United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

August 9, 2010

In Reply Refer To:
USFWS Reference: 13260-2010-F-0070
Hydrologic Unit Code: 17-02-00-08-04, Lower Chewuch River

Mike Liu, District Ranger
Okanogan-Wenatchee National Forests
Methow Valley Ranger District
24 West Chewuch Road
Winthrop, Washington 98862

Dear Mr. Liu:

This correspondence transmits the U.S. Fish and Wildlife Service's (Service) biological opinion, which is based on our review of the Buck Forest and Fuels Project (Project), located in Okanogan County, Washington. Representing the U.S. Forest Service, you requested initiation of formal consultation regarding anticipated adverse effects from the proposed Project on the Columbia River interim recovery unit of the bull trout (*Salvelinus confluentus*). The attached biological opinion describes the effects of the Project on the bull trout in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

The Service received your letter requesting initiation of formal consultation and the final Biological Assessment for the Project on June 10, 2010. Informal consultation regarding effects of the Project on listed species of terrestrial wildlife was completed on June 15, 2010 (Service ref. 13260-2010-I-0069). These materials and a complete record for this consultation are on file in our Central Washington Field Office.

Our analysis of Project effects in the attached biological opinion leads us to conclude that implementation of the proposed Project will not jeopardize the continued existence of the bull trout, nor will it destroy or adversely modify proposed critical habitat. The incidental take statement accompanying our biological opinion provides the U.S. Forest Service with an exemption from the Section 9 prohibitions described in the Endangered Species Act. Please note that this incidental take statement also includes mandatory "reasonable and prudent measures" and "terms and conditions" that are designed to minimize incidental take. We also offer several "conservation recommendations" that are non-binding and are designed to minimize risks to listed species associated with Project implementation.

Thank you for helping to conserve listed species. If you have questions about this biological opinion or your responsibilities under the Endangered Species Act, please contact Karl Halupka of the Central Washington Field Office in Wenatchee at (509) 665-3508 x11 or via e-mail at Karl_Halupka@FWS.gov.

Sincerely,

Jessica L Gonzales for

Ken S. Berg, Manager
Washington Fish and Wildlife Office

Enclosure

cc:

Send by E-mail:

Cameron Thomas, U.S. Forest Service, Supervisor's Office, Wenatchee, WA
Justin Yeager, NOAA Fisheries, Ellensburg, WA
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BIOLOGICAL OPINION

for the

Buck Forest and Fuels Project

U.S. Department of Agriculture
Forest Service
Okanogan - Wenatchee National Forest
Methow Valley Ranger District
24 West Chewuch Road
Winthrop, Washington 98862

USFWS Reference Number: 13260-2010-F-0070
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Hydrologic Unit Code: 17-02-00-08-04, Lower Chewuch River

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Date Aug 9, 2010

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EXECUTIVE SUMMARY

The Buck Forest and Fuels Project (Project) has six purposes: (1) improve forest health, (2) reduce hazardous fuels, (3) enhance and protect habitat within riparian reserves, (4) manage and improve the road network, (5) improve stand health and remove tree hazards in the Buck Lake Campground, and (6) contribute to economic activity through the production of sawtimber and biomass. These objectives will be met using a combination of various timber harvest and thinning treatments, mechanical fuels reduction and underburning, and road management activities. The USFS expects implementation to begin in 2010 and to be completed in 2018. The Project is located in the Lower Chewuch River watersheds, and covers about 27,240 acres.

All of the work elements of the proposed Project have the potential to impact bull trout and their habitat. In consultation with the Service, the U.S. Forest Service reached the determination of "may affect, likely to adversely affect" the bull trout for the proposed Project, triggering formal consultation and the completion of this biological opinion. The USFS also concluded the Project would not destroy or adversely modify proposed critical habitat for the bull trout (designated critical habitat is not present in the Project area).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration. Five segments of the coterminous United States population of the bull trout are essential to the survival and recovery of this species and are identified as interim recovery units. The Project is located in the Columbia River interim recovery unit which currently contains about 100 core areas and 500 local populations. The immense size and complexity of this interim recovery unit make it difficult to determine its current status. In a recent risk assessment, 76 percent of the core areas in the unit (including the Methow core area, in which the proposed Project will occur) are in the two highest-risk categories. This risk profile suggests that unit-wide resilience to further habitat degradation may be limited. The high number of and variability in conditions among core areas, difficulty of assessing aggregate risk, lack of key biological information, and the lack of a completed Recovery Plan to inform 7(a)(2) analysis all contribute to uncertainty about the current status of the unit and the potential unit-wide consequences of localized project effects.

Although bull trout are widely distributed in the Methow core area, abundance is generally low and productivity highly variable. The Methow core area also shows a reduced distribution of the migratory life-history form. Numerous historic and ongoing factors continue to limit the potential for population recovery at the core-area scale. Several spawning locations within the Methow core area have been directly and severely affected by wildfire in recent years. The U.S. Fish and Wildlife Service (Service) expects that recruitment of juvenile bull trout into the spawning population will be depressed until the areas destabilized by wildfires are more fully re-vegetated. Population indicators in the Methow core area are "not properly functioning" due to low estimates of total population size, reduced connectivity among local populations, and concern about introgressive hybridization with brook trout (*Salvelinus fontinalis*).

Despite extensive wildfire effects in recent years, the baseline condition of most habitat pathways in the Chewuch watershed are "properly functioning" in the upper watershed or "functioning at risk" in the lower watershed. Elevated temperature and sedimentation, a deficiency of large woody debris, high road density, and low pool frequency and quality are the primary factors contributing to reduced habitat suitability for bull trout in the lower watershed.

The Project will cause direct negative effects on only the Chewuch River local population; one of ten local populations in the Methow core area. The Project will also result in adverse indirect effects due to increased sedimentation reducing invertebrate productivity. The baseline condition of the Chewuch River local population likely to be adversely affected is "not properly functioning." Baseline habitat conditions are variable, with strong recent influences of wildfire, defoliating insects, timber management, past grazing allotment management, and several restoration projects that improved habitat access. Cumulative effects include potential residential and recreational development on private lands low in the watershed with associated impacts to habitat quality.

The Service believes that adverse direct and indirect effects during Project implementation will cause primarily sub-lethal injury of bull trout from all age classes. Within the context of all the factors that influence the dynamics of bull trout populations, we think the scope and severity of these effects will be too limited to result in changes in the reproduction, numbers, or distribution of the local population affected.

Incidental take of bull trout is likely to occur as a result of Project implementation. We estimate sub-lethal incidental take of up to 55 bull trout due to harassment and up to 10 bull trout redds due to harm associated with habitat degradation during the 8-year term of this Project. Limited, lethal incidental take of alevins is expected to occur. The Incidental Take Statement accompanying this biological opinion includes mandatory Reasonable and Prudent Measures and Terms and Conditions intended to minimize this incidental take. Non-mandatory conservation recommendations are also provided to minimize or avoid adverse effects of this proposed action on listed species and to develop information.

Our opinion is that all Project effects are unlikely to diminish the numbers and reproduction of the local population of bull trout affected and will not reduce the distribution of local populations in the core area. We expect the negative effects of the Project at the local scale to be imperceptible at the larger scales of the core area, interim recovery unit, or range-wide. Based on our review and analysis, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Columbia River interim recovery unit of the bull trout.

INTRODUCTION

The Buck Forest and Fuels Project (Project) has six purposes: (1) improve forest health, (2) reduce hazardous fuels, (3) enhance and protect habitat within riparian reserves, (4) manage and improve the road network, (5) improve stand health and remove tree hazards in the Buck Lake Campground, and (6) contribute to economic activity through the production of sawtimber and biomass. These objectives will be met using a combination of various timber harvest and thinning treatments, mechanical fuels reduction and underburning, and road management activities. The USFS expects implementation to begin in 2010 and to be completed in 2018. The Project is located in the Lower Chewuch River watersheds, and covers about 27,240 acres.

All of the work elements of the proposed Project have the potential to impact bull trout and their habitat, especially the "sediment," "embeddedness", "instream flow," "riparian reserve," "drainage network," and "road density and location" indicators of habitat quality. In consultation with the Service, the USFS reached the determination of "may affect, likely to adversely affect" the bull trout for the proposed Project, triggering formal consultation and the completion of this biological opinion. The USFS also concluded the Project would not destroy or adversely modify proposed critical habitat for the bull trout (designated critical habitat is not present in the Project area). The proposed action includes numerous provisions that are likely to be effective in minimizing Project effects on the bull trout and its habitat. We expect that the Project will also likely have many beneficial effects for bull trout over the long term. The Service agrees that the Project, as planned, is consistent with the Northwest Forest Plan (NWFP).

The U.S. Fish and Wildlife Service's (Service) objective for the following biological opinion (BO) is to determine whether the proposed Project is likely to "jeopardize the continued existence" of the bull trout (*Salvelinus confluentus*). No designated critical habitat for the bull trout will be affected by the Project. The standards for determining jeopardy are described in Section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*) and further defined in 50 C.F.R. 402.14.

The Service's jeopardy determination for bull trout relies on four components of analysis: (1) The *Status of the Species* evaluates the species' range-wide condition, the factors responsible for that condition, and the species' survival and recovery needs. (2) The *Environmental Baseline* evaluates the condition of the species in the action area, the factors responsible for that condition, and the role of the action area in the species' survival and recovery. (3) The *Effects of the Action* determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species. Finally, (4) *Cumulative Effects* evaluates the effects of future, non-Federal activities in the action area on the listed species present.

In accordance with the implementing regulations for Section 7 of the Endangered Species Act of 1973 (Act) and Service policy, the jeopardy determination is made by integrating these components. The integration begins with combining the effects of the proposed Federal action with the aggregated effects of everything that has led to the listed species' current status. This aggregation includes consideration of non-Federal activities in the action area that are likely to affect listed species in the future. The Service uses this assessment of aggregated effects to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery in the wild of the affected listed species.

To facilitate jeopardy analysis and recovery planning for wide-ranging species, the Service sometimes defines interim recovery units. Interim recovery units were defined in the final listing rule for the bull trout in November 1999 (64 FR 58910). We use these interim recovery units to guide consultation analyses and recovery efforts until a final recovery plan is developed. Pursuant to Service policy, when an action impairs or precludes the capacity of a recovery unit to provide both the survival and recovery functions assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the biological opinion describes how the action affects not only the recovery unit's capability, but also the relationship of the recovery unit to both the survival and recovery of the listed species as a whole.

The jeopardy analysis for bull trout in this BO uses this approach. This analysis begins with a consideration of the role of the action area and the Methow core area in the function of the Columbia River interim recovery unit. This functional assessment provides context for evaluating the effects of the proposed Federal action, combined with other relevant effects, on the survival and recovery of the bull trout within the coterminous United States.

This BO is based upon information provided in the final Project Biological Assessment (BA) and numerous documents about bull trout, including previous biological opinions, published literature, and unpublished reports. A complete record of this consultation is on file in the Service's Central Washington Field Office in Wenatchee, Washington.

CONSULTATION HISTORY

The following chronology documents key points of the consultation process that culminated in the following biological opinion for the bull trout.

1. June 10, 1998: The Service issued a Final Rule listing Klamath and Columbia River distinct population segments (DPS) of bull trout as threatened species. This listing was superseded on November 1, 1999, when the Service listed the bull trout as threatened throughout the coterminous United States (64 FR 58910). While the coterminous listing had the effect of combining all DPSs into a single listed entity, the former DPSs were retained as "interim recovery units" for the purposes of section 7 consultation.
2. November 9, 2002: The Service published a Federal Register Notice proposing designation of critical habitat for the Klamath River and Columbia River DPSs of bull trout (USDI 2002, 61 FR 71236). The Methow River was included in proposed critical habitat (USDI 2002).
3. October 6, 2004: The Service published a Final Rule designating critical habitat for the Columbia River DPS of the bull trout. This final rule was remanded to the Service, and a revised final rule was published on September 26, 2005. This final rule excluded all areas that were proposed as critical habitat for bull trout in the upper Columbia River basin, including the action area (70 FR 56212).
4. Janurary 14, 2010, the Service proposed to re-designate bull trout critical habitat throughout its range, with a final rule anticipated by October 2010 (75 FR 2270).

5. March 10, 2010: The Level 1 consultation streamlining process for the Project was completed.
6. June 10, 2010: The Service received a final BA and an official request for formal and informal consultation on the Project from the USFS. Consultation was initiated on that date.
7. June 15, 2010: The Service completed informal consultation on the Project for listed terrestrial wildlife species (Service reference number 13260-2010-I-0069).

BIOLOGICAL OPINION

1.0 PROJECT DESCRIPTION

The project description provided here is an abbreviated summary. For more detailed descriptions of the proposed action, please refer to the Project BA. The Project area occupies about 27,240 acres. The U.S. Forest Service (USFS) proposes an action that will begin in 2010 and continue until 2018. Based on the characterization of the Project presented in the BA, the Service analyzes this Project in terms of 3 elements:

1. *Timber and biomass cutting and yarding*, including commercial harvest, pre-commercial thinning, whole-tree harvest with rootwads, hazard tree removal, vegetation management in the Buck Lake Campground, riparian reserve treatments, and tree yarding (these activities will occur on about 4,548 acres, including 116 acres in riparian reserves). This Project element is expected to produce about 9.4 million board feet of saw logs and 6,800 bone dry tons of biomass chips. The USFS expects to complete the majority of this element by December 2015.
2. *Fuels reduction*, including ladder fuel reduction with machine-piling and pile burning, hand-piling and pile burning, and underburning (about 8,500 acres). Fuel treatments overlap all of the timber harvest acres (including riparian reserves). In addition to fuel treatments in harvest units, fuels treatments alone will occur on 83 acres of riparian reserves. Backing fire only will be allowed outside of harvest units within riparian reserves. Where prescribed fire occurs in riparian reserves, activities would be designed to ensure low burn severity on at least 90% and moderate burn severity on no more than 10% of the area affected. No high-severity burning would occur in riparian reserves. The Buck Lake fuels unit is adjacent to the mainstem Chewuch River and includes a two-lane, paved county road located within 80 to 250 feet of the River. Active lighting would we done to the edge of the road or to 100 feet of the river, whichever is greater, and fire would be allowed to back toward the road. About 11 miles of hand-constructed fireline and 6.5 miles of bulldozer-constructed fireline will occur, including 1.2 miles of hand-constructed line in riparian reserves. These activities would occur primarily from 2015 to 2018.
3. *Roads management, hauling, and landing construction and use*, including construction of 7.6 miles of new permanent roads and 3.8 miles of temporary road construction. About one mile of this new road construction will be within riparian reserves. Road decommissioning is proposed for 20.8 miles of mostly riparian roads. About 14.8 miles of currently open roads would be closed, and 16 miles of currently closed roads would be temporarily opened for use during Project implementation. Road management will also include installation of 12 new stream crossings (3 temporary) and removal of 22 stream crossings. Road maintenance activities (surface blading, ditch cleaning, rock surfacing, etc.) will occur on up to 50 miles of roadway, including about 16 miles in riparian reserves. Hauling of harvested trees will require about 2,000 truckloads of logs and 550 truckloads of chips. This element would occur throughout the implementation period.

These Project elements are used throughout the remainder of this biological opinion to describe and evaluate the likely consequences of the Project for the bull trout.

1.1 **Conservation Measures**

When used in the context of the Act, conservation measures are actions that are included by the Federal agency as an integral part of the proposed action. Because conservation measures are pledged in the Project description by the action agency, their implementation is required under the terms of the consultation (USDI and USDC 1998, page 4-19).

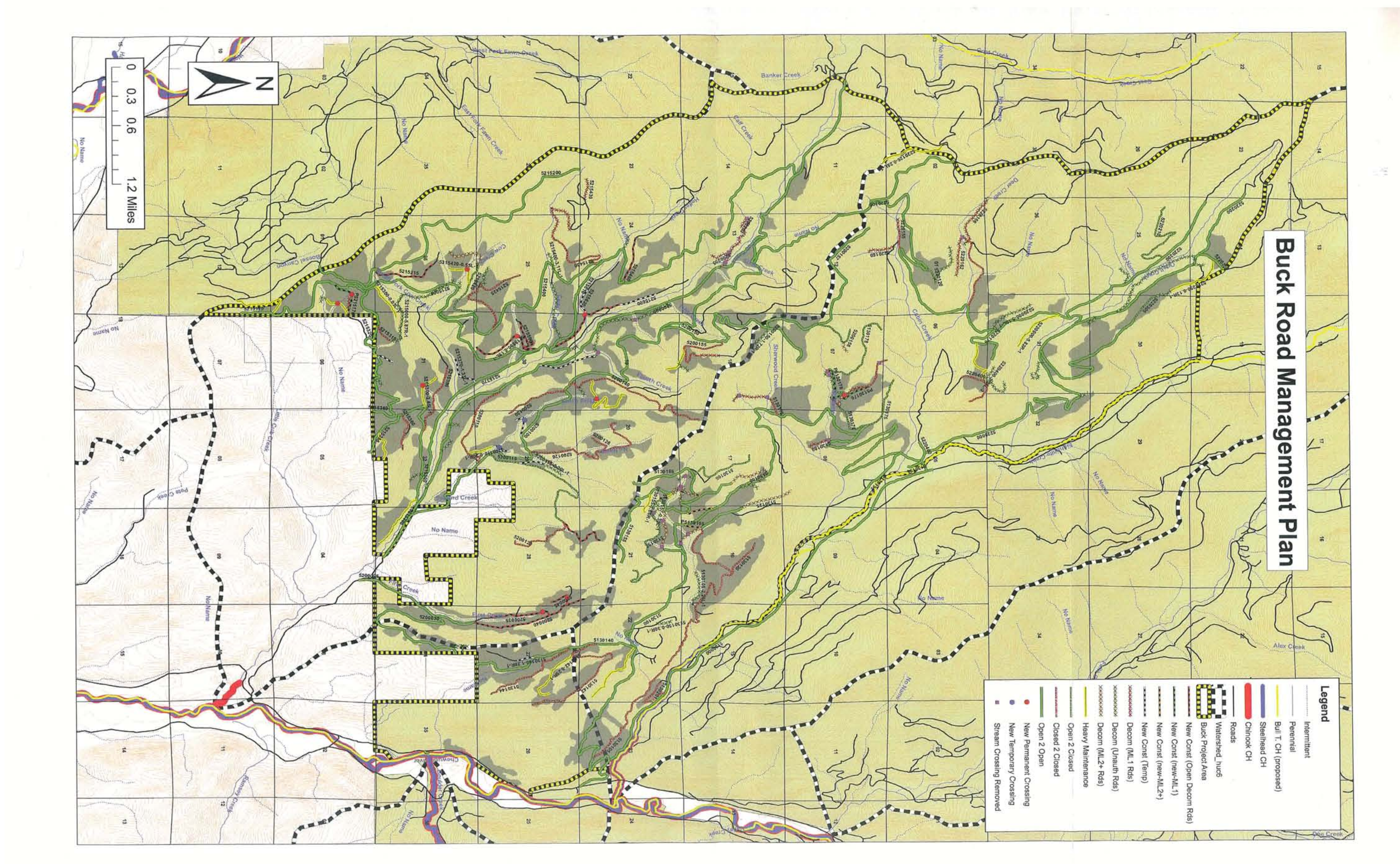
The Project BA included a list of 98 design criteria and15 conservation measures, many of which will reduce Project effects on the bull trout and proposed critical habitat for the bull trout, as well as on other listed species. In particular, design criteria and conservation measures intended to protect soils, aquatic resources, and to minimize impacts from road management will reduce Project effects on bull trout. For culvert replacements at stream crossings, incorporation of design criteria and conservation measures from the Regional Aquatic Restoration Programmatic (FWS reference 13420-2007-F-0055) will minimize impacts to aquatic resources.

