuerell and Williams 2005; Zabel et al. 2006; ISAB 2007).

According to the Independent Scientific Advisory Board (ISAB), these effects pose the following impacts into the future:

- Warmer air temperatures will result in diminished snowpack and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season;

- With a smaller snowpack, watersheds will see their runoff diminished earlier in the season, resulting in lower stream flows in the June through September period. River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow; and

- Water temperatures are expected to rise, especially during the summer months when lower stream flows co-occur with warmer air temperatures.

These changes will not be spatially homogeneous across the entire Pacific Northwest. Low-lying areas are likely to be more affected. Climate change may have long-term effects that include, but are not limited to, depletion of important cold-water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.

Climate change is predicted to cause a variety of impacts to Pacific salmon and their ecosystems (Mote et al. 2003; Crozier et al. 2008a; Martins et al. 2012; Wainwright and Weitkamp 2013). The complex life cycles of anadromous fishes, including steelhead, rely on productive freshwater, estuarine, and marine habitats for growth and survival, making them particularly vulnerable to environmental variation. Ultimately, the effects of climate change on salmon and steelhead across the Pacific Northwest will be determined by the specific nature, level, and rate of change and the synergy between interconnected terrestrial/freshwater, estuarine, nearshore, and ocean environments.

The primary effects of climate change on Pacific Northwest salmon and steelhead include:

- Direct effects of increased water temperatures on fish physiology;

- Temperature-induced changes to stream flow patterns;

- Alterations to freshwater, estuarine, and marine food webs; and
- Changes in estuarine and ocean productivity.

While all habitats used by Pacific salmon and steelhead will be affected, the impacts and certainty of the change vary by habitat type. Some effects (e.g., increasing temperature) affect salmon and steelhead at all life stages in all habitats, while others are habitat-specific, such as stream-flow variation in freshwater, sea-level rise in estuaries, and upwelling in the ocean. How climate change will affect each stock or population of steelhead also varies widely depending on the level or extent of change, the rate of change, and the unique life-history characteristics of different natural populations (Crozier et al. 2008b). For example, a few weeks' difference in migration timing can have large differences in the thermal regime experienced by migrating fish (Martins et al. 2011).

Temperature Effects

Like most fishes, steelhead are poikilotherms (cold-blooded animals); therefore, increasing temperatures in all habitats can have pronounced effects on their physiology, growth, and development rates (see review by Whitney et al. 2016). Increases in water temperatures beyond their thermal optima will likely be detrimental through a variety of processes, including increased metabolic rates (and therefore food demand), decreased disease resistance, increased physiological stress, and reduced reproductive success. All of these processes are likely to reduce survival (Beechie et al. 2013; Wainwright and Weitkamp 2013; Whitney et al. 2016).

By contrast, increased temperatures at ranges well below thermal optima (i.e., when the water is cold) can increase growth and development rates. Examples of this include accelerated emergence timing during egg incubation stages, or increased growth rates during fry stages (Crozier et al. 2008a; Martins et al. 2011). Temperature is also an important behavioral cue for migration (Sykes et al. 2009), and elevated temperatures may result in earlier-than-normal migration timing. While there are situations or stocks where this acceleration in processes or behaviors is beneficial, there are also others where it is detrimental (Martins et al. 2012; Whitney et al. 2016).

Freshwater Effects

Climate change is predicted to increase the intensity of storms, reduce winter snow pack at low and middle elevations, and increase snowpack at high elevations in northern areas. Middle and lower-elevation streams will have larger fall/winter flood events and lower late-summer flows, while higher elevations may have higher minimum flows. How these changes will affect freshwater ecosystems largely depends on their specific characteristics and location, which vary at fine spatial scales (Crozier et al. 2008b; Martins et al. 2012). For example, within a relatively small geographic area (the Salmon River basin in Idaho), survival of some Chinook salmon populations was shown to be determined largely by temperature, while in others it was determined by flow (Crozier and Zabel 2006). The largest driver of climate-induced decline in salmon populations is projected to be the impact of increased winter peak flows, which scour the streambed and destroy salmon eggs (Battin et al. 2007). Steelhead will tend to be somewhat less affected than salmon by that change in timing of peak flow, given the later timed and shorter duration of steelhead egg incubation in stream substrates.

Certain steelhead populations inhabiting regions that are already near or exceeding thermal maxima will be most affected by further increases in temperature and, perhaps, the rate of the increases. The effects of altered flow are less clear and likely to be basin-specific (Crozier et al. 2008b; Beechie et al. 2013). However, river flow is already becoming more variable in many rivers, and is believed to negatively affect anadromous fish survival more than other environmental parameters (Ward et al. 2015). It is likely this increasingly variable flow is detrimental to multiple salmon and steelhead populations, and likely multiple other freshwater fish species in the Columbia River basin as well.

Stream ecosystems will likely change in response to climate change in ways that are difficult to predict (Lynch et al. 2016). Changes in stream temperature and flow regimes will likely lead to shifts in the distributions of native species and provide "invasion opportunities" for exotic species. This will result in novel species interactions, including predator-prey dynamics, where juvenile native species may be either predators or prey (Lynch et al. 2016; Rehage and Blanchard 2016). How juvenile native species will fare as part of "hybrid food webs," which are constructed from natives, native invaders, and exotic species, is difficult to predict (Naiman et al. 2012).

Estuarine Effects

In estuarine environments, the two big concerns associated with climate change are rates of sea level rise and water temperature warming (Wainwright and Weitkamp 2013; Limburg et al. 2016). Estuaries will be affected directly by sea-level rise: as sea level rises, terrestrial habitats will be flooded and tidal wetlands will be submerged (Kirwan et al. 2010; Wainwright and Weitkamp 2013; Limburg et al. 2016). The net effect on wetland habitats depends on whether rates of sea-level rise are sufficiently slow that the rates of marsh plant growth and sedimentation can compensate (Kirwan et al. 2010).

Due to subsidence, sea-level rise will affect some areas more than others, with the largest effects expected for the lowlands, like southern Vancouver Island and central Washington coastal areas (Verdonck 2006; Lemmen et al. 2016). The widespread presence of dikes in Pacific Northwest estuaries will restrict upward estuary expansion as sea levels rise, likely resulting in a near-term loss of wetland habitats for salmon and steelhead (Wainwright and Weitkamp 2013). Sea-level rise will also result in greater intrusion of marine water into estuaries, resulting in an overall increase in salinity, which will also contribute to changes in estuarine floral and faunal communities (Kennedy 1990). While not all anadromous fish species are highly reliant on estuaries for rearing, extended estuarine use may be important in some populations (Jones et al. 2014), especially if stream habitats are degraded and become less productive. Preliminary data indicate that some Snake River Basin steelhead smolts are feeding and actively growing as they migrate between Bonneville Dam and the ocean (Beckman et al. 2018).

Marine Effects

In marine waters, increasing temperatures are associated with observed and predicted poleward range expansions of fish and invertebrates in both the Atlantic and Pacific Oceans (Lucey and Nye 2010; Asch 2015; Cheung et al. 2015). Rapid poleward species shifts in distribution in response to anomalously warm ocean temperatures have been well documented in recent years, confirming this expectation at short time scales. Range extensions were documented in many species from southern California to Alaska during unusually warm water associated with "the blob" in 2014 and 2015 (Bond et al. 2015; Di Lorenzo and Mantua 2016) and past strong El Niño events (Pearcy 2002; Fisher et al. 2015).

Non-native species benefit from these extreme conditions to increase their distributions. Green crab recruitment increased in Washington and Oregon waters during winters with warm surface waters, including 2014 (Yamada et al. 2015). Similarly, Humboldt squid dramatically expanded their range during warm years of 2004–09 (Litz et al. 2011). The frequency of extreme conditions, such as those associated with El Niño events or "blobs" is predicted to increase in the future (Di Lorenzo and Mantua 2016).

Expected changes to marine ecosystems due to increased temperature, altered productivity, or acidification will have large ecological implications through mismatches of co-evolved species and unpredictable trophic effects (Cheung et al. 2015; Rehage and Blanchard 2016). These effects will certainly occur, but predicting the composition or outcomes of future trophic interactions is not possible with current models.

Wind-driven upwelling is responsible for the extremely high productivity in the California Current ecosystem (Bograd et al. 2009; Peterson et al. 2014). Minor changes to the timing, intensity, or duration of upwelling, or the depth of water-column stratification, can have dramatic effects on the productivity of the ecosystem (Black et al. 2015; Peterson et al. 2014). Current projections for changes to upwelling are mixed: some climate models show upwelling unchanged, but others predict that upwelling will be delayed in spring, and more intense during summer (Rykaczewski et al. 2015). Should the timing and intensity of upwelling change in the future, it may result in a mismatch between the onset of spring ecosystem productivity and the timing of steelhead entering the ocean, and a shift toward food webs with a strong sub-tropical component (Bakun et al. 2015).

Columbia River anadromous fish also use coastal areas of British Columbia and Alaska and midocean marine habitats in the Gulf of Alaska, although their fine-scale distribution and marine ecology during this period are poorly understood (Morris et al. 2007; Pearcy and McKinnell 2007). Increases in temperature in Alaskan marine waters have generally been associated with increases in productivity and salmon survival (Mantua et al. 1997; Martins et al. 2012), thought to result from temperatures that have been below thermal optima (Gargett 1997). Warm ocean temperatures in the Gulf of Alaska are also associated with intensified downwelling and increased coastal stratification, which may result in increased food availability to juvenile salmon along the coast (Hollowed et al. 2009; Martins et al. 2012). Predicted increases in freshwater discharge in British Columbia and Alaska may influence coastal current patterns (Foreman et al. 2014), but the effects on coastal ecosystems are poorly understood.

In addition to becoming warmer, the world's oceans are becoming more acidic as increased atmospheric COR2R is absorbed by water. The North Pacific is already acidic compared to other oceans, making it particularly susceptible to further increases in acidification (Lemmen et al. 2016). Laboratory and field studies of ocean acidification show it has the greatest effects on invertebrates with calcium-carbonate shells, and relatively little direct influence on finfish; see reviews by Haigh et al. (2015) and Mathis et al. (2015). Consequently, the largest impact of ocean acidification on salmon will likely be its influence on marine food webs, especially its effects on lower trophic levels, which are largely composed of invertebrates (Haigh et al. 2015; Mathis et al. 2015). Marine invertebrates fill a critical gap between freshwater prey and larval and juvenile marine fishes, supporting juvenile salmon growth during the important early-ocean residence period (Daly et al. 2009, 2014).

Uncertainty in Climate Predictions

There is considerable uncertainty in the predicted effects of climate change on the globe as a whole, and on the Pacific Northwest in particular, and there is also the question of indirect effects of climate change and whether human "climate refugees" will move into the range of salmon and steelhead, increasing stresses on their respective habitats (Dalton et al. 2013; Poesch et al. 2016).

Many of the effects of climate change (e.g., increased temperature, altered flow, coastal productivity, etc.) will have direct impacts on the food webs that species rely on in freshwater, estuarine, and marine habitats to grow and survive. Such ecological effects are extremely difficult to predict even in fairly simple systems, and minor differences in life-history characteristics among stocks of salmon may lead to large differences in their response (e.g., Crozier et al. 2008b; Martins et al. 2011, 2012). This means it is likely that there will be "winners and losers," meaning some steelhead populations may enjoy different degrees or levels of benefit from climate change while others will suffer varying levels of harm.

Climate change is expected to impact anadromous fish during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream-flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty.

Summary

The status of Snake River Basin steelhead is also likely to be affected by climate change. Climate change is expected to impact Pacific Northwest anadromous fish during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream-flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty. As we continue to deal with a changing climate, management actions may help alleviate some of the potential adverse effects (e.g., hatcheries serving as a genetic reserve and source of abundance for natural populations, increased riparian vegetation to control water temperatures, etc.).

Climate change is expected to make recovery targets for steelhead populations more difficult to achieve. Climate change is expected to alter critical habitat by generally increasing temperature and peak flows and decreasing base flows. Although changes will not be spatially homogenous, effects of climate change are expected to decrease the capacity of critical habitat to support successful spawning, rearing, and migration. Habitat action can address the adverse impacts of climate change on steelhead. Examples include restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters, protecting and restoring riparian vegetation to ameliorate stream temperature increases, and purchasing or applying easements to lands that provide important cold water or refuge habitat (Battin et al. 2007; ISAB 2007).

The timeframe for implementing the proposed action will occur while climate change-related effects are expected to become more evident in this and other watersheds within the range of the Snake River Basin steelhead DPS. Climate change may increase the risk of large rain-on-snow runoff events (Crozier 2013) which could increase erosion on roads. However, the NPCNF's proposed road upgrades and crossdrain installations will reduce future potential for sediment delivery and reduce the overall amount of sediment delivered to streams.

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 action area includes the Clear Creek watershed (National Hydrography Dataset, hydrologic unit code 1706030401). The watershed includes the Lower, Upper, and South Fork Clear Creek subwatersheds and all streams in these subwatersheds. Green Creek is outside the Clear Creek watershed but is included in the action area because a haul route, Road 1106, crosses and is adjacent to Green Creek. Steelhead critical habitat is found in the three subwatersheds and on Green Creek (Figure 5).

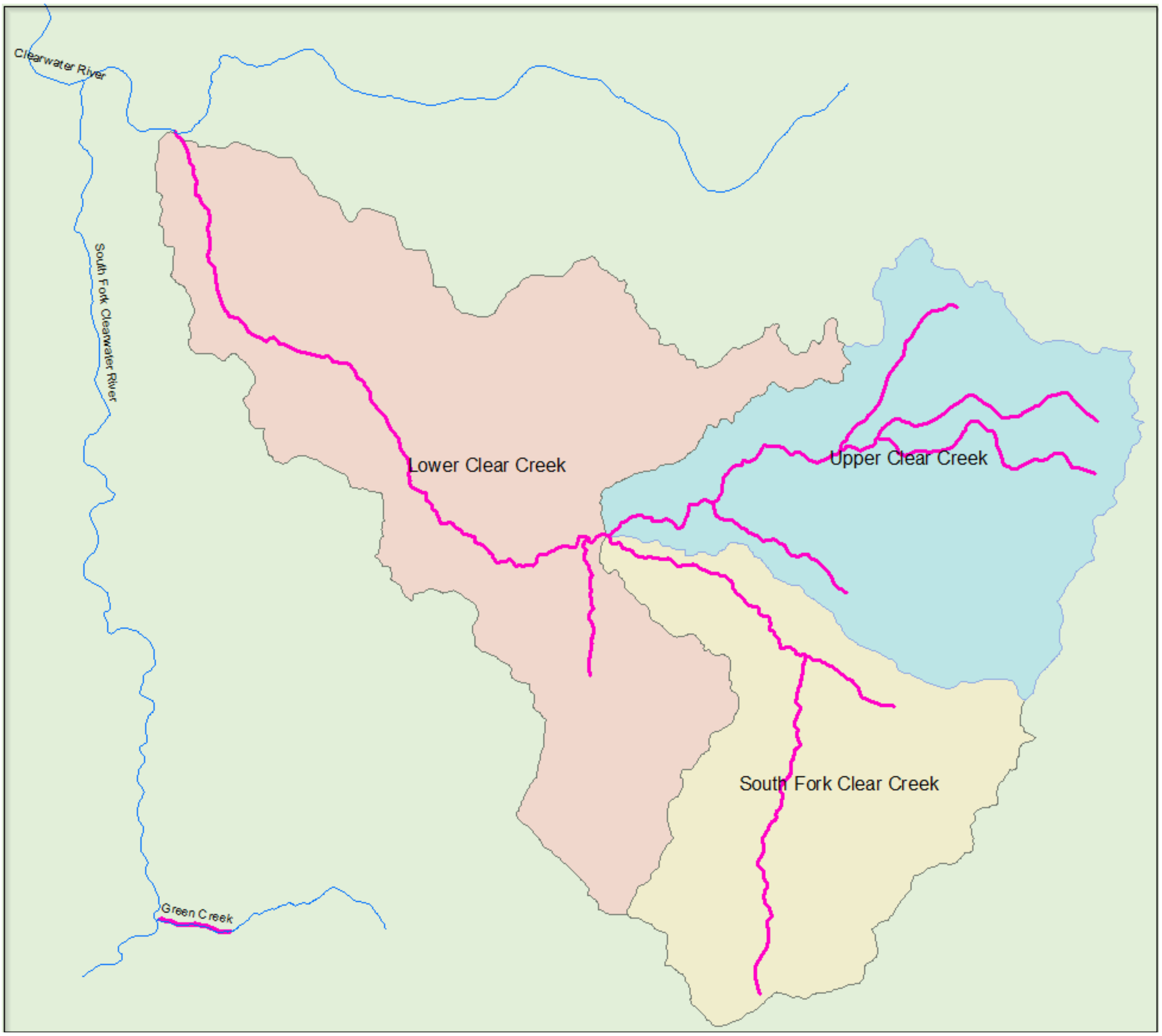

Figure 5. The action area including three subwatersheds (shaded) and critical habitat (pink lines).

The action area is used by all freshwater life history stages of threatened Snake River Basin steelhead. Streams within the action area are designated critical habitat for Snake River Basin steelhead (Figure 3). Designated critical habitat for Snake River Basin steelhead includes specific reaches of streams and rivers, as published in the Federal Register (70 FR 52630). The action area, except for areas above natural barriers to fish passage, is also EFH for Chinook and coho salmon (PFMC 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for this species.

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).

2.4.1 Watershed Overview

Clear Creek is a 5th field HUC tributary to the Middle Fork of the Clearwater River, entering at river mile 77, 2 miles east of Kooskai, Idaho. Clear Creek is approximately 20.5 miles in length and contains 164 miles of tributary streams (Johnson 1984). Of the 65,000-acre Clear Creek watershed, NPCNF administers approximately 43,000 acres (66 percent), the Idaho Department of Lands (IDL) administers 1,900 acres (3 percent), and private ownership accounts for the remaining 20,100 acres (31 percent). Within the NPCNF lands, there is a 9,200-acre Clear Creek roadless area (14 percent of the watershed, 27 percent of the NPCNF land).

The upper 11 miles of Clear Creek (43,000 acres) is contained within NPCNF land. There are eight NPCNF Plan prescription watersheds under NPCNF management (analogous in scope to 7th field HUCs; Figure 1): Pine Knob Creek, Brown Springs Creek, Clear Creek, Solo Creek, Middle Fork Clear Creek, South Fork Clear Creek, Kay Creek, and Hoodoo Creek (Hoodoo and the Middle Fork contain a small amount of IDL and/or private land). Two additional prescription watersheds, Big Cedar Creek and Lower Clear Creek Face, are primarily owned by IDL and/or private parties; however, a small portion of their land (720 acres, or 13 percent, and 570 acres, or 5 percent, respectively) is managed by the NPCNF. The lands in the lower 9 miles of Clear Creek are primarily owned by IDL and/or private parties (21,100 acres combined). There are two NPCNF Plan prescription watersheds under complete IDL and/or private management in Lower Clear Creek: Little Cedar Creek and Leitch Creek.