1.2 Definition of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action, including interrelated and interdependent actions, and not merely the immediate area involved in the action (50 C.F.R. 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. Subsequent analyses of the environmental baseline, effects of the action, cumulative effects, and levels of incidental take are based upon the action area as determined by the Service.

The proposed Project is located in the Lower Chewuch River Watershed. Within the Lower Chewuch River 5th field watershed, the action area includes the Cub Creek, Eightmile Creek, and Chewuch – Pearrygin Creek 6th field sub-watersheds (Figure 1). The action area for this project includes all areas in the above sub-watersheds where logging, hazardous fuels reduction, timber stand improvement, tree planting, and road management activities will occur, including aquatic habitat up to 600 feet downstream of activities that could deliver sediment to streams. NWFP Land Allocations within the action area include Matrix, Late-Successional Reserve, and Riparian Reserves.

Figure 1. Buck Forest and Fuels action area, with timber harvest treatments (gray shading) and roads management activities.



2.0 STATUS OF THE SPECIES FOR BULL TROUT

This section, along with Appendix A, provides information about the bull trout's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This includes description of the effects of past human activities and natural events that have led to the current status of the bull trout. This information provides the background for analyses in later sections of the biological opinion.

2.1 Listing Status and Distribution

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The current range of the threatened bull trout extends from the Klamath River Basin of south-central Oregon and the Jarbidge River in Nevada, north to various coastal rivers of Washington, to Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978, Bond 1992, Brewin and Brewin 1997, Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device); and introduced non-native species (64 FR 58910).

The bull trout was initially listed as three separate Distinct Population Segments (DPSs)(63 FR 31647, 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs, plus two other distinct population segments, into one listed taxon, and the application of the jeopardy standard under section 7 of the Endangered Species Act relative to this species (64 FR 58930):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Thus, the Service's jeopardy analysis for the proposed Project is done at the scale of the Columbia River interim recovery unit.

On January 9, 2001, the Service proposed to list the Dolly Varden (*Salvelinus malma*) as a threatened species in Washington due to similarity of appearance (66 FR 1628). This proposed listing has not been finalized due to the need to complete higher priority listing actions.

2.2 Current Status and Conservation Needs

A summary of the current status and conservation needs of the bull trout within these units is provided below. A comprehensive discussion of these topics is found in the Service's draft recovery plan for the bull trout (USFWS 2002a; 2004a, b), the Service's Science Team Document (Whitesel et al. 2004), Critical Habitat Listing Rule (Service 2005a), the Rock Creek Mine Biological Opinion (USFWS 2006), and the 5-year review (USFWS 2008).

The habitat conservation needs of the bull trout are generally expressed as the "four Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous United States to local populations. The recovery planning process for the bull trout has also identified the following conservation needs for the bull trout: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preserve the diversity of life-history strategies; (3) maintain genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establish a positive population trend (USFWS 2002a; 2004a, b).

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002a, 2004a, b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat. Each of the interim recovery units consists of one or more core areas. About 114 core areas are recognized across the coterminous United States range of the bull trout (USFWS 2002a; 2004a, b).

As noted above, in recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: (1) Jarbidge River; (2) Klamath River; (3) Columbia River; (4) Coastal-Puget Sound; and (5) St. Mary-Belly River. Each of these segments is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to preserve the species' resilience to changing environmental conditions.

2.3 Jarbidge River

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004a). The draft bull trout recovery plan identifies the following conservation needs for this unit: maintain the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area; restore and maintain suitable habitat conditions for all life history stages and forms; and conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning fish per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004a).

2.4 Klamath River

This interim recovery unit currently contains three core areas and 12 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002a). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002a). The draft bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and strategies; conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 3,250 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002a).

2.5 Columbia River

This interim recovery unit currently contains about 100 core areas and 500 local populations. The condition of the bull trout within these core areas varies from poor to good, but generally all have been subject to the combined effects of habitat degradation, fragmentation, and alteration associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; introduced non-native species; and the decline or elimination of salmon populations which provided an important prey base and other essential aquatic ecosystem functions. The draft bull trout recovery plan identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange (USFWS 2002a).

The size and diversity of the Columbia River interim recovery unit make it difficult to determine its current status and the potential unit-wide ramifications of implementing individual projects. The Columbia River Unit occupies all or parts of Washington, Oregon, Idaho and Montana, and contains about 100 discrete or semi-discrete core areas (USFWS 2008). The degree to which demographic performance of core areas is correlated across this vast geography is unknown. Given the large number of factors and threats that influence bull trout populations, it is reasonable to expect different core areas across the Unit to experience different arrays of factors that yield a shifting mosaic of stable, increasing, and declining demographic performance. This mosaic of demographic performance obscures the Unit's actual level of resilience, and at the scale of individual projects, may increase its apparent resilience to persistent localized degradations in habitat quality.

The Service compiled information about core area resilience for its 5-year review of bull trout status, but did not aggregate this information into assessments at the unit-wide scale (USFWS 2005). The core area risk assessment indicates that 76 percent of the core areas in the Columbia River interim recovery unit, (including the Methow core area, in which the proposed Project will occur) are in the two highest-risk categories. This risk profile suggests that unit-wide resilience to further habitat degradation may be limited. Population trends for most core areas in the unit are unknown. Distribution of bull trout at the core area scale has not changed since the coterminous listing in 1999, but distribution changes at the scale of local populations have not been comprehensively evaluated. Furthermore, genetic information necessary for identifying core areas that are distinctive elements of intra-unit diversity is being developed, but is not currently available. Overall, the high number of and variability among core areas, difficulty of assessing aggregate risk, lack of key biological information, and the lack of a completed Recovery Plan to inform 7(a)(2) analysis all contribute to uncertainty about the current status of the Unit and the potential Unit-wide consequences of localized project effects.

2.6 Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004b). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With limited exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Generally, bull trout distribution has contracted and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, angler harvest, and the introduction of non-native species. The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this unit: maintain or expand the current distribution of bull trout within existing core areas; increase bull trout abundance to about 16,500 adults across all core areas; and maintain or increase connectivity between local populations within each core area.

2.7 St. Mary-Belly River

This interim recovery unit currently contains 6 core areas and 9 local populations (USFWS 2002a). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002a). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002a). The draft bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and forms; conserve genetic diversity and provide the opportunity for genetic exchange; and establish good working relations with Canadian interests because local bull trout populations in this unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

2.8 Life History and Population Dynamics

Like other salmonids from western North America, the bull trout is a well studied fish species. Detailed summaries of available information about the diverse life-history strategies exhibited by bull trout and the resulting variability in population dynamics are available in the Service's draft bull trout recovery plan and in the background information for the 5-year status review of the bull trout. A brief overview of this information is presented in Appendix B.

2.9 Consulted-on Effects

Projects subject to Section 7 consultation under the Act have occurred throughout the range of bull trout. Singly or in aggregate, these projects could affect the species' status. In order to assess the effects of previous actions/projects on bull trout, we incorporate by reference the Service's Biological Opinion for the Rock Creek Mine in Montana prepared by our Region 6 office (USFWS 2006). In the Status of the Species section of that BO, the Service reviewed 137 BOs produced by the Service from the time of listing in June 1998 until August 2003. The Service analyzed 24 different activity types (e.g., grazing, road maintenance, habitat restoration, timber sales, hydropower, etc.). Twenty BOs involved multiple projects, including restorative actions for bull trout.

The geographic scale of projects analyzed in these BOs varied from individual actions (e.g., construction of a bridge or pipeline) within one basin, to multiple-project actions, occurring across several basins. Some large-scale projects affected more than one interim recovery unit. In summary, 124 BOs (91 percent) applied to activities affecting bull trout in the Columbia River population, 12 BOs (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound population, 7 BOs (5 percent) applied to activities affecting bull trout in the Klamath River population, and 1 BO (less than 1 percent) applied to activities affecting the Jarbidge and St. Mary Belly populations.

Our aggregate analysis of BOs was also stepped-down from the interim recovery unit scale to the core area scale (USFWS 2006). For example, the Rock Creek Mine Biological Opinion included an evaluation of the Clark Fork River basin from the time of listing until August 2003. Of 37 actions that occurred in this river basin during this period, the majority (35) involved habitat disturbance with unquantifiable effects, 16 actions were ongoing, and 21 actions had been completed and effects were no longer occurring. Similarly, the number of actions, type of actions, and a brief description of the action was provided for each river basin where bull trout may have been adversely affected (USFWS 2006).

For each action, the causes of adverse effects were identified, as were the anticipated consequences for spawning streams and/or migratory corridors, if possible (in most cases, these consequences were known). Actions whose effects were "unquantifiable" numbered 55 in migratory corridors and 55 in spawning streams. The Service also attempted to define the duration of anticipated effects (e.g., "short-term effects" varied from hours to several months). Projects likely to result in long-term benefits also were identified.

At the time of preparation of the Rock Creek Mine Biological Opinion, all other BOs within the range of bull trout reached a “no-jeopardy” determination. After reviewing previous BOs, the Service concluded that the continued long-term survival and existence of the bull trout had not been appreciably reduced range-wide (USFWS 2006). The Service’s assessment of BOs from the time of listing until August 2003 (137 BOs), confirmed that no actions that had undergone Section 7 consultation during this period, considered either singly or cumulatively, would appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any (sub) populations (USFWS 2006).

Between August 2003 and July 2006, the Service issued 198 additional BOs that included analyses of effects on bull trout (USFWS 2006). These BOs also reached “no-jeopardy” determinations, and the Service concluded that the continued long-term survival and existence of the species had not been appreciably reduced range-wide due to these actions (USFWS 2006). All BOs issued after July 2006 also reached “no-jeopardy” determinations.

Currently, the Service is developing a database for tracking consulted-on effects and the exemption of incidental take associated with all biological opinions for bull trout. This database will be used across all Service field offices within the coterminous range of bull trout.

3.0 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. This section analyzes the current condition of the bull trout in the action area, the factors responsible for that condition, and the intended role of the action area in the conservation of the Columbia River interim recovery unit.

Characterizing the environmental baseline for highly mobile species requires a multi-scale analysis that evaluates the condition of all areas used by the affected population. The population of bull trout found in the action area of a project often inhabits a much larger area through the course of its life cycle. For example, bull trout often migrate over 100 km between spawning and overwintering habitat. For bull trout, the Service primarily considers two different spatial scales: (1) the watershed or specific reaches in a watershed affected by the proposed project, and (2) the “core area” scale, which typically incorporates multiple watersheds occupied by separate, but potentially interacting, local populations of bull trout. The watershed or reach scale is used to characterize habitat conditions in the vicinity of the proposed action.

The condition of habitat at both scales is evaluated in terms of seven broad classes of habitat features (pathways), each of which has a related set of specific metrics (indicators) that are rated based on their functional condition. Baseline conditions for each indicator are described on a relative scale of functionality (“functioning appropriately,” “functioning at risk” or “not properly functioning”). This analytical framework is referred to as the Matrix of Pathways and Indicators (MPI) (USFWS 1999). In a similar fashion, the condition of bull trout metapopulations at the core area scale is evaluated in terms of “subpopulation” indicators in the Matrix of Pathways and Indicators (USFWS 1999). The Service uses these hierarchical scales to structure its evaluation of baseline condition as well as its subsequent analysis of project effects and jeopardy.

The action area is wholly within the Methow River core area for the bull trout. For context, we first discuss the baseline condition of the bull trout within the Methow core area, followed by a discussion of baseline conditions in the Lower Chewuch sub-watersheds, with particular attention to the action area. In the following analysis of baseline conditions, most information for the core area scale is drawn from the *Draft Bull Trout Recovery Plan* (USFWS 2002b) with updates from a variety of other sources. Information for the watershed or reach scale is drawn primarily from the Project BA, the Chewuch River Watershed Analysis (USFS 1997), the Biological Assessment for New and Ongoing Activities completed in 2004, and the Biological Assessment for the Tripod Fire Salvage project.

3.1 Environmental Baseline for the Methow Core Area

The Methow Core area is located on the upper Columbia River, in north central Washington State. The size of the core area is about 1,890 square miles (NPPC 2001). The Methow River runs about 86 miles from its headwaters to its confluence with the Columbia River near Pateros. The major tributaries in the core area include Early Winters Creek, Twisp River, Lost River, and the Chewuch River.

Most of the land in the lower watershed is privately owned and has been modified by a combination of irrigated agriculture, residential development, and recreation facilities. Human activities have resulted in a shift in many plant communities’ composition from native to aggressive introduced species. Undisturbed riparian areas in the lower watershed are rare. In disturbed riparian areas, where livestock graze the major shrubs and herbs, native understory tends to be replaced by exotic grasses and noxious weeds. Undisturbed riparian areas in the Methow core area have a more reliable source of water than is available in most parts of the basin, and are therefore heavily vegetated with deciduous trees and shrubs.

Upslope of the private lands, the USFS manages the majority of the core area for multiple uses. Logging and associated road building, fires and fire suppression, grazing, and recreation have impacted aquatic habitats on USFS lands.

Not all of the information necessary to definitively determine the appropriate conservation role of the Methow core area is available, but a reasonable working hypothesis can be deduced from what is known. The conservation role of core areas is best characterized in terms of distribution, numbers, and reproduction of bull trout, given that the Services analysis of project effects and the potential for these effects to jeopardize the continued existence of the bull trout are evaluated in these terms.

In terms of distribution, the Methow core area is located in the northwest corner of the Columbia River interim recovery unit in Washington State. This peripheral location suggests this core area is important for maintaining the historic geographic distribution of bull trout within the unit. A growing body of work indicates that counter to conventional wisdom about geographic patterns of extirpation, peripheral populations often persist longer than populations near the centers of species' distributions (e.g., Channel and Lomolino 2000; Nielsen et al. 2001). It remains to be seen if global climate change might accentuate this trend.

A peripheral location may also expose populations to unusual selection pressures that can favor different alleles, contributing to overall genetic diversity within species. Although samples have been collected, analyses of genetic characteristics of bull trout populations in the Methow core area have not been completed. Presence in the Methow core area of both resident bull trout populations isolated above impassible natural barriers (e.g., Early Winters Creek) and multiple small local populations increase the likelihood of genetic divergence.

From a demographic perspective, the demographic contribution of the Methow core area to adjoining core areas is likely to be small. The Methow core area currently consists of multiple small populations (effective population size less than 100 individuals) and one moderate sized population (N_e = 100 to 500 individuals) in the Twisp River. The Service's draft bull trout recovery plan established an abundance criterion for all local populations in the Methow core area of between 3,610 and 5,886 individuals (USFWS 2002b). Historic population levels are unknown. It is reasonable to assume that when populations of anadromous salmon were more abundant, bull trout also were more abundant. Currently, coho salmon are extirpated from the Methow core area, spring Chinook salmon are endangered, and upper-Columbia River steelhead are threatened. But even at historic levels of bull trout abundance, the relatively long distance between spawning locations in the Methow core area and spawning areas in the neighboring Entiat and Wenatchee core areas suggest that demographic exchange between these core areas was likely limited. Telemetry studies, however, have indicated that bull trout do move between the Methow, Entiat, and Wenatchee core areas. These telemetry studies were not designed to document gene flow, so the level of effective exchange among these core areas remains unknown. Low levels of exchange may be more important for preserving genetic diversity than for supporting positive demographic trends.

If these hypothesized roles of the Methow core area are correct, extirpation or functional extirpation of bull trout from this core area could have negative consequences primarily for the distribution and reproduction of the Columbia River interim recovery unit. Removing populations from the periphery of the range could reduce the potential for long-term persistence of the recovery unit by diminishing the resilience provided by peripheral populations. To the degree genetic diversity promotes productivity in fluctuating environments, loss of the genetic diversity associated with this unique location could reduce the productivity of the unit and reduce its ability to adapt to changing conditions. These outcomes are contrary to the recovery goals and objectives in the Service's draft recovery plan for the bull trout.

This account of the baseline condition of the Methow core area is organized in two sections. First we summarize baseline conditions for local populations in the core area. We conclude with a consideration of factors affecting the bull trout's environment at the core area scale, and a summary of the most potent threats facing bull trout in this core area.

3.1.1 *Population Characteristics in the Methow Core Area*

Bull trout are found in all seven watersheds in the Methow core area, and migratory and resident life-history forms are present. The Washington Department of Fish and Wildlife (WDFW) classifies the status of bull trout in the Lost River as “Healthy,” but the remaining bull trout in the Methow River are classified as “Unknown” (WDFW 1998). Information about population size comes primarily from redd surveys that have been conducted in selected areas of the Methow River basin since 1992 (Table 1). The largest populations of migratory bull trout occur in the Twisp River, Wolf Creek, West Fork Methow River, and the Lost River (NPPC 2001; see Table 1). Resident populations are known to occur in the Lost River, Early Winters Creek, Goat Creek and Beaver Creek.

3.1.1.1 Chewuch River. The bull trout local population in the Chewuch drainage spawns in Lake Creek and the Chewuch River. Because the Project occurs in this watershed, details about bull trout population characteristics are presented below in the baseline account for the Chewuch watershed.

3.1.1.2 Twisp River. Migratory and resident bull trout in the Twisp River local population are found in the mainstem Twisp River, Buttermilk Creek, Bridge Creek, Reynolds Creek, and North Creek (USFS 1995b). From 1998 to 2007 the average number of redds in the Twisp watershed was 93, with a standard deviation of 10.2. The majority of these redds are located in the mainstem Twisp River (from South Creek to the Roads End Campground) and in North Creek. The Twisp River is the largest and most consistently productive population of bull trout in the Methow core area. Both fluvial and resident bull trout use Buttermilk and Reynolds creeks, with the distribution of fluvial fish limited below barriers. The Twisp River is also an important tributary for spring Chinook and steelhead production.

3.1.1.3 Wolf Creek. In the Middle Methow Watershed, Wolf Creek is the most important tributary for bull trout spawning. Redd counts have been as high as 27 and 29 in 1998 and 1999, respectively. The average redd count across all survey years from 1998 to 2007 was 21 redds, with a standard deviation of 5 (differences in survey procedures and surveyors among years may have contributed to apparent variation in counts). Distribution within the subwatershed extends up to approximately river kilometer 18 (river mile 11) where a natural rock and log barrier blocks upstream passage. Resident bull trout have also been located in Wolf Creek below the barrier (WDFW 1998). In 2005 the diversion dam at RM 4 was replaced with a rock cascade structure that is expected to improve fish passage at all flows.

3.1.1.4 Upper Methow River. The Upper Methow River local population includes the West Fork of the Methow River, Trout Creek, Robinson Creek, and Rattlesnake Creek. Most spawning occurs in the West Fork Methow River. A few bull trout have been observed spawning in the lower portions of Trout Creek (WDFW 1998). Bull trout have not been documented in Robinson or Rattlesnake Creeks, but the lower portions of these systems are accessible to bull trout and may provide additional spawning habitat (De La Vergne, J., USFWS, pers. comm., 2001). Resident and fluvial life-history forms are present in this local population. Redd surveys in the upper Methow River have been conducted since 1995. The redd counts are highly variable ranging from 1 redd in 1999 to 64 redds in 2002, with some of this variation resulting from inconsistent surveys (Table 1).

3.1.1.5 Early Winters Creek. The Early Winters Creek local population is found in the mainstem, Cedar Creek, and Huckleberry Creek. Incomplete redd surveys in the mainstem have been conducted since 1995, with a high redd count of 12 occurring in recent years (Table 1). Redd surveys are conducted from Klipchuck Campground up to the falls at river kilometer 13 (river mile 8.0) near the crossing of Highway 20. The falls are thought to be a barrier to Chinook salmon and steelhead. Migratory-sized bull trout were found above the falls during recent electrofishing surveys by the Service (De La Vergne, J., USFWS, pers. comm., 2001). Resident bull trout are known to be above these falls and are thought to spawn in the upper reaches (WDFW 1998).

3.1.1.6 Lost River. The Lost River local population may be represented by resident, fluvial, and adfluvial forms (USFS 1999). In 1993, the WDFW estimated the bull trout population size in the Lost River to be 1,092 fish (WDFW 1998). This estimate did not distinguish between resident and migratory life-history forms and was based on a catch-per-unit-effort density estimate of 210 fish per mile. Timing and distribution of bull trout migration in the Lost River is unknown. Many holding areas in the upper Lost River and near the outlet of Cougar Lake were identified during snorkel surveys conducted by the Service and USFS (De La Vergne, J., USFWS, pers. comm., 2001). Connectivity among headwater lakes and downstream areas occurs only during high runoff periods in spring and early summer. The Lost River periodically goes subsurface near the downstream end of the gorge above Monument Creek. Spawning in the Lost River, currently seems to be occurring upstream of the gorge and in Monument Creek (WDFW 1998; De La Vergne, J., USFWS, pers. comm., 2001).

3.1.1.7 Goat Creek. Redd surveys in the Goat Creek local population began in 2000, when 11 migratory bull trout redds were found. Since that time, the high count of 18 redds occurred in 2007. The 3-mile reach above Vanderpool Crossing is now regularly surveyed. In years when the entire spawning reach was surveyed, an average of 9 bull trout redds was detected. The sub-watershed contains both resident and fluvial fish, but the status of each life-history form is unknown (USFS 1995c). Breeding by resident bull trout was determined by the presence of resident-sized female bull trout that were sexually mature (WDFW 1998).

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Table 1. Methow core area redd survey summary for 1995 to 2007. Total numbers of redds detected by survey year.

Watershed/Stream Surveyed	Miles	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean
Twisp River Watershed															
1. Twisp River															
-Reynolds Cr. to Poplar Flats	1.5	-	-	-	-	-	-	19	13	16	24	35	23	24	22
-South Creek to Roads End	3.0	18*	-	2*	66*	37	72	53	67	30*	56	39	53	46	53
-Roads End CG to barrier falls	0.5	-	-	0*	1*	1	-	0*	-	-	-	-	-	22	12
2. North Cr – Mouth to Falls	0.6	3*	-	-	19*	63	33	0	2	29	18	6	9	15	19
3. E. Fork Buttermilk to Falls	2.0	4*	0	-	0*	0*	0	3	3	2	0	3	3	0	2
4. W. Fork Buttermilk Cr.	2.0	-	-	-	-	-	-	-	7	9	2	4	1	1	4
. Other Surveys in Twisp River		0*	-	-	-	0*	0*	1*	1*	-	1*	-	-	-	
Subtotal Twisp River		***25****	***0****	***2****	***86****	***101***	***105***	***76***	***93***	***86****	***101***	***87***	***89***	***108***	95
Upper Methow River															
1. West Fork Methow River															
-Trout Cr to Falls at Brush Cr	5.3	27	15	13*	11*	1	2	19	54	-[1]	21	44	25	21	21
2. Early Winters-Below Falls	4.0	-	9*	1*	2*	0*	3	5	6	0	1	3	12	12	5
3. Goat Creek above Vanderpool	3.0	-	-	-	-	-	11[2]*	-*	4[2]	3[2]	12[2]	9[2]	8[3]	18[4]	9
4. Other Upper Methow Surveys		1*	2*	1*	-	-	-	3*	-	-	-	-	-	-	
Subtotal Upper Methow River		***28***	***26***	***15***	***13***	***1***	***16***	***27***	***64***	***3***	***34***	***56***	***45***	***51***	29
Chewuch River Watershed															
1. Chewuch – RM 32.9 to 34.2	1.3	-	-	-	-	-	-	9*	11	6	4	19	35	19	16
2. Lake Creek															
-River Mile 4 to River Mile 5	1.0	-	-	-	-	-	10*	1	-	4	0	0	4	2	2
-Black Lake to Three Prong	1.5	22	13*	9*	8*	0	8	21	11	10	6	24	15	25	14
Subtotal Chewuch River		***22***	***13***	***9***	***8***	***0***	***18***	***31***	***22***	***20***	***10***	***43***	***54***	***46***	23
Wolf Creek															
Wolf Cr. – RM 2.6 to N. Fork	4.0	-	**3***	**3***	**27***	**29**	**26**	**20**	**15**	**18**	**24**	**15**	**18**	**22**	21
Gold Creek															
Crater Cr. – RM 0 to 2	2.0	-	2*	2*	1*	0	-	0	1	0	3	4	3	?[5]	2
Foggy Dew Creek[2]		-	-	-	-	-	-	-	-	-	--	10[2]	1[2]	4[2]	
Subtotal Gold Creek		-	**2**	**2**	**1**	**0**	-	**0**	**1**	**0**	**3**	**14**	**4**	**4**	3
Total Methow Basin Redds		***75****	***44****	***31****	***135***	***131***	***165***	***154***	***195***	***127****	***172***	***215***	***210***	***231***	179

Miles = total stream miles surveyed in index reach. * = Incomplete Survey; Mean includes only complete surveys; - = Not Surveyed.

[1]Not surveyed due to Needle Creek Fire.
[2]Likely all resident redds.
[3]Two of these redds are likely migratory bull trout redds.
[4]One to three redds are possible migratory bull trout redds.
[5]Data have not been received at the time of this report (03-25-07). The report will be updated and redistributed when data are received.

3.1.2 *Factors Affecting the Bull Trout's Environment at the Core Area Scale*
Within the Methow core area, historic and current land use activities have impacted bull trout local populations. Some of the historic activities, especially water diversions, forestry, and agriculture, have significantly reduced migratory populations. Lasting effects from some of these early land and water developments still act to limit bull trout production in this core area. Threats from current activities are also present.

3.1.2.1 Dams. No dams that are complete barriers to fish migration are present currently in the Methow Core Area, although some dams may be partial barriers. Mainstem Columbia River dams (Rock Island, Rocky Reach, and Wells) have significantly altered historic habitat conditions within the mainstem Columbia River. Bull trout tagged at these mainstem dams have been tracked to Methow core area streams. Dams on the Columbia River affect salmonids by delaying or impeding adult migration, by injuring or killing juveniles that pass downstream, and by altering the ecology of the river. Information on effects of these mainstem Columbia River dams on bull trout is being collected in the context of hydro-power relicensing (e.g., BioAnalysts, Inc. 2004), but many questions remain unanswered.

3.1.2.2 Forest Management Practices. Both direct and indirect impacts from timber harvest and associated road building have altered habitat conditions in portions of the Methow core area. Impacts from forest management included the removal of large woody debris, reduction in riparian areas, increased water temperatures, increased erosion, and simplification of stream channels (Quigley and Arbelbide 1997). Bull trout are less likely to use streams for spawning and rearing in areas with high road densities and were typically absent at mean road densities above 1.1 kilometer per square kilometer (1.7 miles per square mile) (Quigley and Arbelbide 1997).

In the Methow Core area, roads that access timbered lands are located in the narrow floodplains, with extensive networks in the Twisp watershed including sensitive bull trout tributaries (e.g., Little Bridge and Buttermilk Creeks). A similar situation exists in Lake Creek in the Chewuch watershed (WSCC 2000). High road densities within portions of USFS lands in the Methow River Core Area may contribute to habitat degradation (USFS 2003; 2001a; 2001b). Culverts under these roads are common impediments to passage that fragment both habitat and populations, and degrade habitat by preventing transport of large woody debris.

Forestry activities on State and private lands in Washington State are covered under a recently completed Habitat Conservation Plan that is based on statewide Forestry Practices Rules. The term of the Habitat Conservation Plan is 50 years, and over this period effects to bull trout are expected to include short-term adverse effects to stream temperatures, large woody debris, and sediment, and long-term beneficial effects on habitat access. Analysis of the effects of this Plan led to the identification of bull trout core areas that were at increased risk of exposure to adverse effects, primarily due to the high proportion of private timberlands in these core areas. The Methow core area contains two local populations (Gold and Goat creeks) that are at increased risk. However, it is difficult to predict actual impacts that are likely to occur because level of timber harvest on private land is driven by unpredictable market factors. About 18 percent of the Methow core area is privately or State-owned, and the proportion of this area that is forested is unknown. In the Chewuch watershed, only about 5 percent is privately owned, all in the lower 8 miles of the watershed. For the purpose of describing the environmental baseline in this core area, we assume that rates of timber harvest on private land will not change appreciably in response to completion of the Plan, and the rate of timber harvest will be low.

3.1.2.3 Livestock Grazing. Historically, grazing of cattle, horses, and sheep has occurred throughout the Methow core area (WSCC 2000). Concerns associated with grazing include water withdrawals, loss of riparian vegetation, sedimentation, and redd trampling. Over 60 percent of the private bottom lands in the Methow River area have erosion problems related to grazing (USFWS 1992). Cattle have access to the main channels, resulting in eroded stream banks and associated sediment inputs. Riparian areas adjacent to the Twisp River, lower Wolf Creek, Upper Methow River, Chewuch River, Buttermilk Creek, Gold Creek, and Goat Creek have experienced grazing-related degradation (USFWS 1998).

3.1.2.4 Agricultural Practices and Irrigation Diversions. Irrigation diversions can result in passage barriers by creating structural blockages, reducing instream flow or even dewatering streams, and increasing water temperatures. Decreased stream flow can result in increased stream temperatures that can degrade habitat quality for bull trout or create barriers to upstream migration. Historically, there were many irrigation diversions in the Methow core area that may have totally or partially blocked migrating fish (USFWS 1992). Other irrigation diversions, although not located in bull trout spawning streams, remove instream flow and may impact important foraging and high water refuge habitat.

At the time bull trout were listed, operation of irrigation diversion dams was thought to disrupt annual migrations of fluvial bull trout in five of seven spawning streams in the Methow River basin (USDI 1998). An estimated 60 percent of the available spawning habitat in the Methow has been lost due primarily to high temperatures and dewatering caused by irrigation diversions (Mullan, J., USFWS, as referenced by USDI 1998). Many of these problems have been addressed in recent years. For example, several passage barriers associated with irrigation diversions have been removed from Beaver Creek since 2002, and a partial barrier on Little Bridge Creek (tributary to the Twisp River) was replaced with a roughened channel structure in 2005. Additional improvements to diversion dams are described below.

Some diversion dams that impede fish passage remain. In the Twisp watershed, East Fork Buttermilk Creek has a partial barrier to migration resulting from an irrigation diversion. A diversion dam across the Twisp River on non-Federal land at approximately river kilometer 8 (river mile 5) is used by the Twisp Power Irrigation Ditch and the WDFW for Chinook brood-stock collection (WSCC 2000). The Service assumes that this dam does not impede passage, but further investigation of the diversion's operation is needed to verify suitable passage conditions.

Irrigation withdrawals by three diversions operated in the Wolf Creek subwatershed (including use of Patterson Lake for irrigation storage) may be adversely impacting bull trout (WSCC 2000). The Wolf Creek diversion is one of the largest irrigation ditches in the Methow Valley and has been in operation since 1921. A project implemented in the summer of 2005 is expected to improve passage at this diversion (FWS reference 01-09-2004-F-W0518) and operational changes are expected to improve instream flow conditions.

In the Chewuch watershed, diversions in the lower watershed are an important factor affecting habitat quality. There are two private irrigation ditches in the lower river that divert large volumes of water. The Fulton Ditch has its diversion at river mile 0.7 and has a functional diversion capacity of 22 cfs. The Chewuch Ditch (RM 8) has a current diversion capacity of 30 cfs. The concrete and rock weir at the Chewuch Ditch diversion was replaced with a new concrete dam and rock-ramp fish passage in 2006 (FWS reference 01-09-2005-F-0385). The rock ramp is expected to provide passage for all life stages of fish at all flow rates. Replacement of the rock weir for the Fulton Ditch was the subject of another biological opinion completed in November 2006 (FWS Reference Number 13260-2006-P-0025). The Skyline Ditch (RM 8.7) has a diversion located on land managed by the USFS. Historically, the Skyline Ditch carried a flow in excess of 25 cfs. The current maximum diversion rate into the ditch is 17.8 cfs, and operation of this ditch is governed by a Special Use Permit issued by the USFS. This permit is in turn conditioned by biological opinions from the Service (FWS reference 01-09-2003-F-W0225) and from National Marine Fisheries Service (reference 2003/00123). These permit conditions are expected to improve instream flow conditions in the mainstem Chewuch. A small surface diversion from Eightmile Creek that was used by the USFS to irrigate Eightmile Ranch has been replaced by wells, which also contribute to improved instream flow in the lower Chewuch River.

3.1.2.5 Mining. Mining can degrade aquatic habitats used by bull trout by altering water chemistry (e.g., pH); altering stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Nelson et al. 1991; Spence et al. 1996; Harvey and Lisle 1998). The potential for establishing a gold mine in the Twisp River (North Creek) is being considered (De La Vergne, J., USFWS, pers. comm., 2001). Small scale recreational gold mining occurs within the Methow core area.

3.1.2.6 Residential Development. Numerous areas within the Upper Columbia basin are experiencing a socio-economic shift from an economy based on natural resources (agriculture, forestry, and mining) to an economy more dependent on industries associated with tourism, recreation, and general goods and services. Population growth in Okanogan County was 18.6 percent in the 1990's (WSOFM 2000). Potential development impacts to bull trout include degradation of water quality, instream habitat, and riparian habitat in migratory corridors within the Methow core area (WSCC 2000). Bank armoring in response to high flow events is an ongoing practice that continues to degrade riparian and streambank conditions. Aggregate effects from development within the basin are difficult to estimate, but could be substantial.

Areas of residential development that are degrading aquatic habitat conditions in the Methow Core Area include:

1. Early Winters Creek (riprap and diking of the lower 0.5 miles).
2. Mainstem Methow River (bank erosion and loss of vegetation, beginning at the Early Winters Creek confluence downstream to Pateros).
3. Lower Chewuch River (mouth to river mile 8; loss of vegetation and bank protection).

3.1.2.7 Recreational Development. Campgrounds (including user-built dispersed camps), trails, and other recreational developments in the Methow core area frequently overlap areas of bull trout spawning, juvenile rearing, and adult migration (USFS 1999, 2001a, 2001b). Impacts of these recreational developments can include reduction in large woody debris and its recruitment, loss of riparian vegetation, and diking or bank hardening to protect campgrounds. These developments can also increase stream access, which can lead to poaching of bull trout. In many cases, the USFS is taking action to move campgrounds away from streams and use temporary closures to minimize effects.

In the Twisp River watershed, the Roads End and South Creek Campgrounds and associated trails impact adjacent spawning and holding areas for bull trout (USFWS 2002b, Nelson 2004). The USFS is minimizing these impacts through relocation of campsites away from the streambanks and temporary closures during sensitive time periods.

3.1.2.8 Fisheries Management. Fisheries management can affect bull trout through stocking of non-native species, harvest management, and effects on prey base. All of these effects are occurring in the Methow Core area.

Problems with non-native species in the Methow core area focus primarily on brook trout (WSCC 2000). Brook trout are widespread within the Methow River (NPPC 2001). Brook trout are well-established in Beaver and Eightmile Creeks and are thought to have resulted in the loss of bull trout from these systems (WDFW 1998). Brook trout are also known to inhabit portions of the Twisp River (NPPC 2001).

Although the draft bull trout recovery plan states that stocking of brook trout no longer occurs in the Methow Recovery Unit, apparently stocking of triploid brook trout continues (Molesworth, J., USFS, pers. comm. 2003). Use of triploids reduces the risk of hybridization with bull trout, but a small percentage of triploid fish are fertile (Molesworth, J., USFS, pers. comm. 2003), and the more robust growth rates of triploids may increase their competitive effects on bull trout. Cessation of all brook trout stocking is an important conservation need throughout the upper Columbia basin (USFWS 2002b).

Harvest of bull trout is currently prohibited on all stocks in the Methow core area with the exception of the Lost River above Drake Creek in the Methow drainage (WDFW 1998). The estimated abundance of bull trout in this area (210 catchable-sized fish per mile) was thought to be sufficient to allow retention of bull trout as part of a two-fish catch limit. Fishery rules include a bait prohibition and a 36 centimeter (14 inch) minimum size intended to permit most females to spawn at least once. Angling is minimized by the lack of direct access to the lower end of this reach. The canyon reach is accessible only in late summer when stream flows recede enough for fording. Almost no fishing occurs in this reach. Some fishing occurs below Cougar Lake, in the vicinity of the horse camp around Diamond Creek, and in the area just above the mouth of Drake Creek.

Fisheries management can also impact bull trout by promulgating fishing regulations that lead to the incidental harvest of bull trout and trampling of bull trout redds by wading anglers. Incidental catch during open seasons for mountain whitefish (*Prosopium williamsoni*) and steelhead have been implicated as a possible source of bull trout mortality in the Wenatchee, Entiat, and Methow Rivers. Injury and mortality from incidental catch of bull trout and harvest as a result of misidentification still continues under existing fishing regulations (only 44 percent of surveyed Montana anglers correctly identified bull trout; Schmetterling and Long 1999). In experimental tests, a single wading event just before hatching can result in up to 43 percent mortality of eggs (Roberts and White 1992).

Throughout the Methow core area there have been severe declines in the numbers of native salmonids. Both spring Chinook salmon and steelhead are listed under the Act in this area, and with few exceptions, continue to exhibit low abundances. The decline of salmon and steelhead has reduced both the prey base for bull trout and a historic nutrient source coming into the basin.

WDFW has operated a captive broodstock collection program for Upper Columbia River spring Chinook salmon eggs and juveniles in the Chewuch River (WDFW 1999). Adult Chinook were collected at the fish ladder at the Fulton Dam until this structure was renovated in 2006-2007. New facilities for broodstock collection have not been completed. Proposals to build a separate weir for spring Chinook broodstock collection could result in delay and handling of migratory bull trout due to overlap in migration timing between spring Chinook and bull trout.

3.1.2.9 Isolation and Habitat Fragmentation. Road culverts in watersheds with bull trout can block or impede upstream passage (WSCC 2000; NPPC 2001). Culverts may preclude bull trout from entering a drainage during spawning migrations, emigration of juveniles, and foraging activities, and may also limit access to refuge habitat needed to escape high flows, sediment, or higher temperatures. Culverts have been identified as a limiting factor for salmonids in the Methow River basin (NPPC 2001; WSCC 2000). Specific culverts have been identified as possible passage barriers in the Methow (Twisp River, Beaver Creek, Gold Creek, Little Bridge Creek, and East Fork Buttermilk Creek) core areas. In recent years barrier culverts have been replaced in Libby Creek, the Twisp River (four culverts or bridges, improving passage in 4 tributaries), and Beaver Creek.