Elevations in the Clear Creek watershed range from approximately 2,000 feet at the mouth of Clear Creek to 4,600 feet in the headwaters. Geologically, the area has a dissected mosaic of plutonic, volcanic, and sedimentary rocks distributed throughout the basin. The topography of the watershed is mountainous with slopes often over 70 percent paralleling the stream drainages and relatively flat ridge tops. Modeling predicts 4,850 acres (11 percent) of the NPCNF lands are landslide prone, mostly occurring in the Clear Creek roadless area. The watershed is underlain by granitic and basalt geologies. The watershed has several natural bedrock falls that are barriers to fish passage.

Mean annual discharge at the mouth of Clear Creek is 121 cubic feet per second (cfs). Monthly average flow ranges from a low of 28 cfs in September to a high of 626 cfs in April. Approximately 84 percent of Clear Creek's average annual flow drains from NPCNF. Johnson et al. (1984) observed flow in Clear Creek just above the mouth of South Fork Clear Creek at 15 cfs in late summer. Equivalent clearcut acres (ECA) is a measure of canopy opening. Within the Clear Creek watershed, ECA averages 2 percent on NPCNF land and 6 percent on IDL and/or private land.

2.4.2 Previous Forest Actions and Non-Forest Uses

Harvest. Since 1960, both regenerative and thinning harvest (8,650 and 2,354 acres, respectively) have occurred on 26 percent of the 43,000 acres of NPCNF land within the Clear

Creek watershed. Only 10 acres of thinning, all within Pine Knob Creek, have occurred since 2000. Ground disturbance occurred with this legacy harvest, resulting in additional long-term sediment delivery from upland landscapes (Dunne et al. 2001) and sedimentation of fish habitat (Kirchner et al. 2001). Evaluation of recreational related disturbance of habitat is rated “none” to “low” on NPCNF land, primarily due to poor access, dense bank vegetation, and lack of salmonid habitat in certain reaches.

Grazing. There are two grazing allotments on NPCNF lands in Clear Creek. A total of 175 cow/calf pairs graze from June 1st to October 30th. As noted in the BA, the majority of grazing on NPCNF land occurs along roads near the headwaters due to the mountainous terrain in the drainage. Cattle water almost exclusively at culvert crossings near the roads. While excess grazing can significantly degrade riparian habitat, grazing impact on NPCNF land is considered light and not a threat to riparian habitat at current levels. Nutrient addition from grazing cattle is not considered a significant source of water contamination on NPCNF land.

Lower Clear Creek. Lower Clear Creek begins a short distance below the NFS boundary to the mouth of Clear Creek but includes Forest land in the Big Cedar and Lower Clear Creek Face subwatershed. Timber harvest occurs on IDL lands and is discussed below. Lower Clear Creek is generally bordered by private land where development, timber harvest, agriculture, and grazing occur. The lower stretch of the Clear Creek Road parallels Clear Creek, which flows through residential land and adjacent to some IDL property. Riprap and levees protecting the roads and private lands, restricts natural stream meandering, causes channelized flow, and reduce riparian vegetation. Levees on private land also block floodplain connectivity and cause channelized flow, thereby increasing flow velocity and substrate scouring and creating a streambed dominated by cobble and boulders. Streamside road and levees on private land also reduce or eliminate available riparian and/or undercut bank cover and result in a lack of shade and pools, which reduces overall thermal refugia in lower Clear Creek. Additionally, residential, agricultural, and stock uses have likely resulted in reduced riparian vegetation, unstable stream banks, increased erosion and sedimentation, and reduced streamside cover. Evaluation of water contaminants from lower Clear Creek was not available on IDL or private land, but some level of water contamination is likely, considering potential inputs of contaminants from road runoff, domestic use, cattle, and other agricultural practices. The IDL and/or private land is considered at moderate risk for disturbance of habitat. Loss of riparian vegetation, stream channel and substrate alterations, and loss of connectivity to floodplain due to land uses greatly reduces the functionality of lower Clear Creek as spawning and rearing habitat for steelhead.

The IDL tracks timber harvest on its own land as well as private land in the Clear Creek watershed, accounting for all timbered land that is not administered by the NPCNF. Past and ongoing activity on these lands include:

- The Bruin Strom timber harvest was recently completed on a 640-acre IDL endowment bordering the NPCNF boundary in the Lower Clear Creek Face prescription watershed.

- The Sill Creek timber harvest on an IDL endowment to the University of Idaho on the southwest edge of the action area bordering the Hoodoo Creek prescription watershed is in its final stage of completion.

- The IDL also noted that some Idaho Forest Group activity had recently been completed on private lands in the upper Clear Creek watershed, though most of its activity/impact was expected to occur in an adjacent watershed (Z. Anderson, pers. comm., IDL, February 11, 2015; IDL Digital Lands Records Database Viewer).

- In the Maggie Creek Supervisory Area, which encompasses Clear Creek, IDL implemented the timber harvest and road management measures of the proposed Idaho Forestry Program (IDL 2009) from approximately 2004 to 2014, on IDL timberlands. In comparison to the Idaho Forest Practices Act (IFPA), these measures provided additional leave trees in streamside buffers and additional road maintenance to reduce sediment delivery to streams.

In July, 2014, the IDL revised timber harvesting rules under the IFPA to increase tree retention in stream buffers for fish-bearing streams (http://www.idl.idaho.gov/forestry/fpa/shade-rule/index.html). From that date to present, timber harvest actions under IDL jurisdiction, which include private actions, required adherence to the specifications in the IFPA. Effects from these actions may include noise exposure; water withdrawals; chemical contamination; suspended and deposited sediment; streamflow alteration (ECA); and stream temperature. Road maintenance and use on approximately 45 miles of paved, gravel, and native surface roads will also add suspended and deposited sediment, reduce riparian vegetation along some road sections, and contribute $MgCl_2$ and petroleum products to road surfaces and eventually to streams.

Angling. There does not appear to be substantial angling pressure in the action area. The area is not open for sport angling of adult salmon and steelhead. Tribal subsistence fishing, primarily for adult Chinook salmon, does occur at the mouth of Clear Creek; however, this fishery likely has little impact on the earlier migrating adult steelhead. Angling of juvenile steelhead may occur; however, angling in this area appears to be limited, based on limited use of trails and access points along the stream.

Hatchery. The Kooskia National Hatchery, owned by the USFWS and operated by the Nez Perce Tribe, is located near the confluence of Clear Creek and the Middle Fork Clearwater River. Returning adult spring Chinook salmon are captured with a weir on Clear Creek and used as hatchery stock. Some migrating adult steelhead are also captured; however, they are passed through the weir so they may spawn in the Clear Creek watershed. The hatchery faces challenges with water quality relating to sediment in Clear Creek, as well as seasonal high temperatures.

2.4.3 Sediment

Excess sediment can suffocate redds, block upward passage of fry, and reduce the supply of both food and aquatic cover for rearing salmonids (Kondolf, 2000; Suttle et al., 2004). Roads in sensitive habitat can contribute large amounts of sediment to streams with surface runoff during high moisture events or with dust from high traffic areas.

In preparation for the CCIR project, the NPCNF and Clearwater Basin Collaborative commissioned the consultant Stillwater Sciences to perform a comprehensive baseline study of aquatic habitat and fish populations in the Clear Creek watershed (Figure 6). The study was performed in the summer of 2015. In December of 2015, the final report, *Clear Creek Aquatic Habitat Condition Assessment and Fish Population Monitoring* (Stillwater 2015) was completed.

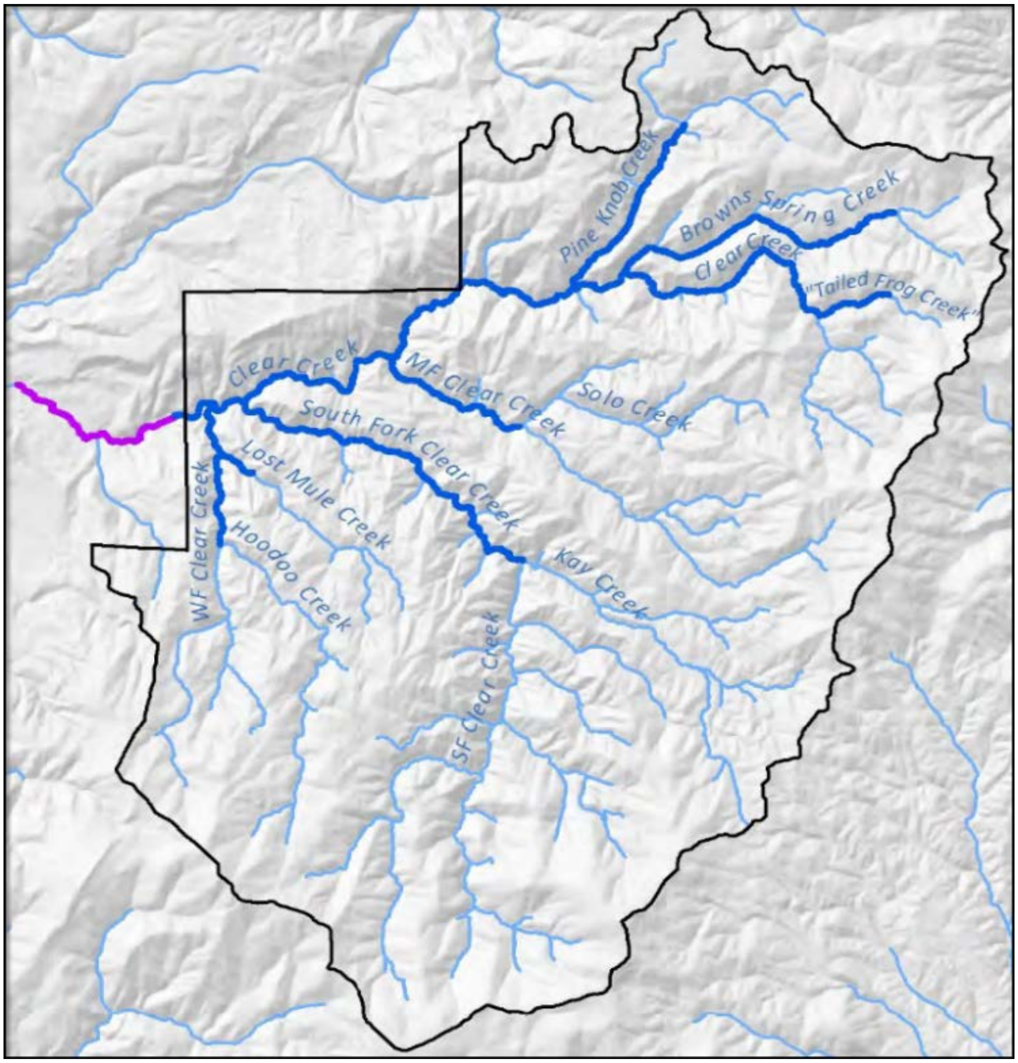

Figure 6. Extent (dark blue and purple lines) of Stillwater (2015) baseline survey.

Stillwater Sciences (2015) surveyed Forest "high priority" streams on NFS lands and lower Clear Creek reaches on State and private land. Stream surveys included 78 transects in 52 stream reaches covering 27 stream miles in eight subwatersheds. The survey did not include all accessible streams in the watershed (Figure 6). However, the overall character of fish-bearing streams (generally 3rd to 5th order) in the watershed can be summarized. Steelhead were widely distributed in the watershed below barriers. Channels were single thread (97 percent) with some multiple channel areas (3 percent) and confined by hillslopes. Access to these limited floodplains is unrestricted. By stream length, 41 percent of channels were 1 to 4 percent gradient, 47 percent were 4 to 8 percent gradient, and 11 percent were over 8 percent gradient. These statistics indicate that the majority of steelhead accessible streams in the Clear Creek watershed are narrow channels with gradients suitable for steelhead spawning and rearing.

Roads. From 2011 to 2016, under other road decommissioning actions, the NPCNF has completed decommissioning 32.4 miles of system roads and 36.6 miles of non-system roads, removed 53 culverts, and replaced 24 culverts. Under these same actions, the Forest will complete further decommissioning of 3.7 miles of system roads and 96.3 miles of non-system roads, and will remove or replace 20 more culverts. These actions have already undergone consultation. There are currently approximately 200 miles of roads within NPCNF land in Clear Creek, averaging a density of 3.28 miles per square miles (mi/mi^2). There are 239 stream crossings on NPCNF land associated with road use, 23 of which are over fish bearing streams. Eight of the 23 crossings are paved bridges over fish bearing streams in lower Clear Creek. Many larger roads and trails have cross drain culverts installed upslope of the stream crossings to minimize risk for transportation of sediment, and oils, fuels, salts, and other chemical contaminants directly into streams. Fuel/chemical leaching from roadways at stream crossings, is not considered a significant source of water contamination on NPCNF land.

Elliot et al. (2018) used the Water Erosion Prediction Project (WEPP) model to predict baseline sediment delivery from the 186 mile road network within the NFS boundary in the Clear Creek watershed. Baseline sediment delivery from the road network to streams is predicted to be 4.5 tons per square mile (tons/mi^2) for the action area of 68 square miles. Sediment production from undisturbed granitic watersheds in Idaho, similar to Clear Creek, are reported to be 23 to 26 tons/mi^2 (Sugden 2018; Elliot 2013; Megahan and Kidd 1972) with a delivery ratio of 0.3 (Elliot and Miller 2017). Applying the sediment delivery ratio to the rates above, the delivery rate from an undisturbed watershed is about 7 tons/mi^2. When compared to the baseline delivery rate of 4.5 tons/mi^2, the existing road network is adding approximately 64 percent more sediment to the watershed annually. Due to the high variability of soil erodibility, at best there is a 90 percent likelihood that the erosion and delivery predictions are within plus or minus 50 percent of the actual amounts (Elliot et al. 2018).

Watershed road density is considered a rough estimate of relative effects from roads to streams in a watershed, NMFS and NPCNF guidelines (NMFS 1996) suggest watershed scale road density for high habitat conditions is <1 mi/mi^2, moderate 1 to 2 mi/mi^2 , and >3 mi/mi^2 representing low conditions (NMFS 1996). The baseline road density in the Clear Creek watershed is 2.9 mi/mi^2, with no subwatersheds in the high function category, four in moderate, and six in the low category. Describing the range, Pine Knob, Browns Springs and Cedar Creek subwatersheds are over 4 mi/mi^2 with the South Fork the lowest at 1.6 mi/mi^2. Considering road density within RHCAs, the Middle Fork Clear Creek is primarily a roadless area and has the only high functioning RHCA road density, whereas Big Cedar Creek has an unusually high 12.3 mi/mi^2 RHCA road density due its stream-adjacent roads. Roads on landslide prone areas within the Clear Creek watershed are in low density 0.1 mi/mi^2 (considered high functioning by NMFS criteria) and present only a small additional risk to landslide initiation and sediment delivery from roads.

Cobble Embeddedness. The level of substrate cobble embeddedness (CE) is important both for spawning and rearing of salmonids and for production of aquatic invertebrates (Rowe et al. 2003). High embeddedness can be caused by the underlying geology of the watershed, or by fine sediment inputs due to land management activities (e.g., road building) or natural disturbance (e.g., landslides). The Stillwater survey reveals CE showed little variation at the stream reach scale when compared to the habitat unit scale (pools, riffles, etc.). Individual reaches averages had embeddedness of 30 to 36 percent (range 1 to 50 percent). Lower Clear Creek (LCC) through private lands showed less embeddedness, averaging 1 to 10 percent with a maximum of 30 percent. Lower CEs of less than 30 percent were not common and were distributed throughout the watershed except the South Fork Clear Creek. Embeddedness for the northern and middle Rockies ecoregion in Idaho has been reported to average 12 percent (Grafe 2002), indicating that embeddedness in the study area was higher than other streams evaluated in the same ecoregion in Idaho. Previous studies have identified high embeddedness as a potential problem in the Clear Creek watershed (Elliot et al. 2018) likely caused in part by the existing road system (Elliot et al. 2018).

Sand and fines (silt and clay) can embed larger particles, reducing the quality of spawning gravels and conditions for incubation, as well as conditions for benthic macroinvertebrate production. The area of bed substrates classified as sand and fines (percent fines) in all subwatershed ranged from 12 to 24 percent. This range of percent surface fines is considered a high to moderate habitat condition (NMFS 1996).

Spawning Gravel. Stillwater (2015) rated spawning gravel as good or fair throughout the Clear Creek watershed. Spawning gravel is distributed across gradients and subwatersheds with the larger LCC area and upper Clear Creek having the greatest spawning area per unit length. Spawning gravel is not considered to be a limiting factor in the Clear Creek watershed.

Large wood is a critical stream habitat component in forested watersheds such as Clear Creek. Large wood promotes scour and pool formation, provides instream cover and habitat complexity elements, and sorts, stores, and regulates sediment in streams. In a study of natural conditions, Overton et al. (1995) describes good stream habitat conditions for Idaho forests as including >20 pieces of large woody debris (LWD) per mile (>12 inches diameter and >35 feet length). Although the Stillwater (2105) survey found abundant wood in streams smaller than this criteria, the Upper Mainstem Clear Creek subwatershed is the only subwatershed meeting this condition with 27 pieces per mile; all other subwatersheds averaged <1 to 11 pieces per mile. This quantity of LWD indicates that streams in the Clear Creek watershed are well below natural conditions.

Deep pools. The quality and quantity of salmonid habitat is often discussed in terms of pool prevalence (Montgomery et al. 1995). Pools provide important habitat for different life stages and species of salmonids and are used for holding, spawning (in pool tailouts), rearing, and high-flow refugia. The U.S. Forest Service (USFS) interim riparian management objectives (RMOs) (Quigley et al. 1997) call for 96 pools per mile in streams 10 feet in wetted-width, and 56 pools per mile in streams 20 feet in wetted-width. Based on these thresholds, the number of pools per mile is well below the USFS RMO thresholds in all subwatersheds. Pool frequency and quality within the Forest boundary can also be affected by upstream management activities. The generally low incidence of deep pools may be the result of low wood loading, high sediment supply. Below the Forest boundary, pools are affected by channelization and disconnection from the floodplain.

2.4.4 Water Temperature

Water temperature can be a major driver of the seasonal migrations and thus distributions of cold water species, with individual fish moving within a watershed to reaches with more thermally optimal temperatures (behavioral thermoregulation) (Behnke 1992, Sauter et al. 2001, Grafe 2002).

Canopy cover, measured as an indicator of stream shade, is important in moderating water temperature and is heavily influenced by past disturbances such as fire and management actions. Mean canopy cover on NFS land ranged from 58 percent to 93 percent, with little canopy in LCC likely partially due to grazing and private development (Stillwater 2015). Mean canopy cover for the northern and middle Rockies ecoregion in Idaho was reported to be 48 percent (Grafe 2002) indicating higher than average canopy cover in Clear Creek when compared with other streams in the ecoregion.