In the Methow Core Area, aquatic habitats have also been fragmented by dikes, resulting in loss of floodplain and off-channel habitats that could provide important rearing areas for bull trout (WSCC 2000). Dikes that contribute to habitat fragmentation are the McKinney Mountain Dike, People Mover Dike, and the dike on the Lost River. Alteration of habitat from channel modification (e.g., bank revetment and riparian alterations) have disconnected floodplains and impacted normal stream function. Specific areas that have been impacted include Goat Creek, lower Early Winters Creek, and the Twisp River.

3.1.2.10 Fires and Fire Suppression. In August and September 2003, the Needles Fire burned about 21,300 acres in the Upper Methow, with about 1,680 acres (8 percent of the burned area) burning at high intensity (USFS 2004). Suppression activities included drift from retardant drops reaching the Methow River, excavating a dip site in the Methow River and helicopter dips from this site, construction of contingency fire lines both perpendicular (5 lines) and parallel (1 line for about 1 mile) to the Methow River, some of which were later used as skid trails to remove timber felled during fire line construction, and refilling of the Early Winters Irrigation Ditch for 10 days after it had been closed due to low flows. Rehabilitation efforts reduced the adverse effects of the fire lines and dip site construction, but the overall quality of habitat in this important spawning area for bull trout was degraded by wildfire effects and fire suppression activities.

In 2006, the Cedar Creek Fire burned in the West Fork Cedar Creek drainage and along the mainstem of Cedar Creek in the Early Winters watershed. The fire perimeter included about 1,630 acres. Preliminary mapping indicates the fire did burn through more than a mile of riparian areas. Detailed information about the distribution of fire severity levels, and the effects of suppression and rehabilitation activities is not available at this time. Several large and severe wildfires have also occurred in the Chewuch sub-watershed where the proposed Project will occur. The effects of these wildfires and associated suppression and rehabilitation activities are described in the following description of baseline conditions at the sub-watershed scale.

3.2 **Environmental Baseline in the Chewuch Sub-watershed**

The Chewuch River is a fifth-order tributary which flows into the Methow River at Winthrop, Washington. The headwaters of the Chewuch River extend almost to the Canada/United States border. Total watershed area is about 340,000 acres, of which about 95 percent is managed by the USFS. About 30 percent of the watershed is located in the Pasayten Wilderness Area. Much of the eastern side of the watershed that is outside designated Wilderness is roadless area. Private land constitutes about 4.5 percent (about 15,000 acres) of the watershed and occurs primarily below river mile 8. The remainder of the watershed (about 5,000 acres) is managed by the Washington Department of Fish and Wildlife. Current condition of the Chewuch watershed ranges from extensive pristine areas in the headwaters to degraded areas on private lands in the lower watershed.

The Chewuch watershed is divided into two 5th field hydrologic units; the Lower and Upper Chewuch watersheds. The Lower Chewuch Watershed (where the proposed Project occurs) consists of the mainstem Chewuch River and all tributaries downstream of Lake Creek, which flows into the Chewuch River at river mile 24.3.

3.2.1 Bull Trout Population Characteristics in the Chewuch Watershed

Bull trout spawning in the watershed occurs primarily in Lake Creek and the upper mainstem Chewuch River. Bull trout in Lake Creek are thought to be an adfluvial population inhabiting Black Lake (DeLaVergne, J., USFWS, pers. comm., 2001). Lake Creek redd surveys conducted since 1995 are low and highly variable (Table 1), resulting in stock status being characterized as unknown, but potentially healthy (WDFW 1998). Above Black Lake, bull trout have been observed in Lake Creek up to Three Prong Creek (USFS 1995a). In 2001, large bull trout were observed spawning in Lake Creek, indicating successful migration. The number of redds in Lake Creek does not appear to be related to flow conditions (USFS 2003). Moderate fishing intensity occurs on Black Lake, in part due to its location in the Pasayten Wilderness, requiring a 5-mile hike to the lake (WDFW 1998).

The mainstem Chewuch River, from the river mouth to the confluence with Thirtymile Creek, is not known to provide spawning habitat for bull trout. In 2001, however, bull trout redds were found in the mainstem Chewuch River above Thirty Mile Creek (USFS 2003). In subsequent survey years, up to 35 redds have been found in this area (see Table 1) Migratory bull trout may also spawn below passage barriers in sections of three tributaries (Andrews, Boulder, and Twentymile Creeks) (USFS 2003). Historically, Eightmile and Boulder Creeks may have supported bull trout (USFS 1994), but none were observed in Eightmile Creek during surveys conducted in 1999 (USFS 2003). Abundant brook trout in these tributaries may exclude bull trout.

Recent surveys in Eightmile Creek have revealed that bull trout spawning occurs in the 1.5 mile portion of the creek below a cascade that partially blocks migratory passage at most flows. At this time, no more than 2 redds per season have been found in this reach of Eightmile Creek. One bull trout, about 11 inches (28 cm) in length, has been found above this cascade at about river mile 6.2. We do not know if this individual represents a resident population or migrated into upper Eightmile Creek from the mainstem Chewuch River during a period of favorable flow. Because no other bull trout have been detected during surveys above the cascades, our working assumption is that this lone individual originated from the Chewuch River local population.

The fish community in the Chewuch River has been affected by both extirpation of native species, severe reductions in abundance of some species, and introduction of exotic species. Coho salmon (*O. kisutch*) were extirpated from the Methow watershed, but efforts to determine the feasibility of reintroducing this species are underway. Upper Columbia River spring chinook and steelhead populations are listed as endangered under the Act, indicating their depressed abundance. The eastern brook trout is an introduced species in the watershed that has been found up to river mile 22.7 (USFS 2003). Brook trout are scarce in the mainstem Chewuch River, but they are abundant in all tributaries below Twentymile Creek (USFS 2003). Mountain whitefish were abundant at all sites surveyed in the lower river (Smith et al. 2000b). Non-salmonid species in the lower river include sculpins (*Cottus* spp.), red-sided shiners (*Richardsonius balteatus*), and dace (*Rhinichthys* spp.). Redband trout and westslope cutthroat trout (*O. clarki lewisi*) are present in upper tributaries, with stocking of westslope cutthroat trout occurring in many mountain lakes (USFS 2003).

3.2.2 Habitat Characteristics in the Chewuch Watershed

The geomorphology of the Chewuch River basin has a strong influence on current landscape features, stream morphologic properties, and hydrologic responses. Two distinct geologic provinces bisect the watershed, with Methow province rock underlying the southwest one-fifth of the watershed, and the Okanogan Range province underlying the remainder. Methow province rocks are primarily sedimentary, except for Buck Mountain. The Okanogan Range province is primarily comprised of highly metamorphosed crystalline rocks (gneiss). The primary geomorphic processes that have had the greatest influence on current landscape features are alpine and continental glaciation along with glacial fluvial processes. Approximately 100,000 to 20,000 years ago, a series of alpine glacial processes were prominent in the Chewuch River and its major tributaries. These alpine glaciers carved out pre-existing V-shaped stream valleys, creating broader U-shaped valleys with steep side slopes. Major tributaries such as Falls, Twentymile, Farewell, and Lake Creek drain hanging U-shaped valleys. Volcanic activity has left ash and pumice deposits on the surface of these glaciated landscapes, especially on northerly aspects and lower- to mid-elevation slopes (USFS 1994, p. 87).

Soils in the watershed have varied origins. Much of the valley bottom landscape has deposits of boulders and glacial till. Areas in the Methow province produce soils of finer grain size derived from sedimentary rocks. Areas in the Okanogan Range province produce sandier soils derived from gneissic and granitic rocks. Landslides are most common in these Okanogan Range province soils throughout the upper reaches of the Chewuch in the Pasayten Wilderness. As of 1994, 26 slope failures ranging in size from10 to 300 acres were identified in the watershed, including debris torrents, large deep-seated landslides, and shallow seated landslides. All were attributed to natural events (USFS 1994, p. 92).

Most soil erosion in the Chewuch watershed is related to road construction and runoff, timber harvest, or fire (USFS 1994, p. 86). Erosion following these activities has deposited sediments in the Chewuch River, Boulder Creek, Doe Creek, and Falls Creek. Soil compaction from forest practices can also accelerate surface erosion. Between 3,300 and 11,200 acres in the watershed is estimated to be compacted due to historic tractor logging (USFS 1994, p. 91).

Hydrology in the Chewuch watershed is dominated by a pattern of fall and winter snow accumulation, with snowmelt and runoff during spring and summer driving the annual hydrograph. No glaciers are present in the watershed. During the late summer, the proportion of flow resulting from snowmelt decreases and groundwater becomes an increasing contributor to instream flow (Golder Associates 2002). During base flow in fall and winter, stream flow is predominantly groundwater discharge (Golder Associates 2002). Glacial tills provide high continuity between ground water and surface waters (USFS 1994). Water storage in wetlands occurs in the upper reaches of several tributaries (USFS 1994). Abundance of beaver (*Castor canadensis*) has been severely reduced in the watershed, reducing the water storage capacity and habitat complexity of the watershed (USFS 1994).

Most habitat pathways in the watershed are “properly functioning” in the upper watershed or “functioning at risk” in the lower watershed. The lower watershed is “not properly functioning” for the “road density and location” indicator. Elevated sedimentation, a deficiency of large woody debris, high road density, and low pool frequency and quality are the primary factors contributing to reduced habitat suitability for bull trout in the lower watershed. Integration of all pathways indicate that the environmental baseline for this sub-watershed is generally “properly functioning” above river mile 19 and “functioning at risk” below that point. Recent surveys of habitat condition and fish use in the lower river suggest that, although the lower river has been degraded by various impacts, it still supports relatively high numbers of rearing anadromous salmonids (Smith et al. 2000a).

3.2.3 *Factors Affecting the Species’ Environment in the Action Area*

The main activities in the watershed in the recent past have been fire suppression and post-fire management, timber harvest, grazing, water diversions, road realignment or closure, habitat restoration, summer home maintenance, and recreation (developed and dispersed camping, hiking, packing with horses, mules and llamas, hunting, outfitter-guiding, rock and ice climbing, and snowmobiling). Housing and agricultural development continues on private lands along the Chewuch River downstream of river mile 8. Several projects in the watershed with the potential to affect both bull trout and aquatic habitats have been the subjects of prior consultations (see Appendix b). The BA for the Buck Project included a baseline update for the lower Chewuch River watershed. This update was focused on recreation activities, water diversions, and grazing allotments. It described the current status of these ongoing USFS activities in the watershed and the likely impacts of these activities on the condition of aquatic habitats.

Wildfire is a major natural disturbance factor in the Chewuch watershed. Wildfires can strongly influence water temperature, chemistry, and quantity, as well as channel structure through changes in transpiration, infiltration, ground water recharge, erosion and mass wasting, riparian shading, and recruitment and delivery of coarse woody debris (summarized in Rieman et al. 2003). These effects on habitat quality can have detrimental effects on populations of bull trout including increasing the potential for brook trout invasion (Dunham et al. 2003). However, effects from specific wildfire events are difficult to predict and vary with the particular characteristics of specific fires and the watersheds where they occur (Rieman et al. 2003). Growing evidence suggests that in some cases fire can increase habitat complexity, providing a benefit to bull trout and other native fish (e.g., Benda et al. 2003).

Fire suppression activities and post-fire management have affected aquatic habitats in the Chewuch watershed. The Thirtymile Fire burned about 9,300 acres of the Chewuch watershed during the summer of 2001. This area is about 3 percent of the watershed and occurred in a swath about 3 miles wide from east to west and 6 miles long from north to south. High fire intensity occurred on 16 percent of the fire area, moderate intensity on 62 percent, and low intensity with scattered unburned areas on 23 percent of the fire area. About 4 miles of riparian areas burned along the Chewuch River between river miles 29 and 37, including known bull trout spawning areas in the mainstem Chewuch River. Subsequent to this fire, the USFS relocated a portion of the Chewuch Road and felled a large number of hazard trees in the area of the road relocation (Service reference 01-09-2005-I-W0194).

During the summer of 2003, the Farewell Creek Fire burned about 81,000 acres in the Chewuch watershed. About 66,000 acres of this total were in the Pasayten Wilderness. High fire intensity occurred on 20 percent of the fire area, moderate intensity on 24 percent, and low intensity on 56 percent of the fire area. Although most of this fire occurred in the subalpine-fir zone at higher elevations, it also burned over known bull trout spawning areas in Lake Creek. This fire also affected some of the area within the perimeter of the Thirtymile Fire. Maps of fire intensity provided by the USFS suggest that in the Lake Creek and Andrews Creek drainages, about 5 miles of riparian areas burned at high intensity and about 5 miles at moderate intensity.

In 2006, the Tripod Fire burned about 107,000 acres or roughly half of the Lower Chewuch watershed. The Ramsey, Boulder, and Twenty-mile drainages experienced the greatest effects. Burn severity was highly variable across sub-watersheds, but averaged 16 percent very low, 22 percent low, 44 percent moderate, and 22 percent high. Erosion potential on most of the burned area is considered moderate. The greatest potential for fire-related erosion is likely within the next 5 to 10 years, before vegetation recovers and stabilizes the soil.

Fire suppression activities included use of an incident command post at Eightmile Ranch, construction of 33 miles of handline (3 feet wide) and 10 miles of dozer line (10 feet wide), some of which occurred in riparian areas, blackline and burnout on an unknown number of acres, construction of safety zones, use of water pumps and seven helicopter dip sites, re-opening of closed roads (road miles unknown), and application of retardant.

Rehabilitation actions included installing waterbars, distributing slash, and blocking access to hand and dozer line, decompacting safety zones and other compacted areas, improving road drainage features, seed and fertilizer application to disturbed areas, and removal of temporary water impoundment and diversion structures. Completed rehabilitation work includes about 13,100 acres of heli-mulching, aerial seeding of 4,400 acres, 13,000 acres of fertilization, danger tree felling, integrated noxious weed control, and road and trail rehabilitation.

The USFS's assessment of effects in the Chewuch watershed stemming from the Tripod Fire and related activities included the factors summarized in Table 2, which the Service considers to be the most substantive changes to the baseline condition of the watershed.

Table 2. Baseline condition of habitat indicators in the Chewuch watershed and major effects of Tripod Fire and related activities.

Indicator	Pre-Tripod Baseline Condition*	Effects of Tripod Fire and Related Activities
Temperature	FAR above RM 27.2 (upper) NPF below (lower)	The Tripod Fire significantly reduced vegetative cover over extended reaches of Twentymile and Boulder creeks, which is likely to lead to increased temperatures below RM 18, especially during base flow. Short-term degradation until stream shade is restored by vegetative growth.
Sediment and embeddedness	FAR	Sediment loads in Boulder and 20-Mile creeks are likely to increase from both surface erosion and debris slides. BAER treatments, though ambitious in scale, only affected a small proportion of the total burned area, making it unlikely that these efforts would substantially limit increases in sediment delivery resulting from the fire. Short-term degradation will persist until vegetation stabilizes soil.
Large woody debris	PF upper FAR lower	Fire-caused tree mortality, expected debris flows, suppression related felling have all increased recruitment. Levels are currently high and are likely to be dynamic over next 5 to 10 years with continued landslides.
Pool frequency and quality	PF	Surveys in 3 reaches after 30-Mile and Farewell fires indicate an average 38 percent reduction in pool area. Duration of decline in this habitat type is uncertain.
Peak and base flow	FAR	Fire effects likely to increase peak flows, but magnitude of change uncertain. Base flows likely to show a minor increase due to reduced evapotranspiration.
Drainage network increase	FAR	Dozer line, increase in open roads, potential for rill erosion in burned areas all degrade indicator.
Riparian Reserves	PF upper FAR lower	Tripod Fire resulted in a moderate loss of riparian function in Boulder and 20-mile creeks. Some effects due to suppression activities in riparian areas and cattle sheltering in riparian during fire. Degraded function will persist until riparian vegetation recovers (decades).
Disturbance Regime	PF upper FAR lower	Large scale disturbance likely moved watershed toward restoration.

* PF = Properly Functioning; FAR = Functioning At Risk; and NPF = Not Properly Functioning

After evaluating the available information about the effects of the Tripod Fire and rehabilitation activities in the Chewuch watershed, the USFS determined that none of these effects were extensive, prolonged, or severe enough to warrant changing the baseline condition of any indicator. The Service agreed with that assessment. Based on the USFS's assessment, we also found that the combined beneficial and detrimental effects of the Tripod Fire to habitat conditions may result in a short-term reduction in the reproductive success of the bull trout local population in the Chewuch watershed. However, based on bull trout response to the Thirtymile and Farewell fires, we expect that the magnitude of this effect will be minor, and too small to influence population dynamics of the entire Methow core area.

The 2002 Chewuch River stream survey found that surface fine sediments were at or exceeded established guidelines at the low gradient (<1%) segments of the river and that surface fine sediments were far less abundant in the stream segments with a gradient greater than 1%. Several debris flows have originated in areas burned in recent years in the Chewuch watershed. Andrews Creek, Lake Creek, and some unnamed tributaries contributed large amounts of fines, sand, gravel, and rocks to the Chewuch River after thunderstorm activity over the Thirtymile and Farewell Fire areas in the summer 2004. Sediment sampling in 2004 did not show any effect to spawning gravels in the Chewuch, but the 2005 sample suggests increased sedimentation is occurring. Fine sediment filled pools and covered gravels affecting spawning and rearing habitat for spring Chinook salmon, steelhead and bull trout. After two years however, the fine and coarse sediment and woody debris that was delivered to the Chewuch River began to stabilize and create high quality, complex instream habitat. Although these disturbance events were extensive, we believe the effects will be short lived and the Thirtymile and Farewell Fires may have helped restore the fire disturbance regime in large portions of the upper Chewuch watershed. Future monitoring may help identify the effects of the slides and subsequent sediment transport on bull trout.

Large wood recruitment is increasing in the upper Chewuch River as a result of the Thirtymile and Farewell fires. The landslides of 2004 also delivered log complexes to the Chewuch River. These inputs of large wood have contributed to improvement in the amount and quality of pool habitat in the upper Chewuch, and may improve floodplain connectivity by raising the elevation of the riverbed. Despite the acceleration of natural recruitment of large wood and restoration efforts that placed large wood into the channel, transport and retention of large wood in the lower 20 miles of the Chewuch River is still below natural levels. This deficit is thought to be due to historic channel cleaning and riparian harvest that removed key large trees (> 40 inches dbh) from the banks of the lower river.

Defoliating insects and disease have also affected the baseline condition of this sub-watershed. Quantitative estimates of tree damage and mortality are not available. However, we have observed relatively extensive defoliation in the sub-watershed. Defoliation could reduce stream shading, increasing water temperature, and by hastening tree mortality could influence rates of woody debris recruitment, peak and base flows, and streambank condition. Another potential effect of defoliating insects, which may be the most consequential, is that extensive tree mortality could increase the severity of subsequent wildfires. Higher fire severity can intensify the immediate negative effects of fire on watersheds and prolong the duration of the post-fire period of instability.

Water diversions in the lower watershed are an important factor affecting habitat quality. There are two private irrigation ditches in the lower river that divert large volumes of water. The Fulton Ditch has its diversion at river mile 0.7 and filed claim in 1910 for 30 cfs. The fish screen at this diversion has a functional capacity of 22 cfs. The Chewuch Ditch filed claim in 1910 for

200 cfs and may have used up to 50 cfs prior to 1950. In 1974 they filed a revised claim for 56 cfs, and the current fish screen has a capacity of 30 cfs. Both ditches have concrete and rock weirs that divert flow into the ditches, with fish ladders to allow fish migration at low flow (Smith et al. 2000a). The weirs are passable to bull trout at higher flows. These ditches joined with the Skyline Ditch Company in 2001 to form the Chewuch Basin Council to address stream flow and endangered species issues (USFS 2003).

In addition to the Skyline diversion, two other ditches and several water transmission lines begin on land managed by the USFS. The Eightmile diversion was owned and operated by the USFS and recently diverted up to 4 cfs. This ditch was abandoned in 2003 and replaced by wells. The Lucille Mason diversion has an interruptible claim for 0.5 cfs (April 1 to October 31) and turns off when the Chewuch River reaches base flow (USFS 2003).

Minimum instream flows for the Chewuch River were established by the Washington Department of Ecology (WDOE) in December 1976 (Caldwell and Catterson 1992). The minimum instream flow set by WDOE for the Chewuch from August 15 through September 15 is 47 cfs (USFS 1998), as measured at RM 8.7, upstream of all major water users. The Skyline, Chewuch, and Fulton diversions presently withdraw up to 68.8 cfs. Periodically, during diversion operations, WDOE administratively established minimum instream flows are not met.

This WDOE study also included an analysis of the relationship between fish habitat availability and instream flow using the Instream Flow Incremental Methodology. The highest quantity of rearing habitat for juvenile bull trout in the lower Chewuch River was estimated to occur at flows near 400 cfs (Caldwell and Catterson 1992).

Below the Skyline diversion, most of the riparian areas of the Chewuch River are in private ownership, with small areas owned by the Washington Department of Fish and Wildlife (Smith et al. 2000a). Development of residential and vacation homes on private lands are affecting riparian vegetation and all of its associated functions, as well as increasing demand for water for domestic use and irrigation.

Rising demand for recreational opportunities has led to many dispersed camping sites along the mainstem and tributaries in the lower watershed that have extensive road systems. The Respect the River program, initiated in 1994 by the USFS, is designed to increase awareness of riparian and aquatic habitat and inhabitants, restoration efforts, and individual responsibility to restore or maintain habitat quality. No new dispersed sites are being allowed and existing sites have been modified to allow riparian area recovery and reduce recreational impacts through improved visitor awareness. Other restoration efforts in the watershed have focused on reducing the impacts of roads in riparian areas, particularly in Cub and Doe creeks. Well-coordinated restoration planning and implementation efforts in the watershed are expected to continue.

Roads have important impacts on aquatic ecosystems in the Chewuch watershed. Road densities exceed 3.5 miles per square mile among most of the river corridor from Lake Creek to the mouth, and many areas have greater than 5 miles of road per square mile (USFS 1994). There are over 1,000 stream crossings, 579 miles of open roads, and 74 miles of closed roads in the Chewuch watershed, most of which are on highly erosive soils (USFS 1994). Areas with the greatest potential for sediment delivery from roads are concentrated in the lower river (USFS 1994).

Noxious weed control projects were covered in a batched consultation (FWS reference number 01-03-2001-I-1262) to be implemented within the Chewuch and Twisp watersheds. This batch included proposed work by the USFS that would occur from May 2001 to May 2006. Treatment would be by chemical, manual, and cultural methods. Generally treatment is restricted to road corridors. Effects of this activity to listed fish would be minimized through implementation of conservation measures that minimize the potential for chemical contamination of surface waters. As this batched consultation expired, the Service completed a regional programmatic consultation on the USFS Region 6 Invasive Plant Program (FWS reference 01-07-2005-7-0653). The BA and associated BOs for this program provide management direction and conservation recommendations that will guide all future weed control actions in the Chewuch watershed.

Prescribed fire projects used as a silvicultural or management tool could occur within the Chewuch watershed under a programmatic consultation (FWS reference number 1-3-00-I-0906). These projects would be designed to reduce fuel (dead wood, brush, grass, etc.) levels, reduce the catastrophic risk of fire particularly to private lands and forest resources, reduce vegetative competition, and to restore the natural fire disturbance regime. The main management activities associated with prescribed burning are fire preparation (fireline construction, pruning adjacent vegetation), ignition of fuels, and containment of fire. Fire is used in the spring and fall as underburns consisting of low to moderate intensity fires with an average flame length of less than three feet and less than 10 percent pine needle scorch. The USFS proposed to implement this between April 2000 and April 2005 with five to ten burns annually across the Okanogan National Forest ranging from 50 to 5,000 acres each. No more than 25 percent of any 6th field watershed would be burned in a single year. Conservation measures to reduce impacts to listed fish would include: using pump chances that will not cause streambed alterations, screening pumps, refueling equipment outside of Riparian Reserves, preventing changes in road use or access, and monitoring of burns within Riparian Reserves.

Two cattle grazing allotments are entirely within the Chewuch watershed as are portions of six others. Ongoing effects of these allotments on aquatic habitats were determined to be insignificant and discountable generally because allotments have little overlap with primary tributaries and mainstem areas used by bull trout, ongoing inspection of pasture fencing, monitoring before turnout, and grazing schedules designed to minimize sediment impacts to listed fish. Sheep grazing no longer occurs in the watershed; and, cattle grazing is declining. Consultation on revised allotment management plans for the Chewuch allotments was completed in December 2005, and for the Cub Allotment in September 2009 (Appendix B).

Timber harvest and mining have not had important effects on aquatic habitats in the Chewuch Watershed since implementation of the Northwest Forest Plan and listing of the bull trout. Other activities in the watershed include backcountry recreation and summer home use. These activities have also had relatively minor impacts on aquatic habitats.

3.3 Global Climate Change

Global climate change has the potential to affect the baseline condition of bull trout habitat at all scales from the coterminous U.S. to the sub-watershed and action area. Available evidence also indicates climate change effects are reasonably certain to continue into the foreseeable future. Consequently, climate change could be addressed under multiple headings in this BO (e.g., rangewide status of the species, environmental baseline, and cumulative effects). Rather than scatter our discussion of this important topic throughout the BO, we consolidate in this section our consideration of how climate change may alter baseline conditions across scales.

Climate change is one of the most significant ongoing effects to baseline conditions for bull trout and their associated aquatic habitat throughout the state of Washington. Climate change, and the related warming of global climate, has been well-documented in the scientific literature (Bates et al. 2008; ISAB 2007). Evidence includes increases in average air and ocean temperatures, widespread melting of snow and glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (Bates et al. 2008; Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Climate change has the potential to profoundly alter the aquatic habitat through both direct and indirect effects (Bisson et al. 2003). Direct effects are evident in alterations of water yield, peak flows, and stream temperature. Some climate models predict 10 to 25 percent reductions in late spring, summer, and early fall runoff amounts in coming decades. Indirect effects, such as increased vulnerability to catastrophic wildfires, occur as climate change alters the structure and distribution of forest and aquatic systems. Observations of the direct and indirect effects of global climate change include changes in species ranges and a wide array of environmental trends (ISAB 2007; Hari et al. 2006; Rieman et al. 2007). In the northern hemisphere, ice-cover durations over lakes and rivers have decreased by almost 20 days since the mid-1800s (WWF 2003). For cold-water associated salmonids in mountainous regions, where upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in size of suitable habitat patches and loss of connectivity among patches, which in turn can lead to a population decline (Hari et al. 2006; Rieman et al. 2007).

Climate change is already affecting the frequency and magnitude of fires, especially in the warmer, drier regions of the west. To further complicate our understanding of these effects, the forest that naturally occurred in a particular region may or may not be the forest that will be responding to the fire regimes of an altered climate (Bisson et al. 2003). In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. 2003).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, stream flow timing will change, and peak flows will likely increase in volume. Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007). Data from long-term stream monitoring stations in western Washington indicate a marked increasing trend in temperatures in most major rivers over the past 25 years (WDOE 2007).

There is still a great deal of uncertainty associated with predictions of timing, location, and magnitude of climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). Research indicates that temperatures in many areas will continue to increase due to the effects of global climate change. According to model predictions, average temperatures in Washington State are likely to increase between 1.7 °C and 2.9 °C (3.1 °F and 5.3 °F) by 2040 (Casola et al. 2005).

Bull trout rely on cold water throughout their various life stages and increasing air temperatures likely will cause a reduction in the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of char species. Groundwater temperature can also be linked to bull trout selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman et al. 2007). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-related warming of lakes will likely lead to longer periods of thermal stratification, forcing coldwater fish such as bull trout to be restricted to the bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the deeper depths of lakes and intensify competition for food (WWF 2003).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change will cause shifts in timing, magnitude, and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007). The increased magnitude of winter peak flows in high elevation areas is likely to affect spawning and incubation habitat for bull trout and Pacific salmon. Although lower elevation rivers are not expected to experience as severe an impact from alterations in stream hydrology, they are generally not cold enough for bull trout spawning, incubation, and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to ensure the persistence of bull trout and other species dependent on cold water. Thermal refugia are important for providing bull trout with patches of suitable habitat while allowing them to migrate through, or to make foraging forays into, areas with above optimal temperatures. Juvenile rearing may also occur in waters that are at or above optimal temperature, but these rearing areas are usually in close proximity to colder tributaries or other areas of cold water refugia (USEPA 2003).

Climate change is and will be an important factor affecting bull trout distribution and population dynamics. As distribution contracts, patch size decreases and connectivity is truncated; populations that are currently connected may become thermally isolated, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007). In areas with already degraded water temperatures or where bull trout are at the southern edge of their range, they may already be at risk of impacts from current as well as future climate change. As these trends continue, the conservation role of bull trout populations in headwaters habitats may become more significant. Long-term persistence of bull trout may only be possible in these headwater areas that provide the only suitable habitat refugia.

3.4 Likelihood of Species Presence in the Action Area

Based on information about the distribution of bull trout in the Project area, we believe there are three distinct zones in the Project area that differ in their likelihood of bull trout presence. Zone One includes the lower Chewuch River and the portion of Eightmile Creek below the partial barrier cascade. Juvenile and sub-adult life stages of bull trout can be present in these areas year round, with increased probability of adult presence from mid-summer to mid-fall when spawning occurs. Bull trout spawning has been observed downstream of the partial barrier on Eightmile Creek. Consistently cold water temperatures in Eightmile Creek suggest juveniles and sub-adults may be present at any time. Rearing juvenile and sub-adult bull trout are less likely to be present in the mainstem Chewuch River during low-flow periods from late summer to mid-fall due to increased water temperatures. The lower mainstem Chewuch River is generally considered to be foraging, migratory, and overwintering (FMO) habitat for bull trout. Zone 2 consists of Eightmile Creek above the partial barrier cascade. Bull trout have been detected in this Zone, but their abundance and distribution is poorly known. Because few detections of bull trout have occurred in this Zone, but brook trout are abundant, we believe there is a generally low likelihood of bull trout presence here. More survey work is necessary to determine if a small resident population of bull trout persists above the partial barrier in Eightmile Creek, and where this population is distributed in the drainage. Zone 3 is the Cub Creek drainage, where bull trout have not been detected, and where habitat conditions in summer and fall are typically unfavorable for bull trout. The likelihood of bull trout presence in this drainage is negligible. The Chewuch River local population of bull trout is the only local population likely to be affected by the proposed Project.

4.0 EFFECTS OF THE ACTION

The Service's section 7 regulations define "effects of the action" as "the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 C.F.R. 402.02). "Indirect effects" are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

To assess potential Project effects, the Service uses a format titled "A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Scale" (USFWS 1999). This format, adapted from the 1996 National Marine Fisheries Service format of a similar name, includes a decision matrix with pathways and indicators (MPI) designed to describe a baseline of subpopulation and habitat conditions and effects of the proposed action on these conditions. Baseline conditions are described on a relative scale of functionality for each indicator. We then evaluate project effects on each indicator in the context of the environmental baseline in the action area. We consider proximity, distribution, timing (duration, frequency), type, intensity, and severity of effects in order to evaluate the degree of effect resulting from project implementation (USDI and USDC 1998, pp. 4-22 to 4-24). The Service typically expresses degree of effect in terms of impacts to individual fish and fish populations and deviations of habitat indicators in the MPI from their baseline condition. This entire process is described in the *Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area* (USDA et al. 2004), a document produced through interagency cooperation between the Service, the National Marine Fisheries Service, the Bureau of Land Management, and the USFS. This analytical process is the framework for our assessment of the proposed action.

To begin our analysis of effects, we typically deconstruct projects into separate elements that trigger different impact mechanisms. We have characterized this Project as having three elements, all of which may result in adverse effects to bull trout (see Project Description above and in the BA for details). The Service used the Project elements defined in the Project Description above to structure our analyses of direct effects to bull trout and indirect effects to habitat conditions. For ease of reference, we use the following labels for the three primary Project elements:

1. Timber and biomass cutting and yarding,
2. Fuels reduction, and
3. Roads management.

To describe and analyze Project effects in a logical way, we identified the following underlying premises:

1. Project elements trigger various impact mechanisms that directly kill (lethal effect), injure, or modify the behavior of bull trout, or result in changes in habitat condition that cause indirect injury (sub-lethal effects). Sub-lethal effects can vary from transient but significant disruptions of feeding behavior that temporarily reduce physiologic condition to physical injuries that reduce longevity and reproductive success.
2. All adverse effects can be integrated and expressed in the common currency of changes in the numbers, distribution and reproduction of bull trout.
3. The beneficial effects of the Project will occur predominantly over the longer term, after areas disturbed during Project implementation have re-vegetated and stabilized.
4. Individual bull trout from only the Chewuch River local populations in the Methow core area may be affected by the Project. Based on the distribution of bull trout spawning and rearing habitat in the Project area, the Service expects only the Chewuch River local population will experience adverse effects.

Based on these premises, our effect analysis consists of two major components:

1. Evaluate the potential for direct injury or mortality of individual bull trout, and
2. Evaluate the potential for effects on habitat indicators to result in indirect adverse effects.

We integrate both components to determine their combined influence on the numbers, distribution and reproduction of bull trout populations exposed to effects of the action.

Evaluating effects at the individual level relative to components 1 and 2 requires several sub-steps:

a. Determine which project elements and impact mechanisms are likely to result in adverse effects,
b. Identify the life stages most likely exposed to those effects.
c. Estimate the number of individuals in these life stages that will be exposed to project effects based on the intersection between the timing of element effects and the seasonal timing of habitat use by different life stages. This typically involves estimating the total number of individuals present in the vicinity at the time project activities begin and the number of individuals likely to pass through the affected area during the anticipated period of effects and,
d. Estimate the relative severity of effects resulting from exposure.

Determining the Project elements likely to result in adverse effects can be accomplished by qualitatively evaluating the potential effects of each element on bull trout individuals and habitat indicators (Table 3). Although Table 3 resembles the "checklist" in the Matrix of Pathways and Indicators, we are not referring here to watershed-scale effects on indicators. Rather, we simply borrow the familiar MPI format to structure our qualitative ratings of the effects of Project elements on bull trout individuals at the action area scale. Identifying life stages likely to be exposed can usually be based on relatively good information about spatial and temporal patterns of habitat use. Estimating numbers of individuals exposed and the relative severity of effects requires many assumptions. The most basic assumption is that average conditions in the past can be used as an index of conditions during Project implementation. Numerous additional assumptions about population size, age structure, migration timing, reproductive rate and other features contribute to high levels of uncertainty surrounding these estimates. The Service attempts to be as transparent as possible about these sources of uncertainty.

Table 3. Relative effects of Project elements on bull trout and habitat indicators.

Indirect impact mechanisms (habitat indicators)	Project Elements		
	Timber and biomass	Fuels Reduction	Roads Management
Direct injury (turbidity)	-	-	---
Temperature	--	--	-/+
Sediment/turbidity	--	--	---
Chemical contaminants and nutrients	-	-	--
Physical barriers			
Embeddedness	--	--	---
Large Wood	-	-	
Pool frequency and quality	-	-	-
Large pools	-	-	-
Off-channel habitat			
Refugia			
Width:depth ratio	-	-	-/+
Streambank condition		-	
Floodplain connectivity			
Peak and base flow	--	--	-/+
Drainage network	--	--	-/+
Road density and location	-/+		+
Riparian reserves	--	--	-/+
Disturbance History	--/+	-/+	-/+
Disturbance regime	+	+	+

Minus signs indicate level of negative impact. One minus sign indicates a negative impact that is insignificant or discountable. Two minus signs indicates a negative impact that has the potential to cause an adverse effect to a listed species that can be reliably avoided by proper implementation of conservation measures. Three minus signs indicate a high likelihood of causing an adverse effect in all or a proportion of individuals exposed to this impact. A blank indicates an indicator is unlikely to be directly or indirectly affected by a project element because there are no impact mechanisms that link the project element to an indicator. Plus signs denote beneficial effects.

4.1 Direct Effects

We think adverse direct effects to bull trout may occur in Eightmile Creek below the partial barrier. Direct adverse effects could occur due to exposure to increased turbidity and sedimentation. The Road Management Project element would be the primary source of sediment mobilization responsible for this effect. While it is possible for bull trout above the partial barrier in Eightmile Creek to be adversely affected by Project activities, at this time we feel the limited available information about the distribution and abundance of bull trout above the barrier suggests a discountable likelihood of exposure. Similarly, in the mainstem Chewuch River, we feel that spatial separation from Project activities, relatively high background sediment levels, and the FMO function of this habitat combine to reduce the likelihood of direct adverse effects to discountable levels. In the Cabin Creek drainage, we agree with the assessment by the USFS that the amount of physical separation between where Project activities will occur and habitats occupied by bull trout eliminates the potential for direct effects to occur.

4.1.1 *Turbidity: Potential Direct Effects on Bull Trout*

Elevated turbidity or suspended sediment concentrations can have adverse direct effects on exposed individuals by altering behavior and causing physiologic stress. Although no specific data are available for bull trout, responses observed in other stream salmonids are likely also to apply to bull trout. Individual fish may avoid high concentrations of suspended sediments altogether (Hicks et al. 1991). Even small elevations in suspended sediment may reduce feeding efficiency and growth rates of some salmonids. At lower concentrations of suspended sediment fish may decrease feeding and at higher concentrations may cease feeding completely (Sigler et al. 1984). In addition, patterns of social behavior may be altered by suspended sediment (Berg and Northcote 1985). Depending upon the concentration and duration of exposure, sediment can directly affect physiological condition and normal behavior (Newcombe and MacDonald 1991; Waters 1995; Newcombe and Jensen 1996; Bash et al. 2001).

Newcombe and Jensen (1996, pgs. 694 - 700) used empirical data from the most sensitive individuals within species groups, including salmonids, to develop a model to estimate a severity-of-ill-effect rating from suspended sediment. The effects characterized by Newcombe and Jensen (1996, pgs. 700 - 705) include a broad range of physiological and behavioral responses to suspended sediment and varies as a function of suspended sediment concentration and duration of exposure. The Service uses this model to evaluate the effects of sediment inputs from proposed projects. Application of this model is hampered by uncertainty surrounding the concentrations and duration of sediment releases from different types of project activities. This is particularly true for projects like the one analyzed here that include multiple activities with diffuse contributions to increasing sediment yield to the drainage.