Richter and Kolmes' 2006 literature review suggests the following 7-day average maximum daily temperature limits for steelhead:

- 55.4°F for spawning and incubation;
- 60.8°F for rearing and growth (reduced growth after 66.2°F; no growth at 72.5°F);
- 64.4°F for adult migration (blockage occurs around 69.8°F);
- At approximately 71.6°F to 75.2°F, temperature becomes a significant mortality factor in both juvenile and adult steelhead.

Water temperatures in Clear Creek support steelhead spawning and rearing. The NPCNF reports action area maximum average water temperatures in the period 2007 to 2012 ranged from 55.4°F to 68°F. These summer temperatures indicate that optimal summer rearing temperatures for steelhead are found within the NFS boundary depending on tributary or location. At the NFS boundary, Stillwater (2015) noted a summer water temperature of 68°F and the BA reported a maximum daily average temperature of 65.7°F. These temperatures are above optimum for steelhead rearing but not prohibitive. Lower Clear Creek annual maximum temperatures, taken at the mouth, are high enough to be a thermal barrier or cause mortality.

It is likely that steelhead, juvenile and adult, use lower Clear Creek as a migration corridor during spring and early summer to reach cooler upstream water. As adult steelhead typically migrate up tributaries in late winter and early spring when air temperatures and snowpack runoff keep stream temperatures cool, it is unlikely the temperatures at the mouth of Clear Creek pose a migration barrier to adult steelhead. Steelhead smolts typically begin migrating to the ocean from natal streams in the spring, overlapping adult spawning. It is unlikely that the temperatures in lower Clear Creek prohibit smolt migration.

As climate change continues to affect snowpack and ambient air temperatures in the watershed, water temperatures will likely increase. However, because water temperatures will not rise above optimal ranges until after peak flows in early summer, water temperatures during spring spawning and outmigration will likely continue to remain in optimal ranges. Low stream volume associated with reduced snowpack runoff in late summer and fall will reduce resistance to warming air temperatures (Mote 2003; Luce and Holden 2009; Clark 2010). While temperature is not likely hindering steelhead in Clear Creek currently, climate change is predicted to increase summer water temperatures. This summer increase will decrease suitable summer rearing habitat in lower Clear Creek.

In conclusion, current water temperatures on NFS land in Clear Creek are in optimal ranges for steelhead spawning and summer rearing. Downstream of the NFS boundary, where there are large amounts of spawning and rearing habitat, summer water temperatures are well above optimal, and at times nearing maximum survivable, temperatures for steelhead rearing. Climate change is predicted to cause increases in summer water temperatures which will reduce steelhead rearing habitat in the lower reaches.

2.4.5 Steelhead Distribution

There were 28 potential or partial barriers to anadromous fish. Only five were considered total barriers and were located in relatively small streams in the upper portions of the watersheds. Others had *O. mykiss* above the potential barriers (Stillwater 2015).

The Stillwater (2015) report describes steelhead as being widely distributed throughout the Clear Creek watershed. Within the National Forest, juvenile *O. mykiss* were observed in the mainstem and all major tributaries surveyed. In mainstem Clear Creek, they were observed from the National Forest boundary upstream to above the confluence of Browns Spring Creek where juvenile densities then dropped considerably. *O. mykiss* were observed part way up Browns Springs Creek. In West Fork Clear Creek, *O. mykiss* were documented from the confluence, upstream to the end of the study area; however, they were not documented in Lost Mule Creek, a small tributary to the West Fork. Likewise, in South Fork Clear Creek, Middle Fork Clear Creek, and Pine Knob Creek, *O. mykiss* were documented in all reaches surveyed.

2.4.6 Baseline Summary

From 1960 to 2000, 26 percent of NFS land in Clear Creek was harvested, contributing considerable acute and chronic sediment delivery. Grazing and recreational use is light and inconsequential to riparian habitat. The existing NFS road network was estimated to increase annual sediment delivery by 64 percent over undisturbed conditions and is likely to be the largest contributor of chronic excess sediment delivery to the watershed.

Streams within the NFS boundary support steelhead spawning and rearing. Steelhead and suitable rearing habitat are widely distributed throughout the watershed. Only 3 percent of channels are multithread with unrestricted access to floodplains. Spawning gravels are evenly distributed through stream gradients and subwatersheds. Cobble embeddedness was measured for each stream reach and averaged by subwatershed. Cobble embeddedness in subwatersheds averaged 30 percent to 36 percent. This level of embeddedness is elevated when compared to

12 percent for the ecoregion. The LWD and pools are well below natural conditions and NPCNF RMOs. Water temperatures on NFS land are within optimal ranges for steelhead spawning and rearing.

Steelhead spawning and rearing habitat below the NFS boundary is more abundant due to stream size. However, habitat is also in less favorable condition with restricted access to floodplains, narrowed channels, and reduced riparian vegetation, due to road and private development in the floodplain. Summer water temperatures are well above optimal for steelhead rearing and may exclude their presence in summer. Climate change is expected to increase summer water temperatures, resulting in a decrease in summer rearing habitat.

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.

The BA provides an analysis of the effects of the Clear Creek Integrated Restoration Project on Snake River Basin (SRB) steelhead and their critical habitat. NMFS uses information in the BA, BA modifications, and BA errata provided by NPCNF for the effects analysis. In addition, NMFS used the best available data and information from databases, government reports, and scientific literature to discuss and evaluate the potential effects of the proposed action on SRB steelhead and the essential habitat features of their critical habitat in the following sections.

2.5.1 Effects on ESA-listed Species

The proposed action will be implemented over a period of 20 years, with activities being conducted as conditions allow (e.g., timber harvest could occur year round, road work will typically occur from April through November, and prescribed fire will typically occur in the spring and fall). All life stages (i.e., incubating eggs, alevins, fry, juveniles, and adults) of steelhead are expected to be present in streams within the Upper Clear Creek, Lower Clear Creek, and South Fork Clear Creek subwatersheds. Steelhead typically spawn from March to June, and fry emerge by mid-July.

The proposed action has the potential to affect SRB steelhead both directly and indirectly due to the following: (1) Construction noise exposure; (2) water withdrawals; (3) chemical contamination; (4) suspended sediment (5) deposited sediment; (6) streamflow alteration (ECA); and (7) stream temperature. These potential effects are described in more detail below.

2.5.1.1 Construction Noise

Heavy equipment (e.g., excavator, grader, log truck, and dump truck, etc.) operation near streams will create visual, noise, vibration, and water surface disturbances. Popper et al. (2003) and Wysocki et al. (2007) discussed potential impacts to fish from long-term confined exposure to anthropogenic sounds, predominantly air blasts and aquaculture equipment, respectively. Popper et al. (2003) identified possible effects to fish including temporary, and potentially permanent hearing loss (via sensory hair cell damage), reduced ability to communicate with species members due to hearing loss, and masking of potentially biologically important sounds. These studies evaluated noise levels ranging from 115 to 190 decibels (dB) referenced at 1 micropascal (re: 1µPa). In the studies identified by Popper et al. (2003) that caused ear damage in fishes, all evaluated fish were caged and thus incapable of moving away from the disturbance. Wysocki et al. (2007) did not identify any adverse impacts to rainbow trout from prolonged exposure to three sound treatments common in confined aquaculture environments (115, 130 and 150 dB root mean square re: 1µPa).

The Federal Highway Administration (2008) has found that noise production by a grader, backhoe, and truck ranges between 80 and 85 dB. Because 150 dB was not found to harm fish (Wysocki et al. 2007), and expected noise levels from road work are not expected to exceed 85 dB, noise from road work is not expected to harm steelhead. Therefore, noise-related disturbances from the proposed action are unlikely to result in injury or death. Although noise levels are not expected to injure or kill fish, they may cause fish to move away from the sounds. If fish move, they are expected to migrate only short distances to more suitable areas for a few hours in any given day. Because the work noise/visual disturbance will last just a few days at road work sites or be sporadic in the case of log haul, and steelhead are located downstream of the culvert replacement or removal sites, juvenile steelhead are unlikely to be harmed by construction noise/vibration or visual disturbances in the action area.

2.5.1.2 Water Withdrawals

Water will be withdrawn from streams for prescribed fire safety, dust abatement, and temporarily pumping/diverting water out of stream channel sections for culvert removal or replacement. The pumping for culvert replacements would occur at the six culvert replacement sites that that will be monitored for turbidity. Although steelhead have not been observed at these six sites, BMPs will be employed to reduce adverse impacts to any fish species. Withdrawing water from streams can impact fish though entrainment in intake hoses, by impingement on fish screens, and by reducing water quality and quantity.

Streamflows are a critical part of fish habitat and viability. Reducing streamflow can adversely affect the amount and quality of habitat accessible, reduce food availability and forage opportunities, and adversely affect water quality. This, in turn, can affect the growth, survival, and productivity of steelhead. Reducing flow could eliminate access of juvenile salmonids to important habitat types such as undercut banks and tributary streams (Brusven et al. 1986; Raleigh et al. 1986). Similarly, reducing the volume of water in streams would reduce the quantity and quality of prey and would limit foraging opportunities and foraging efficiency of salmonids (Boulton 2003; Davidson et al. 2010; Harvey et al. 2006; Nislow et al. 2004; Stanley et al. 1994). In addition to adverse impacts to habitat and forage, reductions in streamflow can adversely impact water quality by increasing summer water temperatures (Arismendi et al. 2012; Rothwell and Moulton 2001).

The equipment used to remove water from a stream or pond will meet NMFS screening criteria, as determined by an NPCNF fisheries biologist. NMFS criteria require that an intake hose will be fitted with screens having a 3/32-inch mesh size and the appropriate surface area such that water velocities at the screen do not exceed 0.4 feet per second. Using NMFS screening criteria, fish are unlikely to be adversely affected by the use of intake hoses.

As noted above, there are also potential effects from removing all or a portion of the water in the stream. The water withdrawals from streams for dust abatement and fire suppression are expected to be infrequent and remove only a small portion (i.e., enough to fill a water truck) of the total volume of water at any given time. The NPCNF estimates that it typically takes less than 2 hours of pumping to fill the tank of a water truck used for these activities. A fish biologist or hydrologist will designate the locations for water withdrawals to maintain streamflow. In addition to the infrequent and carefully sited characteristics of the activities, the NPCNF also proposes limiting pumping to no more than 20 percent of the streamflow. Because the flow reductions will be small, infrequent, temporary (i.e., water will not be continually withdrawn), and limited in volume compared to streamflow, juvenile steelhead will not be harmed by water withdrawal in the action area.

2.5.1.3 Chemical Contamination

The high volume of road work, timber harvest, and haul, over the extended period of time of this action, increases the risk of chemical contamination of streams in the action area. Fuel will be stored near construction, logging, and pumping equipment. The high volume of log haul traffic increases the risk of accidental spills of fuel, lubricants, hydraulic fluid, and similar contaminants on roadways in RHCAs or directly into the water. If haul trucks chronically leak fuels, etc. onto the roadway, the large number of haul trips on many of the roads could create new chronic inputs of toxic chemicals into streams.

Petroleum-based products (e.g., fuel, oil, and some hydraulic fluids) contain poly-cyclic aromatic hydrocarbons, which can cause lethal or chronic sublethal effects to aquatic organisms (Neff 1985). These products are moderately to highly toxic to salmonids, depending on concentrations and exposure time. Free oil and emulsions can adhere to gills and interfere with respiration, and heavy concentrations of oil can suffocate fish. Evaporation, sedimentation, microbial degradation, and hydrology act to determine the fate of fuels entering fresh water (Saha and Konar 1986). Ethylene glycol (the primary ingredient in antifreeze) has been shown to result in sublethal effects to rainbow trout at concentrations of 20,400 milligrams per liter (mg/L) (Staples et al. 2001). Brake fluid is also a mixture of glycols and glycol ethers, and has about the same toxicity as antifreeze.

The risk of fuel spills from fuel storage and transfer will be minimized with proposed BMPs. The NPCNF will require spill prevention and containment materials onsite during inwater work to minimize adverse effects to aquatic biota if a spill were to occur. It is standard practice for loggers to refuel all equipment using 40- to 75-gallon slip tanks stored in the back of pickup trucks. Chainsaws are refueled from 5-gallon containers that may be taken into the field. Logging trucks will refuel in town, outside the action area. All on-site fuel storage, fuel transfer, and machinery servicing is governed by the provisions of the sanitation and servicing portion of the timber contract. The timber contract provisions include, for instance, that contractors will maintain all equipment in good repair and free of abnormal leakage of lubricants, fuel, coolants, and hydraulic fluid. Also, for stationary equipment such as yarders and loaders, contractors will be required to have spill prevention and containment materials available on site. For any oil product storage exceeding 1,320 gallons, the contractor is subject to the rules and provisions of Federal Regulation 40 CFR 112 and must submit to the NPCNF a Spill Prevention, Control, and Countermeasure Plan.

Although storage of fuel for water pumping is allowed in RHCAs, fuel storage container size is limited to 5 gallons with a maximum of 10 gallons total storage between all containers, and spill containment will be available on site. In practice, these storage cans are stored in trucks or are placed on top of absorbent pads.

For culvert or in-channel work, the NPCNF will require that all mechanical equipment be inspected daily and maintained to ensure there are no leaks. Contractors will have spill prevention and containment materials available on site when working in riparian areas or instream to minimize the impact of spills reaching a stream. High volume haul routes could accumulate contaminants from haul trucks. However, as mentioned above, equipment must not have abnormal leakage; therefore, toxic buildup on roads is not anticipated. In addition, crossdrain placement will minimize the length of roadway from which toxic chemicals can be delivered to streams.

The greatest risk of fuel entering streams would be if an accident were to occur at a stream crossing or fuel spilled into a roadside ditch that flowed directly into a perennial stream. If a fuel spill were to occur into a stream, all spawning, rearing, and incubating life stages of fish that are present could be killed or harmed depending on the dilution from a given size of water body. The extent of this effect would vary greatly, depending on the quantity of the spill, and the size and location of the receiving waterbody. There are 239 stream crossings with 23 over fish-bearing streams. Eight of the 23 crossings are paved bridges over fish bearing streams in lower Clear Creek. There are 216 crossings over non-fish-bearing streams because most of the haul routes are near ridgetops upstream of fish-bearing streams and larger collector routes are near the high elevation boundary of the Clear Creek watershed. To calculate the amount of road length draining to streams, NMFS used the number of steam crossings and added the miles of road adjacent to streams. Assuming a 100-foot road length draining from each side the 239 crossings, there are 47,800 feet (9 miles) of road draining to streams at crossings. In addition, there are 1.4 miles of roads adjacent to streams. Of these 10.4 miles, 2.3 miles drains to fish-bearing streams. In summary, there are 156.9 miles of haul routes (Elliot and Miller 2018) with only 6 percent of the haul road network draining to streams at crossings or adjacent sections, and only 1.4 percent draining to fish-bearing streams.

With implementation of standard BMPs including practices such as low speed limits and dust abatement, which improves visibility, there has been a low rate of accidental spills on the NPCNF. The NPCNF reports only one accidental spill during haul of 560 MMBF over many projects in the years 1999 to 2014 and this one spill did not reach a stream. Given this rate of accidents, there is a 0.18 percent chance of a spill for every one MMBF of logs hauled. With a proposed haul of 83 MMBF, there is a 15 percent chance of an accidental spill occurring from haul. With 6 percent of the haul road network draining to streams and 1.4 percent draining to fish-bearing streams, there is a 0.9 percent chance of a spill reaching a stream and an extremely small chance of a spill reaching a fish-bearing stream for the duration of the project.

The NPCNF may use magnesium chloride ($MgCl_2$) for dust abatement on major timber haul routes. The $MGCL_2$ can be carried by road runoff into ditches and streams during a rain event. Chloride concentrations as low as 40 parts per million have been found to be toxic to trout, and concentrations up to 10,000 mg/L have been found to be toxic to other fish species (Foley et al. 1996 and Golden 1991 in Piechota et al. 2004). Salt concentrations greater than 1,800 mg/L have been found to kill daphnia and crustaceans, and 920 mg/L of calcium chloride has been found to be toxic to daphnia (Sanders and Addo, 1993, in Piechota et al. 2004). The $MgCl_2$ for dust abatement can also affect roadside vegetation. In a study in Colorado, (Goodrich et al. 2008), some severely damaged vegetation occurred along most roads regardless of maintenance or $MgCl_2$ treatment procedures; however, a higher occurrence of severe damage was observed on many roadside species along roads treated with $MgCl_2$. The study also linked vegetation effects or lack thereof to the sloped position from the road to the vegetation. More vegetation damage occurred where road slope directed runoff containing the abatement chemical.

The exposure of ESA-listed fish to $MgCl_2$ will be kept to a low level with BMPs and specifications found in the Standard Contract for all timber sales. For example, one BMP requires a 1-foot no-spray buffer be left on the edges of the road, if road width allows, to minimize overspray into ditches. The Standard Contract specifies preparation of the road surface prior to application, the rate of application, and that water be applied after the $MgCl_2$. This BMP and three contract specifications are designed to maximize penetration of chemical into road surface, minimize the amount of $MgCl_2$ used, and to minimize the amount of chemical running off the road surface. Those measures, the road reconstruction upgrades to reduce the hydrologic connection of road surfaces to streams, and the position of primary haul routes upstream of fish-bearing waters will reduce the likelihood to a low level of $MgCl_2$ being introduced into streams and is unlikely to cause harm to steelhead.

Herbicide use is not proposed for this project. The spread of noxious weeds will be controlled through BMPs specifying the cleaning of equipment before arriving on site and replanting bare soil areas, such as landings with weed-free seed. Given these BMPs, the risk noxious weeds spreading in the action area is low and unlikely to cause adverse effects steelhead.

2.5.1.4 Suspended sediment and dewatering from culvert replacements

Concentration of suspended sediment in the water column is often measured as turbidity (i.e., scattering of light due to suspended sediment in the water column) in NTU. The NTUs are often used as an alternative to turbidity measurements expressed in milligrams of sediment per liter of water (mg/L) because readings can be taken instantaneously on-site and, for any project, actions can be altered if readings approach thresholds harmful to fish. The most critical aspects of a suspended sediment (turbidity) effects analysis are timing, duration, intensity and frequency of exposure (Bash et al. 2001).

Suspended sediment can affect fish through a variety of direct pathways: abrasion (Servizi and Martens 1992), gill trauma (Bash et al. 2001), behavioral effects such as gill flaring, coughing, and avoidance (Berg and Northcote 1985; Bisson and Bilby 1982; Servizi and Martens 1992; Sigler et al. 1984), interference with olfaction and chemosensory ability (Wenger and McCormick 2013), and changes in plasma glucose levels (Servizi and Martens 1987). These effects of suspended sediment on salmonids generally decrease with sediment particle size and increase with particle concentration and duration of exposure (Bisson and Bilby 1982; Gregory and Northcote 1993; Servizi and Martens 1987, Newcombe and Jensen 1996). The severity of sediment effects is also affected by physical factors such as particle hardness and shape, water velocity, and effects on visibility (Bash et al. 2001). Although increased amounts of suspended sediment cause numerous adverse effects on fish and their environment, salmonids are relatively tolerant of low to moderate levels of suspended sediment. Gregory and Northcote (1993) have shown that moderate levels of turbidity (35 to 150 NTU) can accelerate foraging rates among juvenile Chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

Salmon and steelhead tend to avoid suspended sediment above certain concentrations. Avoidance behavior can mitigate adverse effects when fish are capable of moving to an area with lower concentrations of suspended sediment. To avoid turbid areas, salmonids may move laterally (Servizi and Martens 1992) or downstream (McLeay et al. 1987). Avoidance of turbid water may begin as turbidities approach 30 NTU (Sigler et al. 1984; Lloyd 1987). Servizi and Martens (1992) noted a threshold for the onset of avoidance at 37 NTU (300 mg/L total suspended sediment). However, Berg and Northcote (1985) provide evidence that juvenile coho salmon did not avoid moderate turbidity increases when background levels were low, but exhibited significant avoidance when turbidity exceeded a threshold that was relatively high (>70 NTU). For the proposed culvert replacements, some fish may respond by moving to less turbid areas.

A summary analysis from 20 culvert, diversion, and road replacement or removal projects from the NPCNF (A. Connor, NPCNF hydrologist, unpublished data 2014) show that there were spikes in turbidity at the onset of dewatering and rewatering at each monitoring site. Results can be generalized and show that these spikes extended between 100 and 600 feet downstream, 50 percent of the spikes exceeded 50 NTU, with a maximum of 250 NTU, for less than 2 hours. Based on the intensity and duration of turbidity exposure for those projects, and effects thresholds summarized in Newcombe and Jensen 1996, it is likely that juvenile steelhead would have experienced non-lethal physiological harmful effects in the areas below the culvert work sites. Expected temporary (up to 2 hours) effects would have included behavioral effects such as volitional movement and/or reduced or increased feeding, and physiological effects including coughing. Because the proposed culvert replacements will occur on similar sized streams, at a similar time of year, effects to steelhead that may be present are expected to be similar to those indicated by the NPCNF's prior assessment of culvert work and defined by Newcombe and Jensen 1996.

Few steelhead, if any, are expected at the 66 proposed culvert replacement sites. However, six culvert replacement sites[1] were identified as the most likely to have steelhead present because

[1] These six sites will be monitored for turbidity.

they were closest to designated critical habitat. Only one of these sites is located within critical habitat. Because of the possible presence of steelhead, these six sites will be isolated by dewatering and monitored for turbidity. To isolate the work area, the site is slowly dewatered to allow fish to volitionally move downstream out of the area. During this process, some juvenile fish may be stranded. When the isolated work area is rewatered, loose sediments mobilize and create a turbidity plume downstream. These plumes are not expected to go more than 600 feet downstream, as evidenced by the 20 culvert replacements discussed above. Steelhead within the plume may experience adverse effects.

Recent surveys, including Stillwater (2015), indicate that steelhead presence is greater than 600 feet downstream at the six sites. However, these six sites are closer to occupied habitat than the other 60 stream crossing replacements and there is the possibility of steelhead distribution expanding to within 600 feet of these six sites during the project timeframe. Three of the six sites are in upper Clear Creek where the farthest upstream juvenile steelhead densities found were 0.0215 steelhead per 100 square feet (ft^2) of stream (Stillwater Sciences 2015). The remaining three sites are high in the South Fork Clear Creek about 5 miles above known steelhead presence (density 0.0269 per 100 ft^2) with no passage barriers (Stillwater Sciences 2015). The average fish density for the two general locations is 0.0242 per 100 ft^2 of stream. Because steelhead are presently unlikely to be at the six sites, fish salvage was not proposed. Without fish salvage, and if steelhead are present at the time of implementation, dewatering the stream channel and consequent turbidity may have adverse effects to steelhead.

To account for possible harm or death of these steelhead, NMFS has taken a conservative approach and has calculated the number of steelhead that could be present and affected by dewatering and turbidity plumes at the six sites most likely to have steelhead present. As discussed above, based on 20 similar culvert replacements on NPCNF roads, the resulting turbidity plume not expected to exceed 600 feet downstream. Assuming a turbidity extent of 600 feet, stream width of 6 feet, and an average steelhead density of 0.0242 per 100 ft^2 of stream, NMFS estimates 0.9, or one, juvenile steelhead to be present in the affected reach at each of the six sites for a total of six juvenile steelhead. Taking a conservative approach, NMFS doubled the number to 12 steelhead. NMFS assumes steelhead would be evenly distributed throughout the 600 feet and estimates that up to half the extent of 600 feet at any of the six sites could be dewatered. Thus, half of the estimated steelhead (six of 12) would be killed from stranding during dewatering. (The number of fish stranded could be less than six because the proposed gradual dewatering technique tends to cause some or most fish to escape the reach being dewatered.)

The remaining six of the 12 steelhead would experience physiological effects from the turbidity plumes below the 300 feet of dewatered area. The NPCNF proposes to monitor turbidity within 600 feet of the six dewatered areas and slow work or dewatering if turbidity exceeds 50 NTU. This conservative approach is within the bounds of non-lethal physiological effects as discussed above. In conclusion, and taking a conservative approach, NMFS assumes greater adverse effects would occur if turbidity exceeded 600 feet downstream at greater than 50 NTU for more than 1-hour.

Other activities that may generate turbidity in fish-bearing streams include instream monitoring, road reconditioning, reconstruction, and decommissioning, and road use. As discussed above, crossdrains presently in place, or added prior to other road work, will minimize the amount of road draining to streams. In addition, sediment BMPs (surface gravelling, revegetation, and sediment filtering structures) should reduce sediment delivery from road surfaces and ditches to streams. With these sediment reduction measures at and near stream crossings, road work and road use is expected to generate significantly less turbidity, per crossing, than from direct streambed disturbance or rewatering of isolated work areas. In general, sediment mobilization from road work areas to streams would occur during high water events when stream turbidity is high and added sediment from roads blends with this background turbidity. Or, during smaller precipitation events without high stream flow, sediment is delivered from roads to streams but is deposited close to the source without creating turbidity at high enough levels to have adverse effects to steelhead. The following section, Deposited Sediment, discusses the effects of the deposited sediment.

2.5.1.5 Deposited Sediment

Proposed harvest, burning, and road activities disturb soils or road prisms which makes fine sediment more available for transport from hillslopes and road prisms to streams. These proposed activities can deliver sediment through the common pathway of soil disturbance, increased surface erosion and transport during precipitation events, and delivery of fine sediment (<2 mm diameter) to action area streams. Once delivered to streams, fine sediments are suspended and transported, then begin to deposit in a graded pattern with larger particles settling out first and smaller particles settling out farther downstream (Foltz 2008), where this excess fine sediment can have cause harm to steelhead.

The Clear Creek watershed has had chronic high sediment levels for the past 30 years from the existing road system, past timber harvest, fire, and local geology. Fine sediment baseline conditions, as measured by cobble embeddedness (average 30 to 36 percent), are impaired (>20 percent; NMFS 1996) for all subwatersheds or NPCNF prescription watersheds in the action area. This deposited sediment analysis starts with an overview of possible effects from excess fine to fish, and then steps through proposed harvest, burning, and road related actions, and their mitigation measures which are designed to minimize short-term impacts from these proposed activities and improve long-term sediment levels in the Clear Creek watershed.

All freshwater steelhead life stages (i.e., adult migration and spawning, and juvenile development from egg to smolt emigration) will be present at various times for the duration of the project. The proposed action has the potential to affect steelhead spawning and rearing through increasing sediment deposition in stream substrates.

Project actions will cause soil disturbance which, particularly during precipitation events or during wet periods, may cause sediment to mobilize into streams, become suspended, transported, and deposited into downstream substrates. When suspended sediment settles out of suspension, it can cause detrimental effects on spawning and rearing habitats by filling interstitial spaces between gravel particles (Anderson et al. 1996; Suttle et al. 2004). Sedimentation can: (1) Bury salmonid eggs or smother embryos; (2) destroy, alter or displace prey habitat; and (3) destroy, alter or displace spawning and rearing habitat (Spence et al. 1996). Excessive sedimentation can reduce the flow of water and supply of oxygen to eggs and alevins in redds. This can decrease egg survival, decrease fry emergence rates (Bash et al. 2001; Cederholm and Reid 1987; Chapman 1988), delay development of alevins (Everest et al. 1987), reduce growth and cause premature hatching and emergence (Birtwell 1999), and cause a loss of summer rearing and overwintering cover for juveniles (Bjornn et al. 1977; Griffith and Smith 1993; Hillman et al. 1987). Through the implementation of recent forest management BMPs, (i.e. such as proposed by the NPCNF), there is little potential for sediment delivery to streams from timber harvest and prescribed burning, but there is a greater potential for delivery from road work and road use (Brown et al. 2013) because road generated sediment can enter streams directly at stream crossings.

Timber Harvest

The NPCNF proposes 7,817 acres of harvest and 1,794 acres of non-harvested pre-commercial thinning (Table 1). Harvest units will be sold in seven sales over 6 years which will distribute sediment effects over space and time, as well as concentrate downstream effects where sales overlap in subwatersheds. Regeneration and commercial thinning representing the most intensive harvest treatments, are approximately equal in acreage, and somewhat evenly distributed among the subwatersheds with a notably large 1,323 acres of regeneration harvest proposed in the Hoodoo Creek subwatershed for the 2019 Lost Mule and 2023 Corral Creek sales.

Sediment modeling

The NPCNF performed a sediment yield analysis in their National Environmental Protection Act (NEPA) and BA documents using NEZSED and FISHSED models to determine if the proposed action would cause sediment yield increases in any of the prescription watersheds that would exceed the thresholds for B and C channels. The model predicted action-related sediment increases of 10 percent to 32 percent over base in affected Clear Creek subwatersheds. Those predicted yields are generally less than the predicted threshold for effects on substrate condition. These models were designed for comparison of project alternatives prior to implementation and were not intended for quantitative analysis of sediment delivery.

The WEPP modeling was used to estimate sediment delivery from harvest, prescribed fire, and wildfire (Elliot and Miller 2017). The WEPP modeling shows an 8.6 percent increase in sediment delivery from harvest activities but this analysis did not include road activity. Due to the limitations of sediment modeling and the size and duration of this project, NMFS will examine more closely how well the specific components of the action are likely to reduce existing sediment delivery and avoid/minimize additional delivery.

PACFISH

Sediment delivery to streams from timber harvest areas will be minimized with implementation of the following: (1) PACFISH buffers will be applied to all RHCAs and landslide prone areas; (2) BMPs will be applied, including on skid trails and yarding corridors to reduce erosion and risk of sediment delivery to streams; and (3) implementation monitoring/adaptive management.

PACFISH buffers exclude timber harvest in streamside, wetland, and landslide prone RHCAs. This helps prevent overland sediment delivery from timber harvest areas to streams, and maintains slope stability.

PACFISH buffers are very effective at preventing action-generated sediment delivery to streams. During Clearwater National Forest annual monitoring of BMPs (including PACFISH buffers) from 1990 to 2002, sediment delivery to streams was observed in only 77 of 3,524 observations (2 percent) with the majority of delivery originating from the roads (USFS 2003). During onsite harvest unit layout, planned harvest areas sometimes are revised or dropped to accommodate PACFISH buffering, and this typically results in a 20–35 percent reduction in harvest area. This reduction in harvest area simply reduces the area of soil disturbance and sediment available for erosion and delivery. In addition, PACFISH buffers preclude harvest in and along landslide prone areas, thus timber harvest should not increase the risk of mass wasting from landslide prone slopes. Implementation of PACFISH buffers has proven to be effective at preventing sediment delivery from harvest areas.

Skid trails and landings

Skid trails, including skyline yarding corridors, and landings created for proposed ground-based and skyline yarding activities can compact soils, decrease infiltration rates and may lead to increased erosion and channelized flow (Croke and Mockler 2001). Skid trail and landing BMPs will be implemented to minimize soil disturbance, erosion, channelized flow, and sediment delivery. These BMPs include avoiding ground-based skidding on steep slopes over 35 percent, restricting skidding activities in wet soil conditions, locating trails and landings outside of RHCAs, and using existing skid trails and landings. No specific BMPs were given to avoid creating converging skid trails, which could concentrate and channelize flow; however, adding drainage features such as waterbars and slash to skid trails is standard practice when signs of erosion occur. In addition, PACFISH buffers will minimize delivery to streams from channelized flow if it occurs. Following use, skid trails and landings will be decompacted and LWD will be applied to bare soils to increase infiltration and minimize erosion.

The harvest design features and BMPs to be implemented on this project have been extensively monitored on the NPCNF and have been shown to be very effective in preventing sediment delivery into streams from timber harvest units. Annual implementation and effectiveness monitoring of PACFISH buffers in the action area will be included in the NPCNP's Annual Monitoring and Evaluation Report. Results from this monitoring will be used in adaptive management of ongoing project actions to further minimize or avoid sediment delivery to streams from timber harvest. Sediment delivery to streams from skidding and landings is expected to be low because of PACFISH buffers, locating landings outside of RHCAs, and other BMPs designed to prevent or minimize soil disturbance (e.g., avoiding working in wet conditions and avoiding ground-based skidding on steep slopes). Because of these BMPs, NMFS expects sediment delivery from yarding to be kept to low levels and not have adverse effects on steelhead or stream substrate.

Prescribed Fire Treatments

Project actions include prescribed (landscape scale) and pile burning. There are 1,371 acres of prescribed burning planned in the western boundary areas to reduce hazardous fuels along the Wildland Urban Interface.

Bêche et al. (2005) found that sediment was not affected and macroinvertebrates communities recovered in watershed streams a year after prescribed fire (with ignition in riparian areas) of low to moderate intensity. For 3 years following a prescribed burn in ponderosa pine forest, Arkle and Pilliod (2010) found no detectable changes in sediment, riparian or stream habitats, macroinvertebrates, and fish.

Prescribed fire effects from this project are expected to be similar to those observed by Bêche et al. (2005) and Arkle and Pilliod (2010). The most important prescribed fire BMPs for minimizing the risk of moderate to high severity burns, soil disturbance, and sediment delivery include no ignition in RHCAs and burning under conditions that favor low intensity fires. The design features and BMPs to be implemented on this project have been extensively monitored on the NPCNF and have been shown to be very effective in preventing sediment movement into streams from prescribed burn areas. With implementation of the BMPs and design features, sediment delivery, increases and thus effects to stream substrate and steelhead are expected to be negligible from prescribed burning.

Roads

The NPCNF roads have significant potential to increase erosion and sedimentation (Patric 1976; Swift and Burns 1999; Aust and Blinn 2004; Grace 2005). The NPCNF roads can alter hillslope hydrology by creating compact and less permeable surfaces (Megahan 1972), decreasing infiltration (Grace 2005), and increasing drainage networks with road surfaces and ditches (Wemple et al. 1996; Croke et al. 2001; Croke and Mockler 2001; Jackson et al. 2005), thus resulting in increased overland flow, erosion, and sedimentation during rain events. Erosion rates or yield, have been shown in monitoring and research studies to be higher from roads and log landings than from adjacent harvested and undisturbed areas (Yoho 1980; Rothwell 1983; Arthur et al. 1998). Sediment yield is the amount of sediment produced or passing a point from an area or feature, sediment delivery is the amount of sediment reaching a stream (Luce et al. 2001). Controls on sediment yield from roads include road slope and length, surface material, soil texture, and vegetative cover (Luce et al. 2001) with surface condition being affected by traffic and maintenance levels (Luce and Black 2001) and delivery dependent on precipitation duration and intensity.

The proposed temporary road construction, and road reconstruction, reconditioning, and decommissioning will be implemented to facilitate timber harvest and reduce roads on the landscape (Table 3). These actions will replace culverts on haul routes and remove culverts during decommissioning (Table 3), which will reduce the long-term risk of culvert and road failure, and its consequent large delivery of fine sediment. Common to all of the proposed road work is ground disturbance that has the potential to increase short-term sediment yield, and upgrades or decommissioning that will reduce long-term sediment yield. The following analysis will consider each type of road work and its contribution to short- and long-term sediment yield and delivery. Mileage and culvert numbers for each activity by watershed can be found in Table 3. Details of these activities are discussed below.

Temporary road construction

Temporary roads (33.6 miles) will be constructed to harvest currently inaccessible harvest units. Temporary roads are narrower and require only minimal construction compared to standard engineered permanent roads. The BMPs that prevent sediment delivery to streams from temporary roads include: (1) No water crossings; (2) temporary roads are built on or very near ridge tops and not on landslide prone slopes; and (3) temporary roads will be constructed and obliterated within 4 years. Obliteration includes recontouring, decompaction, addition of woody material for soil productivity, and erosion protection. Ridgetop roads contribute little to sediment delivery to streams because they have little drainage area above them to increase flow on the roads and have no direct surface connection to the stream network below (Megahan and Ketchusen 1996). As a result, there are no direct pathways for sediment to enter streams from temporary roads. Field reviews and monitoring of temporary roads with these design features and ridge top locations have shown no sediment delivery to streams. Because of the lack of water crossings, the near or on ridge top locations, and the short 4-year duration before obliteration, temporary roads are not expected to create any short-term pulses or long-term chronic inputs of sediment to streams.

Road Reconstruction and Reconditioning

Road reconstruction (35.6 miles) and reconditioning (76.8 miles) are designed to prepare roads for increased haul traffic. The most important BMPs or actions that will reduce the potential for sediment delivery from the road system are the addition of cross drain structures and culvert replacements or upgrades, application of surface aggregate gravel materials, or outsloping during reconstruction. Realignment and reshaping may include reopening grown-over roads, cut and fill slopes that have significant areas of ground disturbance and may capture groundwater which in turn can increase erosion rates. During reconstruction and reconditioning, ground or road surface disturbing activities will increase bare soil area and make more fine sediment available for transport (yield) with only a portion being delivered in the short term. Although sediment yield will increase with an increase in bare soil area, most of the mobilized sediment will not be delivered to streams, in part because of the position in the drainage network and also from application of BMPs such as sediment control devices and stabilizing bare soil areas by replanting vegetation. Sediment yield will decrease over 2 years by 70 percent to 90 percent while vegetation reestablishes on bare soil areas, road shoulders, and ditches (Black and Luce 1999; Megahan et al. 1991). The long-term effects from additional crossdrains, culvert upgrades, and the application of surface gravel are discussed in the following paragraphs.