4.1.2 *Turbidity: Project-specific Direct Effects*

We agree with the assessment presented in the BA that each of the Project elements has the potential to increase sediment yield, and that roads management has the potential for contributing the greatest amount of sediment to the stream network.

The BA provides a well-reasoned argument for the conclusion that the timber harvest element is likely to result in insignificant increases in sediment delivery to the stream network, largely due to inclusion of effective conservation measures and design criteria. We agree that the use of undisturbed riparian buffers, adjusting the width of these buffers for slope, installing waterbars on skid trails, and adjusting yarding systems to accommodate soil types will all minimize sediment mobilization and delivery to stream systems. The presence of well drained soils across most of the Project area, in combination with various conservation measures to reduce soil compaction will also help to minimize accelerated sedimentation associated with timber harvest.

We also agree that fuels treatments are likely to result in insignificant increases in sediment delivery to bull trout habitat. Our level of uncertainty about this conclusion is higher than for the timber harvest element. Several factors contribute to our uncertainty. Given the large total area to be burned, we expect the removal of vegetation due to underburning to decrease surface roughness and increase surface flow and erosion during precipitation events and snowmelt runoff. Underburns, especially within or near riparian reserves, will reduce the capacity of these areas to trap sediment, even if underburns are successfully implemented within prescription objectives. We also expect the hydrophobic response of soils to both underburning and pile burning to be sufficient to increase mobilization of fine sediment. Finally, given that 7.6 miles of fireline will be constructed in or near riparian areas, we expect a small portion of these firelines to concentrate surface flow, and deliver excess sediment to channels. All of these mechanisms of increased sediment delivery can be partially addressed with BMPs. The degree to which BMPs can compensate for inevitable variation in outcomes from these treatments is the primary source of uncertainty regarding effects of this Project element on this indicator. Ultimately, we expect the combination of these factors to lead to a slight increase in sedimentation in areas occupied by bull trout.

Modeling of sediment yield presented in the BA indicates the existing road network and proposed road management activities are by far the dominant source of sediment delivery to the drainage network. Modeling results also suggest that the magnitude of increased sediment yield associated with the proposed Project have the potential to result in a measurable increase in fine sediment to areas occupied by bull trout during the first four to six years of Project implementation (before decommissioned roads and removed stream crossings stabilize).

Several scenarios could rapidly elevate suspended sediment levels in the Eightmile drainage sufficiently to result in adverse effects. Of these, we consider the most likely to be changes in sediment yield associated with spring snowmelt during late spring and summer from year 2 to 6. During this seasonal time frame, alevins may still be in spawning gravels and would represent the life-stage most susceptible to the effects of increased sediment yield (Newcombe and Jensen 1996). In this period, pre-spawning adult bull trout and rearing juveniles and sub-adults also could be present in lower Eightmile Creek.

A recently completed compilation of turbidity effects associated with different management activities did not include any well-monitored examples with the suite of project elements of this Project (J. Muck, pers comm.). Consequently, we provide the following rationale to support our professional judgment that adverse effects are likely. The Service has established that relatively small increases in turbidity will reduce the survivorship of alevins (J. Muck, pers. comm.). Using the suspended sediment concentration and duration of exposure criteria of Newcombe and Jensen (1996), adverse effects can occur when alevins are exposed to an elevation above background levels of 11 micrograms per liter (mg/L) of suspended solids for a period of 1 hour. When exposure duration is increased to 3 hours, an elevation of only 1 mg/L above background can lead to adverse effects on survival (Newcombe and Jensen 1996). We expect that the duration of increased sediment pulses associated with spring runoff will almost certainly exceed one hour, and are more likely to be on the order of 1 to 2 days. We also expect that elevation levels above background will be relatively low, given that spring runoff is typically the period when background turbidity levels are elevated in drainages in the Methow sub-basin (http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=final_data&scrolly=465&wria=48&sta=48A140, accessed August 2, 2010). Finally, we expect the mitigated levels of sediment yield from the proposed Project to be relatively low, and that suspended sediment concentrations experienced by bull trout in Eightmile Creek will be a product of low-volume inputs from small channels with high suspended sediment concentrations that are diluted by the higher volume flow in the main channel.

Our expectations are based on a relatively limited amount of monitoring data and research. A study of culvert removals and forest road obliteration in Washington and Idaho provides the most directly relevant frame of reference. In this study, work occurred on small streams (flow << 0.5 cfs), with baseline suspended sediment levels less than 10 mg/L (Foltz et al. 2008). Sediment control BMPs were found to be highly effective at reducing suspended sediment in streams, but locations with sediment control BMPs still had a peak sediment concentrations between 1,300 and 300 mg/L, with an expected value of 830 mg/L (Foltz et al. 2008, pg. 339). In these locations, compliance with a regulatory criterion of 25 mg/L was achieved at an average distance of 810 meters downstream (Foltz et al. 2008, pg. 336). Duration of exceedance of the 25 mg/L standard ranged from less than an hour to more than 47 hours (when monitoring ceased) (Foltz et al. 2008, pg. 336). In one location, the exceedance persisted for 10 hours at a location more than 800 m (1/2 mile) downstream of a culvert removal. Road construction activities produced more sediment than decommissioning and culvert removal (Foltz et al. 2008).

Road management activities in the Eightmile drainage include opening of decommissioned roads and decommissioning of open roads that cross intermittent channels within 810 meters of areas occupied by bull trout. Because these areas are used for spawning and sensitive life-stages may be present when excess sediment delivery is likely to happen, we believe direct adverse effects associated with exposure to increased turbidity may occur.

To estimate the number of bull trout adversely affected by exposure to elevated suspended sediment concentrations, we assume that all bull trout present in lower Eightmile Creek below the partial barrier to migration will be exposed to increased sedimentation. Site-specific information is insufficient to allow us to estimate the number of bull trout likely to be present in each life stage. Anecdotal reports of bull trout spawning in lower Eightmile Creek suggest that two redds per year is a reasonable expectation. We have no reasonable means for estimating the number of alevins likely to be present per redd, and assume that all alevins present will be adversely affected by elevated suspended sediment. We assume each redd represents two adult spawners, and that these adults may be exposed to elevated sediment during the pre-spawning period. To estimate the numbers of juvenile and sub-adult bull trout likely to be affected, we believe the best available information regarding the density of these life stages is based on surveys conducted in spawning habitats across Washington during the development of a protocol to detect bull trout presence. These surveys revealed a statewide average density of bull trout juveniles and sub-adults in spawning areas of 0.058 bull trout per 100 square meters of stream surface area (range of 0.001 to 0.43 fish per $100m^2$; Thurow et al. 2004, pp. 15 and 53). Because road management activities will occur both above the partial barrier cascade and down to within 810 m of the mouth of Eightmile Creek, we believe adverse effects due to elevated sedimentation may occur throughout the reach of the creek below the cascade. Applying an estimated stream width of 5 meters along the entire 2,400-meter length of Eightmile Creek occupied by bull trout yields an estimate of total stream area potentially affected of 12,000 meters squared. The number of bull trout juveniles and sub-adults potentially exposed to elevated suspended sediment levels can then be estimated as: $12{,}000\ m^2 * 0.058$ bull trout/$100\ m^2 \approx 7$ bull trout.

Because we expect the duration of exposure to elevated sedimentation to be 1 to 2 days per year, a relatively modest increase (< 10 mg/L) in suspended sediment concentration above background levels can result in adverse effects to juvenile, sub-adult, and adult life stages due to disruption of normal feeding patterns and physiologic stress (Newcombe and Jensen 1996; J. Muck, pers. comm.). We believe this type of adverse effect is likely to occur every year from year 2 to year 6 of Project implementation (Table 4). Likewise, alevins can experience both behavioral disruption and physical injury from sediment elevation of this magnitude. We expect some proportion of alevins to experience reduced survival due to this exposure, but we cannot quantitatively estimate this proportion based on available information. We expect all alevins emerging from redds in Eightmile Creek to experience these adverse effects during years 2 to 6 of Project implementation (Table 4). The Service, however, does not expect minor reductions in productivity due to increased alevin mortality to be sufficient to alter overall demographic trends of the Chewuch River local population. This expectation is based on spawners in Eightmile Creek representing less than 10 percent of the total local population, and that increased mortality in early life stages from Project effects is likely to be compensatory rather than additive.

For juvenile, sub-adult, and adult bull trout, exposure to suspended sediment that is elevated above background levels by about 214 mg/L can result in physical injury. Based on our understanding of the context of Project effects described above, we believe that elevation of suspended sediment concentrations sufficient to result in injury to these life stages is unlikely. Consequently, we expect all exposed individuals in these life stages to experience sub-lethal behavioral and physiologic effects (J. Muck, pers. comm.). Injurious elevation of suspended sediment could occur due to an extreme weather event, such as heavy precipitation from an intense convective storm hitting the Project area, but we consider the likelihood of such an event to be discountable.

Table 4. Summary of direct adverse effect estimates stratified by impact mechanism, life stage, and severity of effect. See text for derivation of these estimates.

			Severity of Estimated Effect		
Impact Mechanisms	Exposure context and life stage	Estimated number exposed/yr	Exposed but not adversely affected/yr	Sub-lethal effects/yr	Lethal effects/yr
Exposure to elevated suspended sediment	Adults	4	0	4	0
	Sub-adults and juveniles	7	0	7	0
	Alevins	All from 2 redds		Most	Small proportion
Five-year Totals					
		Estimated number exposed/5 yr	Exposed but not adversely affected/ 5 yr	Sub-lethal effects/ 5 yr	Lethal effects/ 5 yr
Exposure to elevated suspended sediment	Adults	20	0	20	0
	Sub-adults and juveniles	35	0	35	0
	Alevins	All from 10 redds		Most	Small proportion

For most bull trout exposed to sediment pulses, the Service expects that the severity of sub-lethal effects will be sufficiently mild that the likelihood of survival and reproduction of exposed individuals will not be reduced appreciably (e.g., diminished physiologic condition resulting from impaired foraging behavior and depletion of energy reserves can be rapidly alleviated after exposure to Project effects). We do not expect the combined sub-lethal effects of multiple exposures to result in lethal consequences, only increased severity of sub-lethal adverse effects. We also do not expect any other direct effects on bull trout from this Project

4.2 Effects to Habitat Indicators

The following sub-sections address indirect effects to bull trout from Project implementation. Both negative and beneficial Project effects to habitat indicators in the MPI are discussed. The BA for the Project provided a thorough analysis of the likely effects of the Project on habitat indicators. With few modifications, mostly regarding the likely magnitude of effects, the Service agrees with the findings in the BA.

We agree that the Project does not include elements that are likely to affect the following habitat indicators; “physical barriers,” “off-channel habitat,” “refugia,” and “floodplain connectivity.” These indicators will not be discussed further in this BO.

4.2.1 *Temperature*

Baseline stream temperatures are rated as “functioning at risk” in the Project area due to high summer temperatures. Timber and biomass cutting and yarding is unlikely to result in changes in stream shade if implemented as described. Design criteria that prohibit cutting commercial sawlogs within 100 feet of perennial streams and thinning small trees to within 50 feet of Cub Creek should result in insignificant effects on stream temperature. Fuel reduction treatments have the potential to result in small changes in stream shade and slight increases in stream temperatures, especially where they remove shrub cover from areas with immature tree canopies (Fire Science Brief 2010, pg. 3). However, design criteria, particularly riparian buffer distances, should be effective at keeping these effects to insignificant levels.

The overall reduction in tree canopy cover due to both harvest and fuel reduction may also allow more winter snow to reach the ground, potentially increasing groundwater storage and reducing temperatures by increasing flow during base flow periods (Jones et al 2009, pg. 2700). This effect, if it occurred would be both minor and short-lived. Road management activities will have insignificant effects in terms of vegetation removal, making it highly unlikely that this Project element could influence stream temperatures in the Project area. The Project area overlaps a cattle grazing allotment, and planned thinning and burning activities within riparian reserves could increase cattle access to riparian areas and stream banks, as well as increasing the amount and quality of forage in the riparian reserves. These changes could lead to reductions in shade mediated by increased browsing and trampling of riparian vegetation. The BA suggests that using seed mixes that differ in palatability to cattle could be effective at drawing cattle away from streams and reducing potential effects on streamside vegetation.

Overall, we do not expect reductions in stream shading to reach a level sufficient to increase stream temperatures measurably at the site or 6th field watershed scales.

4.2.2 *Sediment and Substrate Embeddedness*

The sediment and substrate embeddedness indicators are "functioning at risk" in the Project area. We agree that each of the Project elements has the potential to affect these indicators (Table 3), and that roads management has the potential for contributing the greatest amount of sediment to the stream network.

The BA provides a well-reasoned argument for the conclusion that the timber harvest element is likely to result in insignificant increases in sediment delivery to the stream network, largely due to inclusion of effective conservation measures and design criteria. We agree that the use of undisturbed riparian buffers, adjusting the width of these buffers for slope, installing waterbars on skid trails, and adjusting yarding systems to accommodate soil types will all minimize sediment mobilization and delivery to stream systems. The presence of well drained soils across most of the Project area, in combination with various conservation measures to reduce soil compaction will also help to minimize accelerated sedimentation associated with timber harvest.

We also agree that fuels treatments are likely to result in insignificant increases in sediment delivery to bull trout habitat. Our level of uncertainty about this conclusion is higher than for the timber harvest element. Several factors contribute to our uncertainty. Given the large total area to burned, we expect the removal of vegetation due to underburning to decrease surface roughness and increase surface flow and erosion during precipitation events and snowmelt runoff. Underburns, especially within or near riparian reserves, will reduce the capacity of these areas to trap sediment, even if underburns are successfully implemented within prescription objectives. We also expect the hydrophobic response of soils to both underburning and pile burning will be sufficient to increase mobilization of fine sediment. Finally, given that 7.6 miles of fireline will be constructed in or near riparian areas, we expect a small portion of these firelines to concentrate surface flow, and deliver excess sediment to channels. All of these mechanisms of increased sediment delivery can be partially addressed with BMPs. The degree to which BMPs can compensate for inevitable variation in outcomes from these treatments is the primary source of uncertainty regarding effects of this Project element on this indicator. Ultimately, we expect the combination of these factors to lead to a slight increase in sedimentation in areas occupied by bull trout.

Modeling of sediment yield presented in the BA indicates the existing road network and proposed road management activities are by far the dominant source of sediment delivery to the drainage network. Modeling results also suggest that the magnitude of increased sediment yield associated with the proposed Project have the potential to result in a measurable increase in fine sediment to areas occupied by bull trout during the first four years of Project implementation (before decommissioned roads and removed stream crossings stabilize).

In the section about direct effects above, we distinguished between levels of increased sediment delivery likely to cause adverse behavioral effects and those likely to result in physical injury. These types of effects are associated with an order of magnitude difference in sediment levels (i.e., 10 mg/L versus over 200 mg/L), and we concluded sediment levels high enough to cause physical injury were unlikely. The levels of sediment elevation that typically result in adverse habitat effects are intermediate in magnitude (i.e., elevations of between 20 and 55 mg/L of suspended sediment, given an expected delivery duration of 2 days; J. Muck, pers. comm.). Because we cannot accurately assess sediment yield from the proposed Project, considerable uncertainty surrounds our determinations about the likelihood of levels of elevated sediment delivery that differ by less than an order of magnitude. To reach a determination based on professional judgment about the likelihood of adverse habitat effects, we considered soil types in the Project area, cumulative impacts of Project implementation through time, steepness of the topography in the Project area, spatial distribution of road management relative to occupied habitat, and variation in precipitation and runoff patterns. Our opinion is that during at least one year of implementation, sediment delivery is likely to be sufficiently high during spring runoff to adversely affect rearing juvenile and sub-adult bull trout until high flows the following spring mobilize and redistribute that sediment. The primary mechanism likely to cause these adverse effects is diminished invertebrate production to a degree that reduces bull trout foraging efficiency and growth. The bull trout exposed to these adverse changes in habitat productivity are likely to be the same individuals directly affected by exposure to elevated suspended sediment. Therefore, we do not expect these adverse habitat effects to increase the total number of bull trout individuals adversely affected by the Project.

4.2.3 *Chemical Contaminants and Nutrients*

The Project does not include any elements that involve the deliberate application of contaminants, except the optional use of dust palliatives. The most important potential sources of accidental chemical contamination from the proposed Project are the use of heavy equipment (for timber and biomass harvest, yarding, and hauling, fireline construction, and road management activities, including stream culvert removals and replacements), and use of petrochemical accelerants to promote pile burning. The Service believes that limiting lignin applications to periods of dry weather will be effective in precluding contamination of surface waters. We also expect that standard safety and hazardous material handling procedures, including equipment inspections, will be effective at minimizing the risk of spills, as well as preparing workers to respond if an accidental discharge of contaminants occurs.

The combination of soil disturbance from timber harvest and fuels reduction treatments, and nutrient release from underburning, can lead to increased nutrient inputs to streams. Design criteria for harvest and burns, including maintenance of low burn severities in riparian reserves and retention of uncut and unburned buffers should promote capture of excess nutrients by riparian vegetation. Consequently, we expect nutrient inputs to result in insignificant changes in aquatic nutrient dynamics in the Project area.

4.2.4 *Large Woody Debris*

The baseline condition for this indicator is "properly functioning" in tributaries to the lower Chewuch, and "functioning at risk" in the mainstem Chewuch River. Effects to this indicator from all three Project elements are possible. Timber and biomass removal from riparian reserves has the greatest potential to reduce large wood recruitment. Some harvest will occur within 50 to 90 feet of intermittent channels, which is within recruitment distance based on a site potential tree height of about 100 feet for this area. We agree that transport of large wood from small, first and second order channels, where near-channel harvest will occur, is unlikely for multiple reasons (insufficient flow, low gradients, intervening road crossings). Low likelihood of transport combined with relatively long distances to occupied habitat suggests impacts on this indicator will have insignificant and discountable impacts on bull trout.

The BA suggests that timber harvest outside riparian reserves would not affect large wood recruitment to the stream. We disagree, given that one substantive source of large wood recruitment in the Chewuch watershed in the recent past has been landslides that originated outside of riparian areas, and delivered large volumes of upland wood to river and stream channels. We recognize that landslides are not anticipated to occur in the Project area, and we are not suggesting that proposed treatments could increase the likelihood of such an event. But the area is very fire prone, and has a history of large slope failures. Removing timber could reduce the amount of wood delivered to streams from landslides in the Project area.

Fuels management activities, especially removal of ladder fuels, could also reduce large wood recruitment. Again, for the same reasons just described for timber and biomass removal, we expect this effect to be insignificant and discountable. In contrast, we expect that underburning could contribute to some tree mortality in riparian reserves, and thus have a beneficial effect on large wood recruitment. The anticipated low severity of burns will limit the scope of this beneficial effect on this indicator, and when combined with the transport issues cited above, suggests this beneficial effect also is likely to be insignificant.

The roads management element will likely have insignificant effects on large woody debris recruitment, primarily due to little timber removal occurring for new road construction, and that this removal will occur far from aquatic habitats occupied by bull trout. Beneficial effects on this indicator resulting from roads management could be associated with reducing stream crossings and removing culverts, which should improve wood transport. This beneficial effect is also likely to be insignificant due to the small sizes of affected streams and distance to occupied habitat.

4.2.4 *Pool Frequency and Quality*

The baseline condition of the pool frequency and quality indicator is rated as "functioning at risk." Because the proposed Project does not include substantive in-channel work, effects to this indicator from the Project elements are fundamentally an integration of the "sediment" and "large wood" indicators described above. We believe that the volume of increased sediment generated by the Project, while sufficient to increase turbidity and embeddedness to an adverse degree, will only have insignificant effects on pool characteristics.

Minor beneficial effects to pool characteristics may result from removal or upgrades of stream crossings as part of the road management element, especially the improvement at the Heifer Creek crossing. These beneficial effects may be imperceptible to bull trout due to spatial separation.

4.2.5 *Width to Depth Ratio*

The baseline condition for this indicator in the Project area is "functioning at risk." As described in the BA, we agree that all the Project elements are likely to result in insignificant effects on this indicator. Similar to the case for pool characteristics, we do not believe that the increase in sedimentation contributed by the Project will be sufficient to affect channel characteristics within the Project area, especially with the retention of riparian buffers.

It is possible that an interaction could occur between the proposed Project and ongoing grazing in the area that could affect this indicator. The combination of timber removal and underburning from the proposed Project could increase cattle access to intermittent and perennial stream channels. Resulting trampling could contribute to undesirable increases in width to depth ratios. We expect that monitoring of grazing activities would lead to remedies before these interaction effects were severe enough to influence channel morphology in downstream areas occupied by bull trout.

Improvements to road crossings may lead to more natural width to depth ratios for affected channels. Again, these beneficial effects are likely to be imperceptible to bull trout.

4.2.6 *Streambank Condition*

This indicator is currently considered to be "properly functioning." All Project elements are likely to result in small-scale, localized patches of streambank destabilization (e.g., due to log skidding across intermittent channels, patches of high severity burning, bank disturbance associated with new stream crossings). Our expectation is that the combination of design criteria and conservation measures associated with each Project element will limit the total scope of these effects on streambanks. In particular, we expect retention of riparian buffers, low fire severity targets in riparian areas, and decrease in the density of riparian roads to reduce Project impacts to streambanks. Consequently, at the reach scale or larger, we expect insignificant changes in streambank condition.

As discussed above for the "channel width to depth ratio" indicator, interactions between the proposed Project and ongoing grazing could lead to increased cattle access to streambanks and associated undesirable streambank destabilization. Again, we expect ongoing monitoring of the grazing allotment to detect this potential effect and, if necessary, lead to changes in cattle management to keep streambank condition "properly functioning."

4.2.7 *Peak and Base Flows*

The peak flow indicator is currently "properly functioning" in the Project area, while the base flow indicator is "functioning at risk" due to water withdrawals for irrigation lower in the watershed. This indicator has an important integrative relationship with multiple other indicators in the MPI, and may be viewed as a driver that strongly influences the condition of these other indicators.

As presented in the BA, the combination of timber harvest and fuels management could have complementary effects on hydrology. The challenge associated with evaluating likely Project effects is determining what the site-specific balance of opposing effects is likely to be. Timber and biomass removal and fuel management will reduce canopy cover and increase the amount of snow and rain reaching the ground, while also reducing tree-mediated transpiration. This could lead to increased infiltration and higher base flows, a desirable hydrologic outcome from the perspective of downstream fish habitat quality. However, if implementation of treatments leads to high levels of soil compaction, rain and accumulated snowpack may run off as surface flow, leading to higher peak flows, an undesirable outcome for fish. The degree to which remaining vegetation will increase water uptake, compensating for the vegetation removed, or that increased insolation and wind speeds will increase evaporation are uncertain, as are the lingering impacts of past management. Climate change adds further complexity. These multiple sources of uncertainty lead to very low confidence about what to expect.

We do know that about 30 percent of the planning area will be treated, representing a relatively intensive level of treatment in the two sub-watersheds affected. Although the proportion of the watersheds treated will be high, we expect conservation measures designed to protect soils and hydrologic processes to be effective at minimizing compaction in treated areas. We also suspect that soil compaction from past management activities is relatively high. Because these Project elements are likely to result in a complex mix of hydrologic effects, our tentative expectation is that these effects will generally counterbalance, and while we expect both peak and base flows to increase, the magnitude of these net changes in peak and base flows will likely be insignificant, assuming typical precipitation patterns. We reach this tentative conclusion in part based on the relatively minor hydrologic responses of the larger Chewuch watershed to the far more extensive and severe impacts associated with recent wildfires. Through time, we expect hydrologic effects to diminish as understory and canopy growth occurs and natural processes gradually reduce soil compaction.

Road management will also result in a mixed-bag of hydrologic effects. New road construction as well as opening and reconstructing closed roads will lead to localized increases in road related runoff. Road decommissioning should decrease road effects on hydrology. Because most changes to the transportation system are spatially separated from streams, hydrologic effects will be partially dampened. Again, we expect this Project element to result in insignificant net increases in both peak and base flows during Project implementation, with a gradual trend toward reduced hydrologic effects as treated areas re-vegetate.

4.2.8 *Drainage Network*

The baseline condition of this indicator is "functioning at risk," with the primary source of risk being the extensive road network and associated ditches. All Project elements have the potential to affect this indicator, primarily via construction of skid trials, fire lines, and roads. We generally agree with the analysis presented in the BA that concludes the Project will result in short-term, insignificant negative effects on this indicator. Achieving this outcome, however, depends on successful implementation of design criteria and mitigation measures that address two different but related factors. First, drainage features are needed to prevent skid trails, firelines, and roads from capturing and concentrating surface flows and delivering concentrated flows and sediment loads to stream channels. We are confident this first factor can be successfully addressed. The second factor is preventing ongoing recreational and livestock use of skid trails, firelines, and closed roads. Our experience is that these uses can degrade and ultimately defeat the purpose of drainage features, and can turn a temporary increase in the drainage network into a long-term source of concentrated runoff and sediment delivery. We are less confident about the effectiveness of conservation measures to limit recreational and livestock use of these features. In order to minimize impacts from ongoing recreation and livestock use to short-term and insignificant levels, efforts to disguise and roughen firelines, skid trails, and decommissioned roads will have to be enthusiastically implemented.

4.2.9 *Road Density and Location*

The baseline condition of this indicator is "not properly functioning." This baseline condition is disturbing given the lower Chewuch is a Tier 1 Key Watershed under the NWFP, and excessive road densities impose a wide range of associated degradation mechanisms on aquatic systems. There is a strong negative relationship between high road densities and persistence of bull trout populations.

We agree with the assessment in the BA that the proposed Project will have an insignificant negative effect on this indicator during implementation, and an insignificant positive effect (due to road improvements and decommissioning) after completion. We are disappointed that the forest restoration orientation of this Project did not carry over more aggressively into the aquatic realm. This Project has a relatively extensive scope in a Tier 1 Key Watershed, yet achieves only a 0.2 mile per square mile reduction of road density in one sub-watershed, and 0.04 miles per square mile in the other. We feel that this large a project should make a much more substantive contribution toward achieving Key Watershed objectives and relieving a major stressor of aquatic systems.

4.2.10 *Disturbance History*

The baseline condition of this indicator is "functioning at risk." Timber harvest on 4,548 acres, construction of about 11 miles of hand-constructed fireline and 6.5 miles of bulldozer-constructed fireline, including 1.2 miles of hand-constructed line in riparian reserves, and extensive road work will all negatively impact this indicator during Project implementation. Slight reductions in road density will have an insignificant positive effect after Project completion. Although this Project has a relatively large footprint, we believe that conservation measures and design criteria will keep impacts to this indicator to insignificant levels.

4.2.11 *Riparian Reserves*

Riparian reserves are generally "properly functioning" with localized areas "functioning at risk." The Project will have a mix of positive and negative effects on this indicator. Timber harvest will include some tree removal from riparian reserves. Cutting and removing these trees will likely result in soil disturbance and changes in microclimate. We believe the extent and magnitude of this disturbance will lead to insignificant negative effects on riparian habitat function. On the beneficial side, removal of trees will reduce competition, and may increase growth rates of remaining trees. Increased growth could enhance shading and nutrient inputs to streams, and could lead to more rapid recruitment of larger key pieces of woody debris. Fuel reduction treatments are likely to have a similar mixture of effects. Fuel management will reduce tree densities in riparian areas, and fireline construction and burning of understory plants and duff may temporarily reduce the sediment filtering ability of treated areas. If fuel reduction activities are successfully implemented as described, we believe these temporary negative effects will be insignificant. We expect that more moist conditions in riparian areas combined with nutrients released by underburning will result in rapid re-growth of riparian vegetation after burning. Roads management will result in a slight reduction in riparian road density, which will slightly improve riparian functions in these areas after decommissioned road beds re-vegetate. Both removal of old stream crossings and installation of new crossings associated with new road construction will lead to transient negative effects on the functionality of riparian areas.

Despite the variety of effects the Project will likely have on riparian reserves, we agree with the assessment in the BA that overall negative effects from all Project elements will have insignificant effects on riparian function. Our primary reasons for this conclusion are: (1) timber harvest effects will largely occur either on intermittent channels far from perennial waters occupied by bull trout, or the intensity of thinning treatments and their associated buffers will effectively limit effects, (2) fuel reduction treatments will pose the greatest risk, but use of paved roads as firebreaks near the Chewuch River and Eightmile Creek, and past experience with successfully backing fire into riparian areas suggest prescribed fire severity levels can be met, and (3) most new road construction, road decommissioning, and stream crossing work will occur on narrow, intermittent channels where recovery of riparian function can occur rapidly .

4.2.12 *Disturbance Regime*

We expect the Project to generally have beneficial effects on this indicator, primarily due to restoration of the forest to a structure and composition that is more consistent with historic disturbance regimes. Improvements to the road network should also have small beneficial effects on the hydrologic disturbance regime of the sub-watersheds affected.

4.3 Responses of Bull Trout to Habitat Effects

Project implementation will have primarily insignificant negative effects on habitat conditions. This section integrates these effects and predicts how these effects are likely to influence the numbers, distribution, and reproduction of the local bull trout populations affected.

The most substantive negative effect on bull trout habitat likely will be:

- Sedimentation mediated increases in embeddedness – we expect increased embeddedness to reduce invertebrate production in Eightmile Creek sufficiently to result in decreased foraging efficiency and growth rates of rearing juvenile and sub-adult bull trout. We expect this level of embeddedness to persist through one low-flow season, and to be remedied by sediment mobilization during high flows in the following spring. We do not expect other habitat effects to interact with these sedimentation impacts to further reduce prey populations.

The Service believes that negative effects on bull trout prey availability will be sufficiently strong to result in adverse effects on exposed juvenile and sub-adult bull trout. We expect these adverse indirect effects to be in the form of significant impairment of feeding and sheltering behaviors that cause sub-lethal reductions in physiologic condition and growth. We expect bull trout that experience these adverse effects to recover, with no long-term reduction in survival or reproduction.

We expect the Project's beneficial effects to be insignificant. The most substantive effect is likely to be reducing the risk of uncharacteristically severe wildfire and setting the stage for returning treated areas to a more natural disturbance regime. The scope of these beneficial effects, however, is unlikely to be sufficient to change the numbers, reproduction, or distribution of bull trout in the Chewuch River local population.

4.4 Integration of Direct Effects and Indirect Habitat Effects

Direct effects of all Project elements will likely result in sub-lethal adverse effects on up to 20 adults and 35 sub-adult/juvenile bull trout (Table 6). Some individuals may experience multiple sub-lethal impacts. The Service believes that the severity of sub-lethal impacts is low enough that if multiple impacts to single individuals occurred they would still not reduce the survival of exposed individuals. We expect all adverse effects to occur to the Lower Chewuch River local population. Although this local population is small, the Service believes that the Project's sub-lethal impacts are too mild and limited in scope to change rates of survival and reproductive success of the entire local population during the 8-year period of Project implementation.

Table 6: Summary of adverse Project effects to bull trout by severity of effect and life stage.

	Effect Type				
	Direct		Indirect (habitat degradation)		
Life Stage	Lethal	Sub-lethal	Lethal	Sub-lethal	**Total**
Adult	-	20	-		20
Sub-adult/juvenile	-	35	-	7	35*
Alevins/redds	Some from 10 redds	Most from 10 redds	-	-	-
Total	-	55	-	7	55

* The same individual bull trout juveniles and sub-adults adversely affected by direct exposure to increased turbidity are also likely to experience indirect adverse effects due to reductions in prey availability.

4.5 Concurrent Effects

While this Project is being implemented, effects from other Projects in the middle Methow watershed and lower Chewuch watersheds will also be occurring. In particular, increased sedimentation from the Tripod Fire area and subsequent rehabilitation efforts will occur, ongoing operations of water diversions may contribute to decreased instream flows, and implementation of the Eightmile vegetation management project may have insignificant effects on aquatic habitats. The Service cannot identify any mechanisms by which these concurrent effects could interact synergistically to increase impacts on bull trout in the Methow core area beyond those anticipated in the independent consultations on these activities.

4.6 Effects to Proposed Bull Trout Critical Habitat

In the Service's recent proposal for re-designation of critical habitat for bull trout, Eightmile Creek was proposed for inclusion (75 FR 2270). At the request of the USFS, we conferenced on the effects of the proposed Project on proposed critical habitat (40 CFR 402.10). The baseline condition of re-designated critical habitat cannot be known until the final rule is published. It is possible, however, to analyze effects to proposed critical habitat as if the designation were final. We attempted to complete such an analysis of effects to critical habitat here. We expect that the final rule designating critical habitat will be published while this Project is being implemented.

On August 6, 2004, the Ninth Circuit Court of Appeals rendered a decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279), finding that the Service's regulatory definition of "destruction or adverse modification" is contrary to law. As ordered in the Director's December 9, 2004, memorandum, this BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat (50 C.F.R. 402.02). Instead, this BO relies on the statutory provisions of the Act to complete the Project analysis with respect to critical habitat.

The Service evaluates effects to critical habitat in terms of Primary Constituent Elements (PCEs), which are the physical and biological features that are essential to the conservation of a species and that may require special management considerations or protection. The proposal for re-designating critical habitat includes the following PCEs:

(1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporehic flows) to contribute to water quality and quantity and provide thermal refugia.

(2) Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

(3) An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

(4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.

(5) Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shade, such as that provided by riparian habitat; and local groundwater influence.

(6) Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.
(7) A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph.
(8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
(9) Few or no nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass; inbreeding (e.g., brook trout); or competitive (e.g., brown trout) species present.

Potential Project effects on these PCE can be largely evaluated in the context of habitat indicators in the MPI. Based on our assessment of Project effects on habitat indicators, the Project will have adverse effects only on the "sediment and embeddedness" indicators. This suggests adverse effects on food base (PCE 3) and substrate characteristics (PCE 6) may occur. Our evaluation of sedimentation effects suggest that the primary mechanism of impact will be to reduce invertebrate prey available to foraging bull trout. We expect this reduction to be temporary (less than one year) and to occur in only a small segment of Eightmile Creek. We believe these localized adverse effect to critical habitat will have insignificant impacts on the functional capacity of the Methow River sub-unit of proposed critical habitat to support the survival and recovery of bull trout.

Analysis of effects on PCE 9 requires information beyond that provided by the MPI. Regarding PCE 9, we do not expect the Project to influence the abundance and productivity of predators or competitors. Large numbers of brook trout are present in the Project area, and the Project is likely to have a neutral effect on this PCE.

4.7 Effects of Interrelated and Interdependent Actions

"Interrelated and Interdependent Actions" are actions that would not occur but for the proposed Project, and therefore they are a connected action and effect that must be analyzed together with the proposed Project. The Service's consultation handbook provides a detailed discussion about how to recognize such actions (USDI and USDC 1998; page 4-25).

We do not anticipate any interrelated and interdependent actions with this Project. In our analysis of Project effects we discuss the potential for interactions between the proposed Project and management of grazing allotments in the same area. Management of these grazing allotments is a separate federal action and the subject of an independent consultation (FWS ref. 13260-2009-F-0128).

5.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. 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 Act.

The Service is not aware of any other future actions that are reasonably certain to occur in the lower Chewuch watershed that are likely to contribute to cumulative effects on bull trout. For this description of cumulative effects, the Service assumes that future non-Federal activities in the area of the proposed action will continue into the immediate future at present or increased intensities. Accordingly, these actions will contribute to some habitat indicators continuing to "function at risk" or to be "not properly functioning."

Less than 30 percent of the sub-watersheds affected by the proposed Project is privately owned. Most of this private land is located in the valley bottom and is used for agriculture or residential development. Continued subdivision of parcels, home building, and well drilling are likely to damage aquatic habitats more rapidly than conservation acquisitions and restoration actions can repair them. As the human population in Washington State continues to grow, demand for rural residential development and dispersed and developed recreation is likely to occur. This trend is likely to result in increasing habitat degradation from housing and road construction, levee building, bank armoring, and campsite development on private lands. These activities tend to remove riparian vegetation (which reduces stream shade, increases stream temperature and reduces the opportunity for large woody debris recruitment), disconnect rivers from their floodplains, interrupt groundwater-surface water interactions, and reduce off-channel rearing habitat. Each subsequent action by itself may have only a small incremental effect, but taken together they may have a substantive effect that will further degrade the watershed's environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover. Watershed assessments and education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

Easements and land acquisitions for habitat preservation are ongoing throughout the Methow sub-basin and these efforts are likely to contribute to maintaining or improving habitat quality. Many of these efforts are targeted at improving riparian habitat conditions in the lower Chewuch watershed. These acquisitions not only prevent development and associated habitat degradation, but they also provide opportunities for restoration of fluvial processes that produce and maintain high-quality aquatic habitats.

6.0 CONCLUSION

The Service has reviewed the current status of the bull trout at the range-wide, interim recovery unit, core area, and action area scales. We have also analyzed the effects of the action and cumulative effects on the bull trout. This review and analysis forms the foundation for determining if the proposed action is reasonably expected to appreciably reduce the bull trout's likelihood of survival and recovery in the wild due to a reduction in its reproduction, numbers, or distribution (i.e., jeopardy). This section describes the key findings of our analyses and discusses them at each relevant scale.

At the scale of local populations, the Project will cause direct negative effects on one of ten local populations in the Methow core area. The baseline condition of the local population likely to be adversely affected is “not properly functioning.” Baseline habitat conditions are variable, with strong recent influences of wildfire, defoliating insects, timber management, past grazing allotment management, and several restoration projects that improved habitat access. Cumulative effects include potential residential and recreational development on private lands low in the watershed with associated impacts to habitat quality. Easements and land acquisitions for habitat preservation are ongoing and likely to contribute to improving habitat quality in the watershed. Concurrent effects potentially include insignificant impacts from timber management. We do not anticipate any interrelated or interdependent effects.

The Service believes that adverse direct and indirect effects during Project implementation will cause primarily sub-lethal injury of bull trout from all age classes. Within the context of all the factors that influence the dynamics of bull trout populations, we think the scope and severity of these effects will be too limited to result in changes in the reproduction, numbers, or distribution of the local population affected.

The local population potentially affected by the Project is relatively well connected to other local populations, with no major barriers to migration between them. Connection among local populations has been identified as a factor that contributes to the persistence of bull trout populations. The Project will not affect levels of connectivity among local populations. The Project will have transient sub-lethal effects on a small number of individuals, but these effects are unlikely to diminish the numbers and reproduction of the local populations of bull trout affected and will not reduce the distribution of local populations in the core area.