Cross Drains

Road surfaces are important hydrologic pathways which affect the volume and distribution of overland flow, and alter the channel network extent, pattern, and processes (Croke et al. 2005). Water control structures, such as ditches with cross drains, broad based dips, water bars, and turnouts, are used to drain insloped road surfaces and minimize the travel length of overland flow and divert water to the forest floor (Keller and Sherar 2003). Brown et al. (2013) found that road segments with excessive lengths between water control structures and inadequate vegetative surface cover delivered the most sediment. In addition, Luce and Black (1999) found that ditch cleaning can produce greater sediment yields than road grading. Increasing the number of cross drains immediately reduces upslope drainage area that collects water, reduces erosion, and reduces surface water connectivity from road segments to streams (Brown et al. 2013). Crossdrains direct water to the forest floor where sediment is filtered out while the water infiltrates into the soil. If the distance from a crossdrain outfall to a stream is too short for complete filtering, sediment is delivered to the stream. Damian (2003) found that sediment delivery from roads is minimized by placing crossdrains within 200 feet of stream crossings and as close as possible to maintain complete filtering of sediment.

A key BMP of the project for minimizing short-term sediment delivery from reconstructed road segments is the addition of cross drain culverts near stream crossings prior to other upslope road work and haul. On reconstructed road segments, cross drains would be installed prior to road prism shaping and ditch reconstruction activities that are upslope of the new cross drain sites, such that sediment generated from subsequent activities would be de-coupled from the stream. Cross drains will be installed within 200 feet from live streams to minimize sediment delivery to streams from road surfaces and ditches. These cross drains will remain on the road system to facilitate long-term reductions in sediment delivery to streams. The proposed action includes implementation monitoring of road reconstruction and reconditioning activities in particular to verify that cross drains are installed first in the reconstruction process and effectively disconnect from the stream network most of the ground disturbance associated with reconstruction. Following crossdrain work, it is estimated that only 6 percent of the haul road network will drain to stream crossings. With crossdrain spacing optimized prior to haul, only a small portion of the haul road network can deliver sediment at stream crossings.

Culverts

Culvert work will mobilize and deposit fine sediment into the stream channel. During culvert work, most of the sediment is remobilized from the stream channel or from bedding material placed in the channel during culvert installation (Foltz 2008). Culvert work on small streams in Idaho during low flow resulted in fine sediment deposits in channels and pools, but these deposits were transported away by annual peak flows (Foltz et al. 2008). Following culvert work, Bakke et al. (2002) found that during subsequent peak flow periods, channel incision, lateral scour, and channel readjustments can add more sediment to the stream than during culvert work itself, but those effects also occur during periods of high sediment transport and redistribution. For long-term sediment control, adding rock adjacent to culvert outfall areas will reduce the risk of erosive gullying and incision below the culverts (Megahan and Ketchusen 1996). Foltz et al. (2008) found that using sediment control BMPs during culvert work resulted in a 96 percent reduction of added sediment when compared to no sediment controls.

There are 66 culverts proposed for replacement on haul roads. One of these replacements is within 600 feet of critical habitat and the closest known steelhead presence to any of the culverts is 0.7 miles (4,000 feet) downstream. Despite this distance, and as discussed above, there are six culvert replacements that may have steelhead present and will be monitored for turbidity. During culvert work, fine sediment is expected to deposit in channels or pools a maximum of 600 feet downstream and remain until the next high water. The BMPs and a low flow work window will be used to minimize fine sediment mobilization and deposition. Based on the Stillwater (2015) steelhead surveys, steelhead are not expected to be within 600 feet of the culvert replacements or the downstream deposition zones. For the six monitored culvert replacements, if juvenile steelhead were present in the deposition zones, they would be in very low numbers and free to move to other areas of the streams with more favorable substrate conditions (passage will be maintained except when initially watering a bypass channel). To counter short- and long-term sediment additions caused by channel adjustments and erosion at all culvert sites, the Forest proposes the addition of rock adjacent to culvert outfall areas. Culvert replacements will cause short-term increases in deposited sediment within 600 feet downstream and long-term risk of culvert failure resulting in larger sediment delivery will be kept to low levels with the addition of rock reinforcement around the new culverts.

Gravel Aggregate

The use of road surface gravel aggregate (i.e., 3 to 6 inches depth of coarse gravel) helps minimize soil erosion, on active roads, and greatly reduces fine sediment introduction to streams at crossings (Brown et al. 2013). Graveling of road surfaces reduces sediment production (erosion) by reducing the surface area of soil exposed to raindrop impact, tire friction, and adverse effects of vehicular weight (Megahan et al. 1991). Graveling of roads and ditches increases surface roughness which decreases water velocity, runoff, sheet erosion, and sediment transport from the road surface (Appelboom et al. 2002). Brown et al. (2013) found that bare soil roads generated 7.5 times more sediment than graveled roads. Following the application of aggregate, reductions in fine sediment delivery are concurrent with increases in plant cover on the roadside (Megahan et al. 1991) or when surface fines have washed away, the road surface stabilizes, and becomes “armored” (Megahan et al. 1991; Luce and Black 1999). Immediate results can vary from short term increases in sediment yield that continue through the winter (Megahan et al. 1991; Swift 1984) to first year reductions of 67 percent to 79 percent (Appelboom 2002; Burroughs et al. 1985 [cited in Burroughs and King 1989]; MacDonald 2005; Swift 1984). Other studies found that sediment yield reductions were complete after 3 years (Luce and Black 1999) or delivery reduced by 53 percent to 88 percent within 4 years (Appelboom 2002; Kochenderfer and Helvey 1987; Megahan 1991). In summary, graveling roads can create an immediate increase in sediment delivery due to surface disturbance but significant reductions in fine sediment delivery, when compared to native soil roads, will occur within 1 to 4 years.

Gravel will be applied to all stream crossings and where currently absent but needed. The application would occur where gravel is absent, and concurrently with road preparation for haul. Implementation monitoring of road reconstruction and reconditioning activities would occur on all reconstructed segments on which log haul occurs, or is planned to occur, to verify that timing of reconstruction activities (including aggregate application) adheres to BMPs. Short-term sedimentation from a gravel application is caused by road surface disturbance and may last through the first winter. Gravel applications can result in a 53 percent to 88 percent reduction in fine sediment delivery from treated roads within 5 months to 4 years and continue into the long term after haul has ceased. These reductions in fine sediment will help mitigate the substantial increases in haul traffic and help provide long-term reductions of road surface fine sediment from the most problematic existing road segments in the action area.

Haul

Log haul can generate sediment as a result of road surface erosion and dust. Where ditchlines terminate at stream crossings, this generated sediment can be delivered to streams. Large amounts of haul, or hauling in wet conditions, can cause rutting of roads. Ruts are channels that can route water and sediment past crossdrains or outsloped sections of road to stream crossings. This rutting can also accumulate flow which accelerates erosion of fine sediments from the road surface and adds more fine sediment to streams.

As proposed, 83 MMBF will be hauled from the action area in an estimated 16,200 round-trip truckloads on three main haul routes including the 286, 650, and 1106 roads. The highest amount of haul will occur on Roads 286 and 1106, which are estimated to be 48 percent and 41 percent of total haul and therefore will carry a greater than average haul load and duration for the project time frame. The other main haul route, the 650 Road, will carry 11 percent of the haul. These main routes are USFS system roads which fully graveled, sized, and designed to resist damage from this rate of haul. Minor haul routes will access individual timber sales and will carry an estimated five to 20 round trips a day which is at or below the average for a system road during a timber sale. Although daily use may not be above average for a sale, these roads will be used continuously for the duration of a sale(s) under allowable haul conditions. Road inspections and maintenance are commensurate with use so main and minor haul routes will be kept in fully functioning condition during haul as described below.

As described above in the spill and crossdrain sections (Sections 2.4.1.4 and 2.4.1.5 above), sediment delivery will occur at stream crossings but these stream crossings are high in the watershed and significantly upstream from ESA-listed fish and critical habitat in most cases. Of the 239 stream crossings on haul routes, 23 are over fish bearing streams and eight of these are paved bridges which will not generate sediment for delivery (231 unpaved). The remaining 216 stream crossings are near ridgetops over non-fish-bearing streams at least 0.7 miles upstream from known ESA-listed fish presence; 215 are over 600 feet from steelhead critical habitat. Considering the general location of stream crossings, overlapping sales, and extended time of haul, NMFS expects the majority of sediment effects from haul to be small at and immediately below each source site, and similarly small in downstream areas occupied by steelhead. Although sediment from multiple individual crossings of non-fish-bearing streams can combine in the downstream reaches occupied by steelhead, the larger size of the collecting streams and the process of that mobilization and deposition (largely during spring high flow) will tend to create relatively small changes, and be limited to the existing downstream depositional areas. The magnitude of the sediment deposition relies on BMPs that limit sediment delivery from upstream sources as discussed below.

Project BMPs will minimize sediment delivery from haul. With installation of crossdrains and outsloped roads draining to the forest floor, only 6 percent of haul road miles drain to streams, and only 1.4 percent drain to fish bearing streams. Road use will be limited during wet periods with haul occurring during dry or frozen conditions. The application of dust abatement is an important factor in stabilizing road surfaces to minimize sediment production and delivery. Project BMPs for road inspection (discussed below) and maintenance will insure that road drainage is functioning properly to route runoff and sediment to the forest floor in most cases and minimize sediment delivery from the short sections of road draining into stream crossings.

The NPCNF proposes to minimize sediment delivery at stream crossings primarily through the aforementioned designs and measures and through contract administration, including monitoring/response to PED (Section 1.3.3). NMFS recognizes that due to weather, design problems, or unforeseen circumstances, there is potential for road drainage features to fail. Under these circumstances, sediment delivery or imminent delivery at stream crossings is greater than anticipated. Despite the quick response to these problems as proposed, NMFS expects that PED will be identified at a limited number of locations on active haul routes. In NMFS judgement, PED would be unlikely to occur at more than approximately one quarter of the stream crossings. As noted in the proposed action, identified PED will be corrected in a matter of a few days.

The PED to a perennial stream from a road system may occur following a precipitation event that causes sediment delivery, or creates conditions of imminent sediment delivery, to that stream. Remediation of a PED on an active haul route is a contractual responsibility of the timber purchaser(s) using the haul route. By NPCNF's definition, PED involves sediment delivery or imminent sediment delivery conditions on a scale that requires mechanized correction (versus, for instance hand removal of sticks from a culvert). The PED may involve any area of a road's drainage system and any point on the road prism where water and sediment can drain directly to a perennial stream; this includes any crossdrain or other feature which is malfunctioning and routing runoff to a perennial stream. Due to the physical composition of the road surface along haul routes (typically soil and gravel), roads may need time to dry to become drivable (i.e., any vehicle must not leave ruts 3 inches deep or more for 50 feet or more) following a precipitation event. Once drivable, a Sales Administrator will begin inspecting active haul routes for PED and unsafe conditions. Within 2 days of becoming drivable, a Sale Administrator(s) must notify the purchaser(s) of any observed PED. Once notified, the purchaser(s) must remediate all PED within 4 days.

NMFS expects that sediment from haul delivered to the streams crossings will initially travel a maximum of 600 feet downstream. During storm events and annual runoff, the small project related depositions immediately below stream crossings will be redistributed farther downstream, and in that process will become more dispersed and diffuse in their effect on stream substrate. Ninety percent of crossings are over non-fish-bearing streams and are at least 600 feet above surveyed steelhead presence (Stillwater 2015) and critical habitat. Haul will increase detachment and areal dispersion of road surface fine sediments. A portion of these fines will be transported to streams through ditches to stream crossings during precipitation events large enough to mobilize these particles. Under these conditions, flows will transport sediment through the stream system following successive waves of precipitation events. These waves, attenuated from each tributary, and the temporal distribution of timber sales and haul, could create a small but constant effect on lower elevation mainstem critical habitats and steelhead throughout the project time frame. However, because only 6 percent of the haul network drains to streams, and haul routes are located in headwaters with crossings over very small streams, the amount of fine sediment added to larger fish-bearing streams and critical habitat downstream will be small and dispersed. For the 1106 Road, where it is adjacent to Green Creek, dust abatement will limit dust from the road. Fine sediment delivered through crossdrains during summer storms is not expected to travel more than 600 feet downstream, impair substrates for use by steelhead in this short reach, or be detectable in the receiving South Fork Clearwater River.

In summary, sediment delivery from haul will be minimized through: (1) BMPs; (2) monitoring and repairs of PE; and (3) dispersed timing and location of sales. Despite these minimizing factors, sediment delivery from haul will be sustained throughout the project and will have small temporary local, and small combined mainstem, adverse effects to stream substrates and steelhead.

Road Decommissioning

Road decommissioning is a ground disturbing activity that results in short-term increase in sediment yield but reduces long-term chronic sediment delivery and landslide risk (Switalski et al. 2004). Ripping and recontouring alleviates most of the risks resulting from concentrated flow including gullying, mass wasting, and increases in peak flows (Luce et al. 2001). However, the unconsolidated material retains some risk of failure, especially on lower slope locations (Madej 2001). In addition, channel adjustment (erosion) may occur following crossing removals, with erosion risk increasing with drainage area, stream gradient, and the volume of fill removed (Madej 2001). As with all ground disturbing decommissioning activities, rapid regrowth of vegetation (Foltz et al. 2008), and in particular tall trees for recontoured slopes, is essential for the success of the decommissioning (Luce et al. 2001). Where soil organic matter is lacking following decommissioning, soil amendments and/or plantings are recommended (Luce et al. 2001).

Proposed road decommissioning (13.2 miles; 13 culverts) includes activities that result in the stabilization and restoration of unneeded roads to a more natural state. Most roads proposed for decommissioning would be fully recontoured and all would be permanently closed. Local short-term increases are expected in sediment delivery and deposition in substrate from soil disturbance and stream crossing removal. The NPCNF will plant shrubs and seed where necessary as erosion control and to facilitate the reestablishment of vegetation to promote rapid regrowth and stabilization of disturbed areas. Reductions in fine sediment content in downstream substrates are expected to be evident in 1 to 2 years and continue into the long-term. On larger scales, studies have linked increased road density to increased sediment delivery (Luce et al. 2001), reduced fish abundance (Eaglin and Hubert 1993), and limited fish occurrence (Dunham and Rieman 1999). Reduction in density of road and stream crossings is expected to have the opposite effect. Proposed road decommissioning is expected to have a small long-term benefit on stream substrate and fish abundance at the watershed scale.

Deposited Sediment Summary

Harvest, burning, road work, and haul will all cause soil disturbance making sediment more available for short-term sediment delivery to streams over the period of this action and a few years beyond until soils and road surfaces stabilize. Any fine sediment delivered to streams will decrease the utility of substrates for steelhead until the fine sediment clears through successive high flows. NEZSED sediment modeling show elevated increases in sediment delivery and FISHSED modeling predicts little effect to stream substrates from project related sediment increases. Because of sediment model limitations, sediment analysis focuses on BMPs that will minimize all sources of sediment delivery from project actions. PACFISH buffering of creeks and landslide prone areas will limit sediment delivery from upland harvest to a low number of isolated incidences at the action area scale. Burning is restricted to times and conditions that are likely to result in low intensity mosaic patterns with minimal impact to riparian areas.

Installing crossdrains prior to other road work and haul, culvert replacements, locating landings away from RHCAs, locating temporary roads near ridgetops, and road decommissioning will minimize the amount of road surface draining directly to streams and will reduce the risk of culvert failure. For road actions, following a 1- to 3-year stabilization period for soil and road surface, the mitigation measures will reduce short- and long-term chronic sediment delivery, and risk of larger episodic, sediment delivery, from the road system. Roads will be upgraded a year prior to a sale and haul will continue for about 4 years during a sale. Stream reaches in or near a sale boundary are likely to have increases in short-term sediment delivery for the duration of haul and a couple of years following haul. However, early installation of crossdrains will greatly limit the amount of road surface draining to streams and 90 percent of stream crossings are over non-fish-bearing streams. In addition, proposed monitoring of active haul routes will insure damaged roads with the potential for, or active, sediment delivery will be fixed as soon as possible (days). Mainstem streams lower in the watershed may have longer periods of elevated fine sediment deposition but at an attenuated intensity compared to stream reaches in harvest activity areas directly below stream crossings.

Steelhead spawning and rearing are widely distributed in the watershed, providing some resilience with respect to disturbance in localized areas. The small adverse effects from sediment will be greatest at the subwatershed scale during individual timber sale activity. At this scale, there are few passage barriers and fish are free to seek more suitable habitat near these localized areas. Due to timber sales overlapping in time, lower mainstem reaches of some subwatersheds and the mainstem Clear Creek will have more protracted but attenuated minor adverse effects to spawning and rearing substrates and thus to steelhead. At the six culvert replacements that will be monitored for turbidity, and to a smaller degree culvert removals, road construction, and road use near streams, steelhead may be present and experience adverse effects from sedimentation of substrates.

2.5.1.6 Changes to Streamflow from Harvest (Equivalent Clearcut Area)

Canopy removal from timber harvest and road building has the potential to cause changes to water yield from the landscape. Removal of canopy reduces evapotranspiration, reduces loss of moisture from interception of precipitation, and alters snow accumulation and melt patterns, all of which can increase water yield (average annual or monthly flow) from the landscape and increase small to moderate peak stream flows. Increases in these peak flows can cause stream channel scour and bank erosion resulting in an increase in fine sediment supply to streams, with potential adverse effects to stream substrates and steelhead.

In considering the effects of timber harvest on peak flow and effects of those peak flow increases on stream channels and fish habitat, prior studies have identified key points, including the following:

(1) Increases in flow are proportional to increased area harvested (Bosch and Hewlett 1982, Keppler and Ziemer 1990; Grant et al. 2008).

(2) Peak flow increases of 10 percent represent the lower limit of detection (Grant et al. 2008).

(3) For small watersheds less than 10 square kilometers (<2,470 acres), changes in peak flows generally become detectable for transient snow zone (TSZ) watersheds when >15 percent of a basin is harvested (Grant et al. 2008).

(4) Effects will be greatest on smaller first and second order drainages because flow paths are shorter and more synchronized when compared to larger drainages (NMFS 2005b).

(5) Riparian buffers serve to reduce harvest area, contribute LWD, and maintain bank stability and resilience during floods (NMFS 2005b).

(6) It is difficult to separate peak streamflow effects of timber harvest from roads because road ditches capture groundwater and shorten flow paths (Megahan 1972, Wemple et al. 1996).

(7) Harvest induced changes in peak flows will occur in relatively moderate peak flows of <1- to 5-year recurrence intervals (Harr 1976, 1986, Ziemer 1998, Beschta et al. 2000, Grant et al. 2008).

(8) It is unclear if changes to peak flow from timber harvest alone have significant effects on salmonid habitat and populations if riparian areas and floodplains are functioning and roads are kept hydrologically disconnected from the stream system (NMFS 2005b).

(9) Flows must have sufficient force to move bed-load material to affect a channel's physical structure (Grant et al. 2008).

(10) Peak flows changes associated with harvest will have little effect on channels with either cobble and larger substrates or gradients over 10 percent (Grant et al. 2008).

(11) Harvest induced peak flow effects on channel morphology should be confined to channels with gradient equal to or less than 2 percent and streambeds and banks of gravel or finer material (Grant et al. 2008).

(12) If channels have beds of fine gravel or sand, including those with gradients over 2 percent, a much closer hydrologic and geomorphic analysis is warranted (Grant et al. 2008).

As a general guideline for third to fifth order streams, NMFS' Matrix of Pathways and Indictors (NMFS 1996) specify a <15 percent ECA as low risk for changes in peak flows. Grant et al. (2008) cites a 10 percent change in peak flows as the lower detection limit for changes in peak flows. In addition, Grant et al. (2008) developed a linear relationship between percent of area harvested and average percent change in streamflow for the TSZ. (The Clear Creek watershed harvest activities are in the TSZ.) Using the relationship developed in Grant et al. (2008), an ECA of 15 percent equates to a 10 percent change in peak flow. Grant et al. (2008) also emphasizes that peak streamflow response to ECA can vary with site conditions. The NPCNF cites several studies that support ECAs of 20 percent to 30 percent for third to fifth order streams before a 10 percent change in peak flows can be detected (NPCNF 2015).

A paired watershed study by Gerhardt (1998) in the Selway River watershed (watershed adjacent to Clear Creek), illustrates the need for ECA analysis at multiple scales including first and second order stream drainages. In the study, road building and clearcutting resulted in an ECA of 15 percent for a third order stream and up to 80 percent in upstream first and second order streams. Although there was no change in flow patterns in the third order stream (King 1998), peak flows increased 15 percent to 36 percent in the first and second order streams. In addition, following high flow events 3 to 7 years after harvest, sediment traps showed greater gravel and cobble movement when compared to the non-harvested control watershed. The consensus at the time was that the greater movement of sediment was caused by ECA related flow increases and consequent channel scour in the first and second order streams. This study demonstrated that, to capture the full effects of ECA, ECA changes to flow and sediment supply should include analysis at the scale of first and second order stream drainages.

The NPCNF used an ECA analysis model to estimate effects on water yield caused by canopy removal from harvest and roads at the third to fifth order stream scale. The analysis was performed on the three subwatersheds in the action area including the Upper Clear Creek, South Fork Clear Creek, and Lower Clear Creek. The analysis of proposed harvest predicts ECA increases of 9 to 13 percent with final ECAs, including baseline, of 10 to 15 percent. These final percentages are at or under the 15 percent to 30 percent thresholds where changes in peak flows begin to be detected. In addition, the NPCNF ran the ECA model at a finer scale for 10 prescription watersheds within three subwatersheds (NPCNF 2015). Additionally, NMFS spot checked ECA for four areas with high intrinsic potential for steelhead presence located on Clear Creek below Pine Knob Creek, Clear Creek south of Big Cedar Creek, and two points on the South Fork Clear Creek. Estimated ECA from both analyses for these prescription watersheds and points on third to fifth order streams ranged from 4 to 26 percent, still within the 15 to 30 percent thresholds where changes in peak flows may be detected. Increases in peak flows at the third to fifth order stream scale are expected to be either undetectable or marginally detectable, and would only increase smaller peak flows of 1- to 5-year recurrence interval (Harr 1976, Harr 1986, Zeimer 1998, Beschta et al. 2000, Grant et al. 2008), and thus are not expected to cause an appreciable increase in channel response (movement of streambed and streambank material) at that scale.

The NPCNF conducted field surveys of channel sensitivity and condition and analysis of ECA effects to flow in first and second order drainages where ECA was high. The NPCNF identified first and second order drainages with greater than 50 percent regeneration harvest as a surrogate for percent ECA[2]. The USFS (Benoit 1973) established guidelines for ECA thresholds based on stream elevation and stream condition. Depending upon those variables, the guidelines allow for ECAs of up to 70 percent in first order streams and 50 percent in second order streams before causing increases in water yield of greater than 10 percent. The NPCNF supplemental information shows that first order streams with proposed regeneration harvest are at elevations between 3,500 and 5,500 feet (all in the TSZ) and generally in good condition, with a few stream reaches in fair condition. Using the guidance relationship for streams in good condition, first order streams at 3,500 feet are allowed an approximate ECA of ≤23 percent, and for 5,500 feet the approximate allowed ECA is ≤63 percent. Grant et al. (2008) presents a linear relationship for small TSZ watersheds relating percentage ECA to percent change in peak flows. Using Grant's relationship, ECAs of 23 percent to 63 percent would be expected to cause peak flow increases of approximately 11 percent and 17 percent. Peak flow increases of this magnitude would increase the frequency of moderate peak flows capable of moving gravel and smaller substrates but unlikely to cause significant erosion.

NMFS followed up with a similar geographical information system screening using an approximate 30 percent or greater ECA threshold for regeneration harvest. This screening assumed there would be a 20 percent reduction (NPCNF 2015) in the map-delineated harvest area due to required area exclusions during layout (e.g. for riparian and unstable areas). Analysis areas were selected by visual inspection of a map of all proposed regeneration harvest units within first and second order drainages. The conservative 30 percent threshold was based on the following: (1) The Clear Creek watershed is in the TSZ, so effects from harvest should be similar at the range of proposed harvest elevations; and (2) using the relationship for small watersheds in the TSZ (Grant et al. 2008), a 30 percent ECA would be expected to increase peak flows by 12 percent, an increase slightly above detectable limits, From this screening, 14 harvest units were selected for further analysis. It should be noted that during harvest layout, 25–30 percent of proposed harvest area is further excluded from harvest due to PACFISH buffering; therefore, actual ECA values are likely to be less than those reported in this analysis.

NMFS screened the 14 harvest units in eight areas for proximity to known steelhead presence, stream gradient, and channel sensitivity and condition to determine the potential level of effects to fish and critical habitat. In addition, NMFS considered the areas burned in the 2015 Baldy Fire. Four of the eight areas are unlikely to have changes in peak flows because stream channels have steep gradients, large substrates, and are in good to excellent condition with abundant large wood, and stable streambanks. These channels have characteristics that would be resistant to changes from moderate increases in smaller peak flows. For the remaining harvest units, additional examination was warranted and is summarized in the four paragraphs below.

Harvest unit 109 in the Clear Creek subwatershed surrounds a second order watershed that drains directly into occupied steelhead critical habitat and has proposed harvest of 40 percent. Using

[2] Using percent regeneration harvest as a surrogate for ECA overestimates ECA because regeneration harvest is less than a clearcut, but at the same time underestimates ECA by not including roads. Roads can be a bigger factor than harvest in causing peak flow responses (Grant et al. 2008). However, the action includes disconnecting and minimizing road connections to the stream network. Although not precise, the overestimating and underestimating factors create somewhat of a balance, making percent regeneration harvest a reasonable approximation of percent ECA.

information from Grant et al. (2008), this could result in an increase of 14 percent in moderate peak flows. Channels and banks in the harvest area are in good stable condition with functioning floodplains and large wood. Headwater reaches in Unit 109 have gradients of 2 to 3 percent, and are dominated by sand and gravel with underlying cobble substrates. Although these finer sediments are more vulnerable to scour, banks and channels are not likely to scour because they are in good stable condition, have underlying large substrate, have functioning floodplains, and large wood. If realized, increases in moderate peak flows in unit 109 stream reaches may cause minor additional fine sediment transport to downstream critical habitat in Clear Creek. This additional sediment would enter the much larger Clear Creek and move through the system with the potential to settle in substrates and cause short term, minor adverse effects to rearing steelhead, such a small reduction in invertebrate forage and thus possibly minor effects on growth of some individual fish.

NMFS identified two harvest areas and the area burned by the 2015 Baldy Fire in the South Fork Clear Creek drainage as possible areas of concern. The first area (units 139, 141, and 226) has an ECA of greater than 30 percent, channel gradients of 4 to 10 percent, cobble substrates, and channels in good condition. Despite the high ECA and chance of smaller peak flows increasing, these channels pose little risk of scour and adding fine sediment to downstream habitats because of their large substrate and stable channel conditions. The second area (units 141, 142, and 224) have some sensitive channel types as represented by a survey of unit 224. The ECA in this second order drainage is 25 percent. The channels are in excellent condition and are therefore likely resistant to any small changes in peak flow. Because ECA is below 30 percent and the channel is in excellent condition, changes to smaller peak flows and erosion of the channel are unlikely. The third area of concern is the headwater area burned by the 2015 Baldy Fire. Because of the limited acreage, ridge top location of the high severity burn areas, and regrowth of ground vegetation, there is little potential for sediment transport into the South Fork Clear Creek.

The West Fork and Hoodoo Creek have three areas identified as having ECAs above 30 percent when the project is implemented. All channels in these areas have stable, larger substrate channel types in good condition and are unlikely to respond to moderate changes in small peak flows. Using the relationship for TSZ (Grant et al. 2008) for units 128 and 229, ECA would increase peak flows by about 16 percent. Although this change in flow is above the 10 percent detection limit, the stream in unit 229 was dry when surveyed, indicating that this small intermittent stream has limited flow, scour, and transport potential during small peak flows. Tributaries associated with harvest units 230 (West Fork) and 234 (Hoodoo Creek) are significantly upstream of West Fork critical habitat. Unit 230 is over two miles above critical habitat and unit 234 is 0.8 miles above a passage barrier. Although unit 234 channels were not surveyed directly, they are adjacent to other surveyed channels in the same watershed and assumed to have similar characteristics. Channels in units 230 and 234 are steep (>2 percent) with cobble substrates and are in good condition. Using the Grant et al. (2008) relationship, small peak flow increases would be just over the detectable limit and unlikely to cause scour of the large substrates. Because scour and transport of significant fine sediment is unlikely, the risk of adverse effects to downstream substrates and steelhead is low from these harvest areas.
The final area of concern is a tributary in Kay Creek with an ECA of over 30 percent. This watershed has steep stable channels and banks characterized by larger substrates and is 0.7 miles

above critical habitat in Kay Creek. With these physical characteristics and location, small increases in moderate peak flows are unlikely to cause channel changes or fine sediment mobilization and deposition great enough to cause adverse effects to downstream critical habitat or steelhead.

ECA Summary

NMFS completed ECA analysis at the subwatershed to headwater scales that show ECAs of three to 26 percent for third to fifth order streams in the Clear Creek watershed. As shown by the above-referenced literature, with ECAs of this magnitude, flow response in third to fifth order streams is unlikely to be detectable. Without detectable increases in peak flow, it is unlikely that scour, and associated addition of sediment, would cause adverse effects to steelhead.

NMFS analysis of first and second order watersheds with regeneration harvest of ≥30 percent of the watershed area revealed similarities between watersheds. Streams in these watersheds are characterized by steep gradients, large substrate, stable vegetated banks, and large wood, and are not expected to scour appreciably from the changes in peak flows. However, one second order tributary to Clear Creek, coincident with harvest unit 109, is likely to have moderate increases in moderate peak flows resulting in minor scour and entrainment of sediment. The amount of additional sediment transport is expected to be limited, given that the peak flow increases could be just over detectable limits and channels in the area are in good condition. Potential channel responses from this watershed may cause some increase in sediment delivery and deposition in downstream spawning and rearing substrate as the channel readjusts over several years. Although steelhead can move to other areas, spawning and rearing habitat would be reduced for several years having a small adverse effect on the steelhead population.

2.5.1.7 Stream Temperature

Steelhead require cold water to successfully spawn and rear. Stream shading helps to maintain cold stream temperatures, and as shade increases, water temperature decreases (Murphy and Meehan 1991). Project activities that remove or alter vegetation that provides shading to streams have the potential to increase solar insolation and in turn increase stream temperatures. Brazier and Brown (1973) determined that an 80-foot buffer strip provided maximum shading on small coastal streams and Steinblums (1977) concluded that an 85-foot buffer strip provided stream shade similar to that of an undisturbed canopy. DeWalle (2010) found buffer widths of approximately 60 to 66 feet provided approximately 85percent to 90 percent of total shade to streams.

Proposed timber harvest, temporary road building, new landings, road preparation, road decommissioning, and culvert replacements will remove trees. However, no-harvest PACFISH buffers will be implemented so no harvest or new roads or landings will occur in RHCAs or affect stream shading. Existing haul roads cross streams through RHCAs and will require removal of vegetation to clear running surfaces, meet width requirements, and replace culverts. There are 156.9 miles of haul roads with 6 percent of the haul road network draining to streams and only 1.4 percent draining to fish-bearing streams, indicating a relatively small potential for tree clearing at stream crossings to directly affect fish. For road preparation, the removal of vegetation affecting stream shade is expected to be limited to small areas; therefore, no detectable increase in stream temperatures are expected from road work near or at stream crossing sites. Vegetation may be removed for access and recontouring during road decommissioning. However, road decommissioning is limited to 13.2 miles with 13 culvert removals dispersed across the Clear Creek watershed. Reduced shade from clearing at decommissioning sites will be minimal and dispersed, and is not expected to cause significant stream warming.

Prescribed fire will be allowed to back into RHCAs increasing the potential for tree and stream shade loss. As noted in the BA, observations made by the Clearwater Forest Fisheries Biologist, Pat Murphy, noted little change or effects to streams for burns on the North Fork Clearwater District after the Elizabeth and Snow Fires of 2000 and Boundary Junction Fire in 2007. These fires were natural fire starts without suppression, burned at low intensity, and burned less than five percent of riparian areas. Prescribed fires will not be ignited in RHCAs, but will be allowed to back burn into RHCAs. Burns are done in spring and fall when fire is expected to be low intensity and proceed in a mosaic pattern based on varying humidity in riparian areas and proximity to streams.

Seasonal prescribed burning with implementation of BMPs may result in reductions of trees or other vegetation and loss of stream shading in localized areas. These incremental and localized reductions in shading are not expected to result in any detectable change in water temperatures at the local or subwatershed scale. Incidental prescribed fire in RHCAs may provide benefits by to riparian function in the longer term by reducing fuels that have the potential to increase fire intensity, and increasing stand vigor resulting in long-term increases in shade.

In summary, the proposed actions related to harvest, road work, and prescribed burning may result in small, localized reductions in streamside vegetation and shade without measurable effects to stream temperatures or steelhead.

2.5.2 Effects on Critical Habitat

The action area contains designated critical habitat for SRB steelhead. The proposed action has the potential to affect the following steelhead PBFs of designated critical habitat (Table 6): (1) Water quality; (2) water quantity; (3) substrate; (4) forage; (5) natural cover/shelter; and (6) passage. Any modification of these PBFs may affect freshwater spawning, rearing, or migration in the action area. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, rearing, and the growth and development of juvenile fish.

2.5.2.1 Water Quality

Road reconditioning, reconstruction, and decommissioning, increased road use, and crossing removal and/or replacement are expected to generate periodic turbidity pulses. The intensity and duration of these turbidity pulses will be minimized by implementing various BMPs (e.g., appropriate sediment erosion control measures, dewatering culvert work areas, cross drains, and gravelling). As discussed in the species effects section, only one culvert removal or replacement is within 600 feet of designated critical habitat, and turbidity pulses are expected to be infrequent, temporary, and of low magnitude. Turbidity from sediment delivery associated with road reconstruction and road use is expected to be minor, particularly with implementation of cross drains that limit the length of road that drains into streams, gravelling and sediment control structures to reduce and contain erosion near stream crossings, and monitoring/response to PED at stream crossings.

The proposed action involves the storage and use of petroleum products and the use of equipment and vehicles in RHCAs. In addition, the high amount of logging-related traffic creates a greater potential for fuel spills near streams. As described in Section 2.5.1.3, above, the NPCNF has a long history of avoiding spills and has included minimization measures/BMPs to reduce the risk of spill reaching a stream. Because of the history and proactive BMPs, a spill that would have adverse effects on the water quality PBF is unlikely in the action area.

Contractors may spray magnesium chloride on roads to control dust. As discussed above in Section 2.5.1.3, above, proper application of the chemicals as required by NPCNF personnel and contractors, as well as road work that directs sediment and other road-related chemicals away from streams, will help keep dust abatement chemicals from entering streams at levels harmful to the water quality PBF in the action area.

Considering the information summarized above and described in more detail in the species effects section, the proposed action is not expected to affect the function and conservation value of the water quality PBF within the action area.

2.5.2.2 Water Quantity

The proposed action has the potential to alter streamflow through the removal of forest cover and water withdrawals for prescribed fire and dust abatement. Effects of moderate peak flow increases from forest cover removal were discussed previously in Section 2.5.1.6, above. With few exceptions, critical habitat is coincident with third or greater order streams in the Clear Creek watershed. Moderate increases in ECA at the third to fifth order stream scale (i.e., middle and upper reaches of steelhead habitat) are expected to cause undetectable to marginally detectable increases in peak and base flow in steelhead critical habitat. Those effects are not expected to be of sufficient magnitude to significantly alter the water quantity PBF in steelhead critical habitat in the action area.

As described in Section 2.5.1.2, above, the proposed action is authorizing the withdrawal of water to support fire suppression and control road dust. These withdrawals are expected to be infrequent and are expected to remove only a small portion (i.e., enough to fill a water truck, which requires less than 2 hours of pumping) of the total volume of water at any given time. In addition, a fish biologist or hydrologist will designate the locations for water withdrawals to maintain streamflow. Because the flow reductions will be small, infrequent, and temporary (i.e., water will not be continually withdrawn), they are not expected to appreciably alter the water quantity PBF in steelhead critical habitat in the action area.

In summary, the proposed action is not expected to change the function or conservation value of the water quantity PBF in the Clear Creek watershed.

2.5.2.3 Substrate

As discussed Section 2.5.1.2, above, increased sediment yield and delivery to streams in the Clear Creek watershed and Green Creek may occur in the short term. Although soil erosion from timber harvest activities and prescribed burning will increase, sediment delivery to streams from those activities should be effectively minimized through implementation of PACFISH buffers and other sediment control BMPs.

This action is most likely to affect sediment delivery and stream substrate conditions through activities involving roads. Road work, stream crossing work, and increased road traffic will add to road-generated sediment movement in the short term. Prior to other road work and increased use of the roads, the installation of cross drains will disconnect most of the road area from the stream network so that most of this road-related erosion and sediment movement will not result in delivery to streams. Road BMPs including outsloping, cross drains, gravelling, sediment control measures, and dust abatement, along with monitoring/response to PED at stream crossings, are expected to minimize new sediment inputs and reduce existing sediment delivery from roads to streams.

Data are not available to determine the extent to which the action's reduction in existing sediment deliveries from roads will offset new inputs of sediment from reconstruction and road use near streams. During precipitation events, road preparation, culvert removals and replacements, haul, and road decommissioning will cause sediment delivery and deposition directly downstream of stream crossings in the action area. Sediment that is delivered to streams is expected to settle out on substrate in localized low velocity areas (i.e., pools, stream margins, or low gradient spawning and rearing habitats) within a short distance downstream of stream crossings. In the short term, the sediment will move downstream (in <1- to 4-year intervals) becoming more diffuse before settling in the next depositional reach or leaving the watershed. The areas of harvest activity and road work in the subwatersheds of Clear Creek are somewhat separated in space and time, such that both sediment additions from new activities (to the extent that these are not minimized or offset on site) and sediment reductions from road removals and repairs a year or more earlier, would converge in mainstem Clear Creek. Because of that distribution of activity effects, and the minimization of effects at the sources and delivery points as noted above, substrate conditions are not expected to change appreciably in Clear Creek in the short term.

As discussed in Section 2.5.1.6, above, certain levels of ECA increases can affect peak flow detectably and can cause channel scour that would affect stream substrate. The ECAs of 3 to 26 percent for third to fifth order streams in the Clear Creek watershed are not likely to result in a detectable increase in moderate peak flows. However, larger ECA values in some first and second order streams may cause moderate increases in small peak flows upstream of critical habitat (harvest unit 109). Although these increases in flow will be attenuated in third and higher order streams, some channel scour from increased peak flow may occur in the first or second order streams above. This scour would cause fine sediment to move downstream into critical habitat in third or greater order reaches. This sediment is expected to be of limited quantity and dispersed in time and space in designated critical habitat. As a result, there will likely only be minor adverse effects to the substrate PBF and conservation value of steelhead critical habitat for the duration of the project.

As discussed in section above, fine sediment will be introduced at stream crossings from road work or haul. There are 215 of 239 stream crossings that are over non-fish-bearing streams and upstream of critical habitat. At the stream crossings over critical habitat, road generated fine sediment will settle on substrates for up to 600 feet downstream and remain until the next high water. For the 1.4 miles of Green Creek adjacent to Road 1106, fine sediment is not expected to be detectable beyond the mouth of Green Creek in the South Fork Clearwater River. The quantity of sediment introduced to, or re-suspended in, streams during project implementation is not expected to be great enough, even at the site level, to greatly impair the utility of critical habitat (e.g., fill interstitial spaces to a degree that precludes the use of gravel by spawning adults or rearing juveniles). In the long term, the proposed action is expected to reduce the sediment yield and delivery to streams in the Clear Creek watershed as a result of the addition of cross drains, other road improvements, road decommissioning, and stream crossing removal. In summary, possible short-term additions of sediment to stream substrates are expected to result in small, localized effects on the function of the substrate PBF, and project actions are expected to somewhat improve the function and conservation value of the substrate PBF in the long term in the action area.

2.5.2.4 Forage

Macroinvertebrate forage may be affected by fine sediment deposited in substrates and may also be affected by road dust abatement chemicals that enter the stream.

As discussed in Section 2.5.2.3, above, the project may generate sediment pulses below stream crossings in the short term. Project road improvements and BMPs are expected to offset to some extent, and otherwise substantially minimize sediment deliveries such that effects on stream substrate are expected to be small, localized, and temporary. In a study with moderate levels of sediment increase from road improvements in a headwater stream drainage, little change in biomass of invertebrates was found (Kreutzweiser et al. 2005). Also, because sediment deposition may be localized, insect drift through the affected areas may be similar to unaffected areas (Bjornn et al. 1977).

Road reconstruction BMPs to reduce length of road with runoff into streams, and $MgCl_2$ application techniques favoring chemical penetration into the road surface will tend to limit the instream concentration of $MgCl_2$ and limit its effects on invertebrates to small areas near the crossings. Therefore, fine sediment deposition and dust abatement chemical effects to forage are expected to be small, localized, and temporary.

The removal of vegetation in the riparian area can reduce the amount of terrestrial habitat for insects near the stream environment. Very little riparian vegetation will be killed or removed during roadwork, culvert work, or prescribed fire activities. Following this work, bare soil areas will be revegetated. In addition, timber harvest activities will not occur in riparian areas and prescribed fire will only be allowed to back into the riparian areas. For these reasons, any effects to riparian vegetation and associated insects from the proposed action are not expected to reach levels that will adversely affect the forage PBF. The action as a whole is not expected to change the function or conservation value of the forage PBF in the action area.

2.5.2.5 Natural Cover/Shelter

The proposed action has the potential to affect channel and riparian indicators that contribute to natural cover/shelter. Channel indicators include pool frequency and quality, width/depth ratio, and off-channel habitat. Sediment and channel adjustments from stream crossing replacement or removal may cause short-term effects to stream cover.

Only one of the crossing replacements or removals is within 600 feet of steelhead critical habitat, and are on non-fish-bearing streams. Sediment introductions from this work will be minimized through implementation of project BMPs. Sediment pulses are not expected to be of sufficient magnitude to cause geomorphic changes to the stream or fill pools and gravels. Therefore, no changes are expected to pool frequency and quality, channel width-to-depth ratios, and off-channel habitats at the local and watershed scales. Because project effects to channel structure and associated cover for steelhead are likely to be minor, short term, and limited to six crossings, the project is not expected to reduce the conservation value of the cover PBF at the local to watershed scales.

The proposed action may reduce the amount of LWD in a given location during select road activities (i.e., road reconstruction and culvert work) and when prescribed fires back into RHCAs. Prescribed fires that back into RHCAs are expected to result in little tree mortality; however, if trees are killed, they will become more readily recruitable as LWD to streams. Arkle and Pilliod (2010) found no effect on LWD after prescribed fire (with no direct ignition in RHCAs) in a ponderosa pine forest. Road activities in RHCAs will result in limited, if any, tree removal. If trees are removed from work sites, they will be placed on the ground in the RHCA. Considering the very limited areas that will be impacted coupled with the limited amount of existing or potential future LWD that could be removed, the proposed action is expected to have a minimal effect on LWD recruitment and related instream cover/shelter in the action area. In summary, project actions are not expected to have adverse effects on the natural cover and shelter PBF in the action area.

2.5.2.6 Unobstructed Passage

The removal and/or replacement of six culverts monitored for turbidity will improve passage and will decrease the likelihood of culvert failure that would obstruct future passage. Because this is a long-term beneficial effect, the proposed action is expected to maintain, and slightly improve this PBF within upper Clear Creek and South Fork Clear Creek, where those culverts occur. During the replacement process, however, passage to upstream and downstream habitats will be obstructed for one day while the stream is moved to a temporary channel. Once the stream flows through the artificial channel, there will be temporary passage. This is a short-term effect as culvert replacements on these small streams will take approximately 5 days to complete, at which point the natural channel will be rewatered and fish passage conditions restored. Only small, short-term adverse effects to the “free of artificial obstructions” PBF are expected, and in the long term the action will increase the function of this PBF in upper Clear Creek and South Fork Clear Creek.

2.5.2.6 Climate Change

Project actions that last more than 10 years may cause adverse effects that are amplified by climate change. Although all timber sales will be sold within 10 years, implantation of the harvest sales may extend beyond 10 years with continued prescribed burning and decommissioning of temporary roads. In addition, prescribed burning may continue for over 10 years. Although climate change is predicted to change water temperatures, precipitation patterns, and snow runoff timing, it is the change in precipitation patterns, or an increase in rain-on-snow (ROS; Leung et al. 2004; Musselman et al. 2018) events that has the potential to amplify effects of the project. Ten years after the project begins, road obliteration and prescribed burning will continue to create bare soil areas in a mosaic of small patches. These areas have a greater chance of erosion and consequent sediment delivery than vegetated areas. An increase in the frequency of ROS would increase the risk of erosion in the bare soil areas. However, as discussed above, project-related cleared or burned areas are expected to revegetate within 1 to 2 years and PACFISH buffers would leave riparian areas vegetated and capable of filtering eroded sediment from burn areas. If eroded sediment from these patches were delivered to streams, it would likely be to a small number of streams in the action area and be transported out of the action area during the powerful high flows associated with ROS events.

During an ROS event, there would be a small increase in risk of landslides and consequent large sediment addition from the few temporary roads that have not yet been obliterated in the 10-year time frame. Landslides initiated from temporary roads are unlikely because there would be few if any temporary roads remaining on the landscape beyond the 10-year time frame and coincident with an ROS event. In addition, these roads have no direct connection to the stream network. Therefore, a temporary road failure would have little potential for sediment delivery to a stream. In summary, climate change is unlikely to amplify adverse effects from project actions because of the temporary and small expose of base soil areas to ROS events and the lack of exposure the stream network if a temporary road were to fail during an ROS event.

2.5.3 Summary of Effects on Steelhead and Critical Habitat

The action will have localized adverse effects on fish and habitat in the short term. Direct effects from stranding at six culvert replacement sites may kill up to six juvenile steelhead with an additional six steelhead affected by turbidity. Localized, short-term increases in deposition of sediment on substrates below stream crossings, the stream adjacent section of Road 1106, and below the mouth of a small watershed with high ECA and fine substrate (scour from increased streamflow) may result in harm of fish through direct exposure, displacement from current habitat, and reduction in stream functions that can affect fish growth and survival. Other modes of effects from exposure to toxins, visual and noise disturbance, prescribed fire, water drafting, ECA-related changes to streamflow (water quantity), and stream temperature changes are expected to be minor and not likely to result in harm to steelhead.

This action will result in small, temporary decreases in the condition of critical habitat PBFs within the action area in the short term, and will improve the condition of some PBFs in the long term. The action involves increased application of $MgCl_2$ salt to roads and a great deal of movement of vehicles containing fuels and other toxic chemicals through the action area creating a risk of chemical contamination of streams. Truck, equipment, and haul BMPs, and actions that will reduce road connectivity to streams will minimize the risk and amount of those effects on the water quality PBF in the action area.

Project related sediment mobilization and inputs will reduce water quality temporarily, most notably after rewatering following culvert work. Sediment inputs from road and culvert work and from haul may also reduce stream substrate condition in areas below stream crossings and below the mouth of a small watershed with high ECA and sensitive channels. These sediment impairments would continue for the time period between implementation of the activity (culvert work, road reconstruction near streams, heavy road use at stream crossings), and the time road surfaces stabilize 1 to 2 years later. In the longer term, sediment delivery should be reduced and substrate PBF conditions improved through elimination of permanent roads, addressing existing sediment sources on roads, and applying/verifying BMPs primarily within the short sections of road that remain linked to streams. Culvert replacements should decrease the risk of future culvert failure and associated sedimentation, and impairment of fish passage conditions at the six sites proposed for turbidity monitoring. Effects on the forage, natural cover/shelter, and water quantity PBFs are expected to be very small and not likely to change the condition of those PBFs in the action area.

Climate change could increase the frequency of ROS events in the action area. The ROS events are not expected to amplify project related effects because base soil areas, and thus sediment erosion and delivery, are limited to small isolated areas. In addition, landslides initiated from temporary roads during an ROS event are unlikely because there may be none or only a few miles of temporary roads left in the action area 10 years after the project begins.

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 IDL tracks timber harvest on its own land as well as private land in the Clear Creek watershed, accounting for all timbered land that is not administered by the NPCNF. Future actions include:

- Timber in the second 640-acre IDL endowment, located on the NPCNF boundary in the Clear Creek prescription watershed is not currently proposed for harvest.

- There are approximately 200 acres of IDL land endowed to public schools in the Leitch Creek prescription watershed, and no timber harvest is currently proposed.

- The Sill Creek timber harvest on an IDL endowment to the University of Idaho on the southwest edge of the action area bordering the Hoodoo Creek prescription watershed is in its final stage of completion.

In July, 2014, the IDL revised timber harvesting rules under the IFPA to increase tree retention in stream buffers for fish-bearing streams (http://www.idl.idaho.gov/forestry/fpa/shade-rule/index.html). All future timber harvest actions under IDL jurisdiction, which include private actions, require adherence to the specifications in the IFPA. Effects from these actions may include noise exposure; water withdrawals; chemical contamination; suspended and deposited sediment; streamflow alteration (ECA); and stream temperature. Based on past patterns of non-federal land forestry activity in the action area, it is likely that IDL and private parties will continue to complete pre-commercial thinning and commercial harvest in blocks of a few hundred acres or less in this watershed. Road maintenance and use on approximately 45 miles of paved, gravel, and native surface roads will also add suspended and deposited sediment, reduce riparian vegetation along some road sections, and contribute $MgCl_2$ and petroleum products to road surfaces and eventually to streams. The effects of timber and road activities managed or permitted by IDL are expected to be less than baseline due to improved riparian conservation measures in IFPA.

The Snake River Salmon and Steelhead Recovery Plan identifies degraded floodplain connectivity due to development and reduced flows due to surface water consumption as potential habitat limiting factors and threats to steelhead recovery (NMFS 2017). As discussed in the Environmental Baseline section, State of Idaho and private actions in the Clear Creek watershed, including residential, agricultural, and stock uses, have likely resulted in reduced riparian vegetation, unstable stream banks, increased erosion and sedimentation, some level of water nutrient and toxin load, reduced streamside cover, and reduced floodplain connectivity. Between 2010 and 2014, the population of Idaho County decreased by 0.3 percent (U.S. Census Bureau, 2015). NMFS assumes that future private and state activities will continue at approximate current rates, maintaining the current factors and threats limiting steelhead recovery. NMFS is not aware of any specific future non-federal activities within the action area other than those discussed above.

Recreation activities such as camping, hunting, fishing, firewood cutting, and trail use will likely continue at approximately the same rate and may have localized adverse effects on riparian vegetation, streambank stability, and cause delivery of sediment and petroleum products from some sites. There does not appear to be substantial angling pressure in the action area nor does NMFS anticipate this will not change in the future. The area is not open for sport angling of adult salmon and steelhead. Angling of juvenile steelhead may occur; however, angling in this area appears to be limited, based on limited use of trails and access points along the stream (e.g., in areas with pools). NMFS anticipate this will not change in the future.

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 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.

The Lower Clearwater steelhead population is not meeting its VSP criteria or achieving the desired low risk viability status for recovery. As discussed in the Status and Baseline sections, Clear Creek is one of six major spawning areas for the Lower Clearwater River population. Steelhead use the Clear Creek watershed for spawning, rearing, and migration. Surveys reveal that juvenile steelhead are found throughout the watershed. Critical habitat in the action area supports steelhead spawning and rearing with a wide distribution of suitable substrate and water temperatures. However, the lower mainstem of Clear Creek is temperature impaired for summer rearing but supports the greatest amount of steelhead spawning (not temperature impaired in spring) due to stream size. Critical habitat is impaired with elevated fine sediment throughout the action area likely due to the extensive native and gravel surface road network.

Baseline substrate conditions in the Clear Creek watershed are impaired by pulsed and chronic sediment delivery. Pulsed sources are from harvest (NPCNF, State of Idaho, and private) and wildfire; chronic sediment delivery sources are primarily from NPCNF and non-NPCNF roads and legacy harvest activity. In recent decades, it is likely that a lack of road sediment delivery controls at or near stream crossings is the main cause of chronic sediment delivery to streams.

As noted in the effects section (Section 2.5), implementation of the proposed action and BMPs will affect SRB steelhead and designated critical habitat in several ways:

- Juvenile steelhead within approximately 600 feet downstream of the six culvert work sites in streams known or assumed to have steelhead[3] are likely to be displaced or experience temporary reductions in foraging efficiency and/or predator avoidance due to suspended and deposited sediment. NMFS estimates that six juvenile steelhead will have minor behavioral and physiological responses to sediment produced during culvert removal and replacement activities, and six may be killed by stranding.

- Due to existing and proposed crossdrains, only 6 percent of the haul road miles will drain water and sediment to stream crossings. Because of the general headwater or ridgetop locations of haul routes, only 1.4 percent of haul road miles drain to fish-bearing streams.

- New ground disturbance and heavy use of roads during project implementation are expected to increase fine sediment delivery at steam crossings in the short term. There

[3] As noted earlier in the document, the six sites are assumed to have steelhead because there are no passage barriers below these sites.

will be some level of maintenance, haul, and/or ground disturbance near or over 231unpaved stream crossings. Of these crossings, 15 are over fish-bearing streams and only one is within 600 feet of critical habitat. The remaining crossing are in headwater areas away from steelhead and critical habitat. Increased sediment delivery at stream crossings will continue for a period of 1 to 4 years following road upgrades or until active haul ceases, whichever is greater. During this active period road upgrades and crossdrains will minimize the road length draining to crossings, and PED monitoring will minimize damage to road drainage.

- In the short term, after a pulse of sediment from road work, the reduced road length, larger culverts, and graveling will reduce delivery when compared to baseline. In the long term, road and drainage improvements, and road decommissioning are expected to reduce fine sediment delivery from roads when compared to baseline.

- Initial deposition of sediment from crossings will be within 600 feet downstream from crossings. Beyond 600 feet, effects will be delayed and attenuated depending on distance downstream from crossings.

- For timber harvest, the use of PACFISH buffers, exclusion of landslide prone areas from harvest, and other measures to avoid creating channelized flow to streams are expected to minimize any fine sediment delivered to streams to immeasurable levels.

- The NPCNF and NMFS analyses show that a peak flow response from ECA for third to fifth order streams in the Clear Creek watershed would be unlikely or undetectable, unlikely to scour, and unlikely to cause adverse effects to substrate and steelhead. In South Fork Clear Creek, the 2015 Baldy Fire burn area, in combination with proposed harvest, did not increase ECAs to levels associated with detectable increase in peak flow. At the finer scale of headwater streams, streams in one area (containing harvest unit 109) was identified as being at risk for scour from higher ECA and potential increases in peak flows. Although channels in this area around unit 109 are in good condition, channels are composed of finer, more erosive materials which could mobilize if peak flows increase. Potential scour from these channels may cause an increase in sediment delivery and deposition in downstream substrates resulting in short-term, minor adverse effects to spawning and rearing steelhead, and critical habitat.

- Prescribed fire treatments, dust abatement chemicals, equipment/truck leaks, spills of fuels, water withdrawals, temporary fish passage obstructions, vegetation removals at near-stream work sites, and construction/haul noise all have the potential to adversely affect steelhead and critical habitat. However, the NPCNF will employ numerous precautionary measures/BMPs that NMFS expects will reduce the occurrence of those effects and limit the effects to those that will not harm steelhead.

- Fine sediment levels throughout the action area are elevated. The proposed action will add dispersed short-term pulses during project implementation but will reduce long-term chronic sediment delivery. Road work, in preparation for haul, will add short-term pulses of sediment with localized accumulations below stream crossings. However, during

> project implementation and after haul for a given timber sale is complete, road improvements are expected to reduce sediment inputs in these sale areas when compared to baseline. In addition, one harvest unit has been identified as a risk for channel erosion and sediment delivery. Over time, localized accumulations of sediment will move downstream in successive high water periods creating a more attenuated small but constant effect on downstream substrates in critical habitat. Because of improvements to the road network and road decommissioning, long-term chronic sediment delivery from the road network is expected to decrease.

Regarding cumulative effects, available information indicates that ongoing private and state timber harvest-related activities, private land development, grazing, water use, and recreation in the Clear Creek watershed are expected to continue at approximately the same level. NMFS assumes the effects from these activities in combination with the existing channelization of lower Clear Creek will continue to limit habitat function for steelhead migration, rearing, and spawning in Clear Creek downstream of the NPCNF boundary at a level similar to what currently exists.

Climate change may increase the risk of large rain-on-snow runoff events (Crozier 2013) which could increase erosion on roads. However, the NPCNF's proposed road upgrades and crossdrain installations will reduce future potential for sediment delivery and reduce the overall amount of sediment delivered to streams. The 20-year timeframe for implementing the proposed action will occur while climate change related effects are expected to become more evident in this and other watersheds within the range of the Snake River Basin steelhead DPS.

As noted above, the effects of the action involve both short-term increases in sediment delivery from reductions site specific culvert work and haul and long-term reductions in sediment delivery from road improvements. During the 20-year implementation period, road improvements, recent and ongoing road decommissioning, and haul will be occurring at the same time and deliver sediment at stream crossings. These positive and negative effects for steelhead habitat and steelhead appear to be distributed fairly evenly in time through the 20-year period as the sequential road work and timber harvest is implemented. There will be spatial variations in the effects, as the main areas of harvest and log haul move from subwatershed to subwatershed with the timber sales occurring one after another. Even in the areas of the most activity in a particular year, the negative effects of increased sedimentation are expected to be localized (e.g. to a few hundred feet below stream crossings), mostly occurring on streams that do not have steelhead, and of small magnitude because of the PACFISH buffers for harvest activities and various road BMPs that can be very effective in eliminating and minimizing sediment inputs and monitoring to ensure that they are.

The proposed action is expected to have short-term minor effects on steelhead habitat condition in Clear Creek over the life of the project. During and after the project, the project road work will likely combine with other work underway in the watershed to decrease sediment delivery from roads and eventually help reduce fine sediment levels in the stream substrate. The Proposed ESA Recovery Plan for Snake River Idaho Spring/Summer Chinook Salmon and Steelhead Populations (NMFS 2017) has noted that substrate sedimentation is one of the primary limiting factors to tributary habitat production for the Lower Clearwater Mainstem steelhead population, of which the steelhead in Clear Creek are a part. The proposed action's effects, as limited by various BMPs, are not expected to appreciably increase fine sediment in the short term, and should reduce fine sediment in the long term, in the Clear Creek major spawning area (one of six major spawning areas for this population). The action, therefore, is not expected to appreciably reduce habitat function and steelhead production substantially for this population in the short term, and may, to a small degree, improve steelhead habitat and production for this population in the long term. Those minor effects within the population will not hinder, and may in a small way help its progress from its current moderate risk status to the Recovery Plan goal of low risk/viable status, which is necessary for the Clearwater Basin MPG to achieve viable status. Viability of the Clearwater Basin MPG is a necessary component for the recovery of the Snake River Basin steelhead DPS.

The number of juvenile steelhead estimated to be killed or injured in the course of this action will not be large enough to influence the number of adult fish returning to the action area. Considering these potential effects of the proposed action along with the status of the species, baseline condition, potential effects of climate change, and cumulative effects in the action area, NMFS concludes that any realized mortality should not appreciably reduce the likelihood of the survival and recovery of Snake River Basin steelhead.

Considering the potential effects of the proposed action with the status of critical habitat, baseline condition, potential effects of climate change, and cumulative effects in the action area, NMFS concludes that the proposed action is not expected to appreciably reduce the conservation value of critical habitat in the short term, and may increase the long-term conservation value of critical habitat in the Clear Creek watershed.

2.8 Conclusion

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

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). On an interim basis, NMFS interprets "harass" to mean "Create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "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.

2.9.1 Amount or Extent of Take

The proposed action is reasonably certain to result in incidental take of ESA-listed species. NMFS is reasonably certain the incidental take described here will occur because: (1) Recent, and historical surveys indicate ESA-listed species are known to occur in the action area; (2) the proposed action involves construction and maintenance activities on roads and heavy use of roads within RHCAs that could result in sediment delivery to streams; and (3) the proposed action includes instream work activities that could harm or kill juvenile steelhead (e.g., dewatering, rewatering/turbidity). In the biological opinion, NMFS determined that incidental take would occur as follows:

(1) Mortality of juvenile steelhead during channel dewatering for culvert replacements;

(2) Harm of juvenile steelhead as a result of temporary turbidity plumes associated with construction activities for culvert replacements;

(3) Harm of juvenile steelhead from sedimentation of substrate below stream crossings associated with culvert removals and replacements, and with road reconstruction and use near streams;

(4) Harm of juvenile steelhead from ECA-related sedimentation of substrate below first and second order streams adjacent to harvest unit 109.

Incidental Take from Channel Dewatering

As described in the species effects analysis, NMFS was able to quantify the take associated with the six culvert replacements that are most likely to have steelhead present (i.e., take from channel dewatering and turbidity plumes). NMFS estimated the total number of steelhead that may experience adverse effects if steelhead are present at any of these six culvert replacement sites. Up to 12 steelhead may be present within 600 feet of the six culvert replacements. Of the 12, six juvenile steelhead may be killed as a result of stranding during channel dewatering. Therefore, NMFS will consider the extent of take exceeded if more than six juvenile steelhead are found dead within 600 feet downstream of the six culvert replacements.

Incidental Take from Turbidity Plume

NMFS estimated that up to six juvenile steelhead could be temporarily displaced due to elevated turbidity levels resulting from instream work at six culvert replacements. Because it is not feasible to observe fish fleeing the area, NMFS will use the extent and duration of the turbidity plumes as a surrogate for take. Because turbidity is the direct cause of take of steelhead, and it is known what levels of turbidity cause adverse effects to steelhead, monitoring turbidity is an excellent surrogate for this take pathway. NMFS will consider the extent of take exceeded if turbidity plumes at any of the six monitored culvert replacements extends beyond 600 feet downstream at greater than 50 NTU for more than 60 consecutive minutes.

Incidental Take from Sedimentation of Substrate

Similarly, it is likely that there will be increased levels of deposited sediment below stream crossings associated with culvert work, road reconstruction, or heavy road use. These areas will also likely be contained within the 600 feet as described above. However, due to the extremely high variability that occurs when measuring deposited sediment in stream substrates (Leonard 1995), it is not practicable to assess changes in deposited sediment through direct measurements. The type of sampling design and number of samples required to detect a statistically significant change would be prohibitive. In addition, take cannot be quantified because steelhead presence and density is highly variable due to natural factors such as seasonal water temperature or flow, or channel conditions. For this reason, NMFS will use the condition of the road at the stream crossings as a surrogate for take from sedimentation of substrate. Road condition is a reasonable surrogate for take because of the causal relationship between disrepair of roads and consequent sediment delivery to streams and substrate. Because road surface and drainage condition affect the amount of erosion and fine sediment delivery from the road to stream substrates, and excess fine sediment in substrates can cause harm to steelhead, monitoring road surface and drainage conditions is a reasonable surrogate for this take pathway. The NPCNF monitors the road surface and drainage condition while administering timber sales and uses PED (Potential Environmental Damage) as a threshold for any deterioration of the road surface or drainage in need of mechanical repair. The PED develops after significant precipitation events. Because of the potential for erosion and sedimentation of substrates downstream from roads segments exhibiting PED, it is important that PED be identified and repaired as quickly as possible after PED develops.

NMFS will consider the extent of take to be exceeded if PED meets any of these conditions:

(1) PED is present at 25 percent or more of the stream crossings on active haul routes within 2 days of roads becoming drivable (i.e., a Sales Administrator's vehicle);

(2) PED is present at 25 percent or more of the fish-bearing stream crossings on active haul routes within 2 days of roads becoming drivable (i.e., a Sales Administrator's vehicle); or

(3) PED on active haul routes is not corrected within 6 days after roads become drivable for cars.

NMFS uses 25 percent PED as a threshold of take not to be equaled or exceeded because it would represent (on average) need for mechanized repairs at a quarter or more of active haul crossings of fish-bearing streams and a more-than-infrequent occurrence of effects on non-fish bearing streams that could be sources of eventual sediment movement into areas with steelhead. Effects in excess of that percentage would seem to indicate a prevalence of design/maintenance execution problems and/or rain events that were more intense than the planned designs and maintenance withstood effectively. Although these effects would be addressed quickly under the action, their temporary presence could indicate future erosion issues and a greater source of sediment delivery at these crossings, and more take in the stream reaches below the crossings, than NMFS anticipated.

Incidental Take from ECA-related sedimentation of substrate

As described in the effects discussion, changes in ECA may have adverse effects on steelhead and critical habitat through peak flow increases causing erosion/sediment delivery from two small watersheds. If these adverse effects occur, they will be sources of take of steelhead. The additional amounts of sediment associated with harvest-induced peak flow increases from channels in these watersheds cannot be quantified because there are many uncontrolled environmental variables (such as precipitation and peak flow quantity) that affect the outcome. For these reasons, the effects of that sediment on steelhead growth, survival, and reproductive success also cannot be quantified as a number of fish killed or harmed. Therefore, NMFS will use the regeneration harvest acreage (percent of watershed area) itself as the surrogate for take. Regeneration harvest acres is a reasonable surrogate for take because of it is causal relationship to take. Regeneration harvest removes canopy cover, reductions in canopy cover can cause increases in peak stream flow which can cause stream channel scour and sedimentation of downstream substrates, and sedimentation of substrates can cause harm to steelhead. Take will be exceeded if regeneration harvest in the watershed containing harvest unit 109 exceeds the proposed regeneration harvest area of 132 acres. The area for this watershed will be delineated from its drain point at its confluence with Clear Creek. Prior to harvest, if the NPCNF finds it necessary to plan to exceed 132 acres of regeneration harvest for this watershed the NPCNF will reinitiate consultation. Although this surrogates could be considered coextensive with the proposed action, monitoring and reporting requirements will provide opportunities to check throughout the course of the proposed action whether the surrogates are exceeded. For this reason, the surrogates function as effective reinitiation triggers.

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 Snake River Basin steelhead or destruction or adverse modification of their 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 NPCNF and U.S. Army Corps of Engineers (COE) (for those measures relevant to the Clean Water Act [CWA] section 404 permit) shall comply with the following RPMs:

1. Minimize the potential for incidental take from culvert replacements, road preparation and haul, and harvest.

2. Ensure completion of a monitoring and reporting program to confirm that the terms and conditions in this ITS were effective in avoiding and minimizing incidental take from

permitted activities and ensuring amount/extent of incidental take defined herein is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the NPCNF and (where applicable to any CWA section 404 permitting) COE must comply with them in order to implement the RPMs (50 CFR 402.14). The NPCNF and COE have 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 incidental take statement (50 CFR 402.14). If the NPCNF and COE do not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1) To implement RPM 1, the NPCNF and COE (for those measures relevant to the CWA section 404 permit) shall ensure that:

   a) The proposed action, including all described conservation measures and BMPs, will be implemented as described in the BA and Proposed Federal Action section of this Opinion.

   b) Sediment sources on reconstructed roads and haul routes will be identified and eliminated or minimized prior to log haul activities for each of the planned timber sales. Correction of these sediment sources will be field verified through implementation monitoring prior to haul.

   c) The creation of channelized flow through harvest activities (i.e. skid trails, yarding activities, land construction and design) is avoided.

   d) The NPCNF or COE shall require contractors to maintain all equipment operating in the action area in good repair and free of abnormal leakage of lubricants, fuel, coolants, and hydraulic fluid.

   e) All motorized equipment and vehicles used in or near the stream or riparian areas are cleaned of external oil, dirt, and mud; and repair leaks prior to arriving at the project site.

   f) The NPCNF or COE shall require onsite contractors to have spill prevention and containment materials on site during inwater work to minimize the risk of an accidental spill of petroleum products resulting adverse effects to water courses and aquatic biota in the event of a spill.

   g) No fuel storage will be allowed within RHCAs.

   h) NMFS is contacted within 48 hours of any project log truck accident that occurs within 50 feet of moving water or is leaking fuels or other toxic chemicals into streams.

i) NMFS fish screen criteria (NMFS 2011) will be utilized for all water pumping activities. A qualified fisheries biologist shall inspect all pumping locations. Undercut banks shall not be exposed and connected flow at and below pump sites shall be maintained. Upstream and downstream juvenile and adult passage shall be maintained. No more than 20 percent of streamflow shall be pumped.

j) For $MgCl_2$ applications, a 1-foot buffer zone is applied on the edge of gravel, if the road width allows.

2) To implement RPM 2 (monitoring and reporting), the NPCNF and COE (as relevant to the CWA section 404 permit) shall ensure that:

a) All steelhead injured or killed shall be identified, counted, and recorded. These data will be reported in the annual project report.

b) If project take of steelhead (total of six fish) from stranding is exceeded at the six culvert sites, work will be suspended and NMFS will be called to discuss reinitiation of consultation.

c) Turbidity monitoring shall be conducted for the six stream crossings proposed for turbidity monitoring. Turbidity readings shall be collected at the following locations: (1) greater than 50 feet upstream of the action area; and (2) 600 feet or less downstream of the action area. Turbidity at the downstream sample location shall be recorded every 30 minutes until the plume is no longer visible at 600 feet or less downstream. Monitoring of NTUs, time and distance of measurements, and maximum extent of turbidity will be reported in the project annual report.

d) The NPCNF shall inspect all active haul road drainage systems for signs of PED within 2 working days of roads becoming drivable (i.e., a Sales Administrator's vehicle) following a precipitation event. Within the 2 working days of inspection, the NPCNF will also notify and direct the responsible purchaser to correct the cause of the PED condition within 4 days following notification. The NPCNF will keep a log of identified PEDs and of NPCNF and contractor compliance with the corrective 4-day time frame. Logged PED will be submitted in the Project annual report. Further details of this monitoring can be found in Sections 1.3.3 and 2.9.1.

e) The Forest Service shall not plan more than 132 acres of regeneration harvest in the watershed containing harvest unit 109 (i.e., this watershed may have multiple regeneration harvest units). The watershed containing unit 109 has a drain point with coordinates latitude 46.0589, longitude -115.7487. NMFS will provide the NPCNF the watershed delineation file of the watershed so the NPCNF can verify that the planned regeneration harvest does not exceed 132 acres. After layout and prior to harvest, if the NPCNF finds it necessary to plan to exceed 132 acres of regeneration harvest for this watershed, the NPCNF will reinitiate consultation. The NPCNF will report the final layout acreage for regeneration harvest in the annual report for the year that work is completed in the watershed.

f) If the extent of take described above (for steelhead mortality, turbidity, harvest, or PEDs) is exceeded, the NPCNF shall cease take-causing activities and contact NMFS within 72 hours.

g) Post-project reports summarizing the results of all monitoring shall be submitted to NMFS by December 31 annually. The annual project reports shall also include a statement on whether all the terms and conditions of this Opinion were successfully implemented.

h) The post-project reports shall be submitted electronically to: nmfswcr.srbo@noaa.gov. Hard copy submittals may be sent to the following address:

National Marine Fisheries Service
Attn: Ken Troyer
800 Park Boulevard
Plaza IV, Suite 220
Boise, Idaho 83712-7743

i) NOTICE: If a steelhead or salmon becomes sick, injured, or killed as a result of project-related activities, and if the fish would not benefit from rescue, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. If the fish in question appears capable of recovering if rescued, photograph the fish (if possible), transport the fish to a suitable location, and record the information described above. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by proposed activities, or some unnatural cause. The finder must contact NMFS Law Enforcement at (206) 526-6133 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. To mitigate the effects of climate change on ESA-listed salmonids, the NPCNF and COE should follow recommendations by the ISAB (2007) to plan now for future climate conditions by implementing protective tributary, mainstem, and estuarine habitat measures; as well as protective hydropower mitigation measures. In particular, implement measures to protect or restore riparian buffers, wetlands, and floodplains; remove stream barriers; and to ensure late summer and fall tributary streamflows.

2. To increase the scope of crossdrain sediment monitoring, the NPCNF should consider adding the 1106 Road to their crossdrain monitoring. Specifically, the NPCNF could monitor each crossdrain on the 1106 Road that is immediately upstream of each stream crossing within the South Fork Clearwater watershed and on Forest Service land. The crossdrains would best be monitored prior to haul on this road and thereafter at the same frequency as the proposed crossdrain monitoring.

Please notify NMFS if the NPCNF or COE, or another entity, carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Clear Creek Integrated Restoration 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.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (Section 3.) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

On September 12, 2014, NMFS approved Amendment 18 to the Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California (FMP). Amendment 18 revises the description and identification of EFH for Pacific salmon managed under the FMP, designates habitat areas of particular concern, updates information on fishing activities, and updates the list of non-fishing related activities that may adversely affect EFH and potential conservation and enhancement measures to minimize those effects.

This analysis is based, in part, on the EFH assessment provided by the NPCNF and descriptions of EFH for Pacific coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) (PFMC 2014), including Amendment 18 (79 FR 75449) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The PFMC designated EFH in the Clear Creek watershed for Chinook salmon (PFMC 1999) and for coho salmon (Amendment 18). The action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of coho and Chinook salmon. The Tribe has undertaken the reintroduction of both coho and Chinook salmon, and both species are successfully returning to the watershed.

3.2 Adverse Effects on Essential Fish Habitat

Based on the information provided in the BA and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will have the following adverse effects on EFH designated for Chinook and coho salmon: (1) Increased sediment temporarily affecting water quality and substrate in some areas; and (2) temporary disruption of juvenile migration and rearing activities.

3.3 Essential Fish Habitat Conservation Recommendations

The NPCNF and COE should ensure that:

1) The proposed action, including all described conservation measures and BMPs, will be implemented as described in the BA and Proposed Federal Action section of this Opinion.

2) Spill prevention and containment materials will be kept on site to minimize the risk of an accidental spill of petroleum products, as well as to protect water courses and aquatic biota from adverse effects in the event of a spill.

3) No fuel storage will be allowed within RHCAs.

4) NMFS is contacted within 48 hours of any Project log truck accident that occurs within 50 feet of moving water or is leaking fuels or other toxic chemicals into streams.

5) Sediment sources on reconstructed roads and haul routes would be addressed and eliminated or minimized prior to log haul activities for each of the planned timber sales.

6) NMFS criteria (NMFS 2011) are utilized for all water pumping activities. A qualified fisheries biologist shall inspect all pumping locations. Undercut banks shall not be exposed and connected flow at and below pump sites shall be maintained. Upstream and

downstream juvenile and adult passage shall be maintained. No more than 20 percent of streamflow shall be pumped.

7) All motorized equipment and vehicles used in or near the stream or riparian areas are cleaned of external oil, dirt, and mud; and repair leaks prior to arriving at the project site.

8) The creation of channelized flow through harvest activities (i.e. skid trails, yarding activities, land construction and design) is avoided.

9) Contractors shall maintain all equipment operating in the action area in good repair and free of abnormal leakage of lubricants, fuel, coolants, and hydraulic fluid.

10) For $MgCl_2$ applications, a one-foot buffer zone is applied on the edge of gravel, if the road width allows.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, NPCNF and COE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the federal agency have agreed to use alternative time frames for the federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The NPCNF and COE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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 document are the NPCNF, its representatives, its contractors, and the COE. 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: Timber Harvest, and Road Construction, Maintenance, and Repair.

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 NMFS' ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion/EFH consultation contain 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 MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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