Although bull trout are widely distributed in the Methow core area, abundance is generally low and productivity highly variable. The Methow core area also shows a reduced distribution of the migratory life-history form. Numerous historic and ongoing factors continue to limit the potential for population recovery at the core-area scale. Several spawning locations within the Methow core area have been directly and severely affected by wildfire in recent years. The combined effects of the 30-Mile, Farewell, Needles, and Tripod fires, in particular, have degraded spawning habitat conditions for bull trout in key spawning locations in Lake Creek, the upper Chewuch River, the upper Methow River, and upper tributaries of Beaver Creek. The Service expects that recruitment of juvenile bull trout into the spawning population will be depressed until the areas destabilized by wildfires are more fully revegetated. Population indicators in the Methow core area were “not properly functioning” before these wildfire events. The wildfires may contribute to temporary declines in productivity. Recent redd surveys suggest declines in some burned areas, but core area totals are at or above pre-fire numbers. The statistical power of redd surveys to detect changes in population dynamics in this area has not been determined. Nonetheless, available information from redd surveys suggests that high-severity wildfires that burned about 15 miles of riparian areas did not result in a detectable change in reproduction, numbers, or distribution of bull trout at the core-area scale. Because we expect the effects of the proposed Project to be much less severe and extensive than those of recent wildfires, we believe the effects of this Project are highly unlikely to shift bull trout population dynamics at the core-area scale.

The Methow core area encompasses a large geographic area, but the total bull trout population in the core area is intermediate in size between the more abundant population in the Wenatchee core area and the less abundant Entiat core area. Ongoing habitat restoration and preservation efforts, along with natural recovery processes post wildfire are likely to contribute to a positive trend in the abundance of bull trout in the Methow core area. Telemetry studies suggest that demographic exchange and perhaps gene flow may occur among these three core areas. We do not expect the proposed Project to affect bull trout abundance in the Methow core area, nor should it influence the level of exchange among core areas in the Upper Columbia River area.

The Columbia River Interim Recovery Unit is vast, and contains a mix of core areas with increasing, stable, and declining demographic trends. The Methow core area is among those with a relatively stable population trend at an abundance level that is roughly an order of magnitude less than the goal for this unit in the Service's draft recovery plan, and as such is not currently contributing to the recovery of the Unit. The proposed Project would likely maintain this pattern. Slight degradation in habitat conditions at the local scale will not be sufficient to change population trends or distribution at the core area or interim recovery unit scales.

Over the long term, we expect the negative effects of the Project at the local scale to be imperceptible at the larger scales of the core area, interim recovery unit, or coterminous range. Based on our review and analysis, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Columbia River interim recovery unit of the bull trout.

Incidental take of bull trout is likely to occur as a result of Project implementation. The Incidental Take Statement accompanying this biological opinion includes mandatory Reasonable and Prudent Measures and Terms and Conditions intended to minimize this incidental take.

Regarding proposed critical habitat, it is the Service's conference opinion that the expected minor and transient effects of the Project are not likely to destroy or adversely modify proposed critical habitat. The limited scope and duration of adverse effects that are likely to occur to PCE 3 (food base) from the proposed Project will have insignificant impacts on the function of the proposed Methow River subunit, and will not preclude the development of PCEs in the action area in the future. We do not expect cumulative effects or interrelated and interdependent actions to influence the effects of the proposed Project on proposed critical habitat.

This concludes the conference for the Buck Forest and Fuels Project. The USFS may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation when bull trout critical habitat is re-designated. This request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm this conference opinion as the biological opinion on the project and no further section 7 consultation is necessary.

7.0 REASONABLE AND PRUDENT ALTERNATIVES

Regulations implementing Section 7 of the Act (50 C.F.R. §402.02 *et seq.*) define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3)

are economically and technologically feasible; and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Because the proposed action is not likely to jeopardize the continued existence of the bull trout or destroy or adversely modify proposed critical habitat for the bull trout, no reasonable and prudent alternatives are required.

INCIDENTAL TAKE STATEMENT

1. Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions or omissions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the U.S. Forest Service so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The U.S. Forest Service has a continuing duty to regulate the activity covered by this incidental take statement. If the U.S. Forest Service fails to assume and implement the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) will lapse. In order to monitor the impact of incidental take, the U.S. Forest Service must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [(50 CFR §402.14(i)(3)].

2. Anticipated Amount or Extent of Take of Bull Trout

In the "Effects of the Action" section of the accompanying biological opinion, the Service estimated the number of bull trout that would be exposed to adverse effects from this Project after making several simplifying assumptions. The rationale for these assumptions is presented in the "Effects of the Action" section. These assumptions necessarily introduce uncertainty into our estimate of incidental take.

The primary mechanisms of incidental take will be (1) harassment caused by direct exposure to increased sedimentation rates that result primarily from road management activities, and (2) harm resulting from indirect exposure of juveniles and sub-adults to reduced habitat quality (increased embeddedness that reduces prey availability). The amount of incidental take expected to occur, based on the number of bull trout from different life stages exposed to adverse effects from different project elements, is summarized in the following table:

Table ITS-1: Summary of incidental take of bull trout by severity of effect and life stage.

	Effect Type				
	Direct		Indirect (habitat degradation)		
Life Stage	Lethal	Sub-lethal	Lethal	Sub-lethal	**Total**
Adult	-	20	-		20
Sub-adult/juvenile	-	35	-	7	35*
Alevins/redds	Some from 10 redds	Most from 10 redds	-	-	-
Total	-	55	-	7	55

* The same individual bull trout juveniles and sub-adults adversely affected by direct exposure to increased turbidity are also likely to experience indirect adverse effects due to reductions in prey availability.

All incidental take discussed here will occur to the Chewuch River local population of the Methow Core Area, within the Columbia River interim recovery unit. Because this Project will occur near spawning and rearing habitat of a local population and has an 8-year duration, estimated numbers of individuals to be incidentally taken are relatively high (Table ITS-1). We expect incidental take to occur during the first five years of Project implementation and that annual rates of incidental take due to direct effects will be roughly one-fifth of the values presented here. We expect indirect effects to occur during only a single year, to affect only the juvenile and sub-adult life stages, and to affect the same individuals that are affected by direct effects, so indirect effects will not increase the total incidental take. Effects of increased sedimentation on redds cannot be quantified, but we expect limited lethal effects to occur.

The Service acknowledges that the amount of incidental take of bull trout resulting from the Project will be difficult to detect due to: (1) primarily nocturnal activity patterns, tendency to hide in or near the substrate, small body size and cryptic coloration and behavior of juvenile and sub-adult bull trout (2) the low likelihood of finding an injured or dead individual in the relatively complex habitats in the action area, and (3) high rate of removal of injured individuals by predators or scavengers. Given these difficulties, any detection of incidental take can provide valuable information to enable the Service to develop better methods for avoiding and minimizing incidental take, and to refine estimates of incidental take for future projects of a similar nature in similar contexts.

The Service believes that attempts to precisely track the quantity of incidental take occurring during Project implementation would likely result in more harm to bull trout than the Project alone. To comply with the Act, however, the U.S. Forest Service must ensure that its activities do not result in levels of take exceeding that anticipated in this incidental take statement. The Service's proposed solution to this dilemma is based on the relationship between specific Project elements and resulting incidental take. In the accompanying biological opinion, the Service attempted to estimate the numbers of bull trout to be taken during Project implementation and to associate this take with different Project elements. The Service believes that as long as each Project element is implemented as described in the biological assessment, the U.S. Forest Service will not exceed the level of incidental take exempted here. However, if implementation methods are changed in ways that are likely to result in different net effects, resulting incidental take could exceed the level exempted here and reinitiation of consultation is required.

3. Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

4. Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of bull trout.

RPM 1. Minimize incidental take resulting from increased sedimentation.

5. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the U.S. Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above, and are designed to minimize impacts to bull trout. These terms and conditions are mandatory.

To implement RPM 1:

T&C 1. Complete the District-wide minimum roads analysis as soon as possible and use the results of that analysis to reduce road density more aggressively in the Eightmile Creek drainage.

T&C 2. Dust palliatives should be required, with the restrictions specified in the BA (page 31). The Biological Assessment currently suggests that dust palliatives may be used at the discretion of the contractor to control dust from road management.

T&C 3. Roughen and disguise (with slash, rock, and debris) decommissioned roads, firelines, and skid trails for at least 200 feet (60 meters) wherever they intersect an open road, trail, riparian reserve, or area of high cattle use.

T&C 4. Conduct redd surveys for bull trout in Eightmile Creek downstream of the partial barrier cascade.

6. Reporting Requirements

In order to monitor the impacts of implementation of the reasonable and prudent measures, the U.S. Forest Service shall prepare a report describing the progress of the proposed Project, including implementation of the associated terms and conditions, and impacts to the bull trout (50 CFR § 402.14(I)(3)). The report, which shall be submitted to the Central Washington Field Office on or before March 1 of the year following monitoring, shall list and describe:

1. Adverse effects to bull trout resulting from Project activities including number and life stages of affected individuals detected, if any.
2. Dates when Project implementation began and ended for the reporting year.
3. Deviations from proposed Project description.
4. Results of all monitoring activities.
5. Implementation of any conservation recommendations.

Upon locating a dead, injured, or sick specimen of an endangered or threatened species, initial notification must be made to the nearest Service Law Enforcement Office (Richland, Washington; Special Agent Corky Roberts, telephone 509.546.8344). Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The Service believes that no more than 55 bull trout will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiating of consultation and review of the reasonable and prudent measures provided. The U.S. Forest Service must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures. Because incidental take for this Project is difficult to estimate and detect, the Service must be contacted if implementation plans change substantially from those described and the project effects no longer fall within the effects analyzed in the accompanying biological opinion.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service provides the following recommendations:

- CR 1. Continue to investigate the potential for improving fish passage into Eightmile Creek, past the partial barrier cascade.
- CR 2. Continue to survey for bull trout presence in Eightmile Creek above the cascade.

In order to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiating 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 take 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 to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In particular, if monitoring indicates that changes in allotment management are needed that could change effects to bull trout, reinitiation of consultation should occur before April 1 to allow adequate time for analysis of the proposed changes. Likewise, if during the 10 year term of this permit, restoration actions occur in Eightmile Creek that improve opportunities for bull trout access, reinitiation will be necessary. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A: Bull Trout Life History and Population Dynamics

1. Historic and Current Range

Bull trout are native to northwestern North America, historically occupying a large geographic range extending from California north into the Yukon and Northwest Territories of Canada and east into western Montana and Alberta (Cavender 1978). They are generally found in interior drainages, but also occur on the Pacific Coast in Puget Sound and in the large drainages of British Columbia.

The historic range of the bull trout is likely to have contracted and expanded over time in relation to natural environmental and climate changes; the distribution of the species was likely patchy even in pristine environments. Despite uncertainty about the exact historical range, the number and size of historical populations, and the role of natural factors in the status of the species, there is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and continue to pose significant risks of further extirpations of local populations.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the MacKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997). The current distribution of bull trout is highly fragmented.

The distribution of bull trout has shrunk in the Pacific Northwest and northern California. The distribution of bull trout has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelbide 1997). Within the Puget Sound basin, bull trout distribution is similar to historic conditions, but population abundance has significantly decreased. In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' range. The last confirmed report of bull trout in the McCloud River was in 1975, and this population is now considered to be extirpated (Rode 1990).

2. Life History

Bull trout populations exhibit three different life-history types: resident, migratory, and anadromous. Resident and migratory forms exist throughout the range of the bull trout (Rieman and McIntyre 1993) and spend their entire lives in freshwater. The anadromous life- history form is currently only known to occur in the Coastal-Puget Sound region within the coterminous United States (Volk 2000; Kraemer 1994; Mongillo 1993). Multiple life-history types may be expressed in the same population, and diversity of life-history types is considered important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

Life history type determines where the majority of the growth and maturation occurs. Anadromous bull trout growth and maturation mostly occurs in estuarine and marine waters.

Juvenile bull trout displaying the anadromous life history spend 1 to 3 years near freshwater natal areas before moving to estuary and/or nearshore marine areas to mature (Rieman and McIntyre 1993). Migratory bull trout mostly grow and mature in lakes, reservoirs, and large river systems. Like anadromous bull trout, juvenile migratory bull trout typically rear in or near natal streams for 1 to 3 years before migrating downstream into larger rivers or lakes. In some systems, age 0+ fish may migrate directly to lakes (Riehle et al. 1997). Resident bull trout populations are generally found in small headwater streams where the fish remain for their entire lives.

2.1 Freshwater Habitat

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon several habitat characteristics, including: cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and connectivity among streams supporting bull trout populations. Stream temperature and substrate type, in particular, are critical factors for the long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. Consequently, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman et al. 1997a).

Although bull trout clearly prefer cold waters and nearly pristine habitat, they can occur in degraded habitats. It is likely that small remnant populations of bull trout persisting in degraded rivers are using less than optimal habitat because that may be all that is available. In basins with high productivity, such as the Skagit River basin, bull trout may be using marginal areas when optimal habitat becomes fully occupied (C. Kraemer, WDFW, pers. comm. 2002). Bull trout have been documented using habitats that may be atypical or characterized as likely to be unsuitable (USFWS 2000).

2.1.1 Temperature. Bull trout are typically associated with the coldest stream reaches within basins. For long-term persistence, bull trout populations need a stream temperature regime that ensures sufficient amounts of cold water are present at the locations and during the times needed to complete their life cycle. Temperature is most frequently recognized as the factor limiting bull trout distribution (Dunham et al. 2003a; Dunham and Chandler 2001; Rieman and McIntyre 1993), which partially explains their generally patchy distribution within watersheds (Fraley and Shepard 1989; Rieman and McIntyre 1995). When maximum daily temperatures did not exceed approximately 11 to 12^{o} C, the probability of occurrence for juvenile bull trout in Washington was high (75 percent) (Dunham et al. 2001). The most productive bull trout habitat in several Oregon streams had temperatures which seldom exceeded 15 ^{o}C (Buckman et al. 1992; Ratcliff 1992; Ziller 1992).

Stream temperatures must drop below 9 or 10 ^{o}C before spawning occurs (McPhail and Murray 1979; Riehle 1993). Water temperature also seems to be an important factor in determining early survival, with cold water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992). Optimum incubation temperatures range from 2 to 6 ^{o}C, while at 8 to 10 ^{o}C, survival ranged from 0 to 20 percent (McPhail and Murray 1979). Stream temperatures for tributary rearing juvenile bull trout are also quite low, ranging from 6 to 10 °C (Buchanan and Gregory 1997; Goetz 1989; Pratt 1992; McPhail and Murray 1979).

Although bull trout require a narrow range of cold water temperatures to rear, migrate, and reproduce, they are known to occur in larger, warmer river systems that may cool seasonally, and which provide important migratory corridors and forage bases. For migratory corridors, bull trout typically prefer water temperatures ranging between 10 to 12 °C (McPhail and Murray 1979; Buchanan and Gregory 1997). When bull trout migrate through stream segments with higher water temperatures they tend to seek areas offering thermal refuge such as confluences with cold tributaries (Swanberg 1997), deep pools, or locations with surface and groundwater exchanges in alluvial hyporheic zones (Frissell 1999).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough et al. 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993; Craig and Wissmar 1993 cited in USDI 1997; MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Selong et al. 2001; Leary et al. 1993). Recent laboratory studies suggest bull trout are at a particular disadvantage in competition with brook trout at temperatures >12 °C (McMahon et al. 2001; Selong et al. 2001).

2.1.2 Substrate. Bull trout show a strong affinity for stream bottoms and a preference for deep pools in cold water streams (Goetz 1989; Pratt 1992). Stream bottom and substrate composition are highly important for spawning site selection and juvenile rearing (Rieman and McIntyre 1993; Graham et al 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985; Pratt 1992; Suttle et al. 2004) but may also limit access to substrate interstices that are important cover during rearing and over-wintering (Goetz 1994; Jakober 1995). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard et al. 1984). Due to this close connection to substrate, bed load movements and channel instability can negatively influence the survival of young bull trout.

2.1.3 Cover and Stream Complexity. Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail1997; Fraley and Shepard 1989). This association appears to be more important for bull trout than for other salmonids (Pratt 1992; Rieman and McIntyre 1993). Cover may be in the form of overhanging banks, deep pools, turbulence, large wood, or debris jams. Young bull trout also use interstitial spaces in the substrate for cover. Bull trout distribution and abundance are positively correlated with pools and complex forms of cover, such as large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder) (Rieman and McIntyre 1993; Jakober 1995; MBTSG 1998). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

Large pools offeringa wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and are an important component of channel complexity. Large wood in streams creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). All these functions of large wood enhance the quality of habitat for salmonids and contribute to channel stability (Bisson et al. 1987). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986).

Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (Bisson et al. 1987; House and Boehne 1987; Spence et al. 1996). Studies conducted with Dolly Varden, a species similar to bull trout, showed that population density declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983; Dolloff 1986; Elliott 1986; Murphy et al. 1986).

2.1.4 Channel and Hydrologic Stability. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Bull trout are exceptionally sensitive to activities that directly or indirectly affect stream channel integrity. Juvenile and adult bull trout frequently inhabit areas of reduced water velocity, such as side channels, stream margins, and pools that are easily eliminated or degraded by management activities (Rieman and McIntyre 1993).

Channel dewatering caused by low flows and bed aggradation (accumulation of rock and sediment) can block access for spawning fish, resulting in year class failures (Weaver 1992). Aggradation of the streambed can be accelerated by management activities that increase the frequency of landslides (e.g., road building and timber harvest) or that constrict stream channels (e.g., undersized culverts at stream crossings).

Patterns of stream flow and the frequency of extreme flow events that influence substrates may be important factors in population dynamics (Rieman and McIntyre 1993). With lengthy overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with the rain-on-snow events that are common in some parts of the range (Rieman and McIntyre 1993).

2.1.5 Migration and Habitat Connectivity. Bull trout are highly migratory. The persistence of migratory bull trout populations requires intact migration corridors. Migration corridors link wintering areas with foraging, spawning, and rearing areas used at different times of the year, and by different life-history stages (MBTSG 1998, Rieman and McIntyre 1993). In the Coastal-Puget Sound DPS, migratory corridors may link marine and freshwater habitats as well as linking lake, river, and tributary complexes that are necessary for bull trout to complete their life cycle. Migratory corridors also link local populations, providing opportunities for gene flow and demographic exchange.

Bull trout migratory movements include both spawning migrations and downstream emigration of juveniles from headwater rearing areas to feeding and maturation areas. Migratory bull trout may begin their spawning migrations as early as April and have been known to migrate upstream as far as 250 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Current radio-telemetry work being done in the upper Columbia River basin is revealing movement patterns of migratory bull trout that extend over 160 kilometers (100 miles), from the headwaters of the Wenatchee and Methow basins to the Columbia River and the pools formed by Rocky Reach, Rock Island, and Wells Dams (J. De La Vergne, pers. comm. 2001; BioAnalysts 2004). During these long migrations, bull trout use a wide variety of habitats. Compared to spawning migration, relatively little published information is available about juvenile emigration. Age of emigration varies from one to three years old (Rieman and McIntyre 1993), and annual timing of emigration is highly variable and can extend from spring until winter.

Stream habitat alterations that restrict or eliminate bull trout migration corridors include degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, impassable barriers (such as dams and culverts), and structural modification of stream habitat (such as channelization or removal of cover). Dam and reservoir construction and operations have altered major portions of bull trout habitat throughout the Columbia River basin. Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations. The operations of dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997). Many populations of "resident" bull trout that are isolated above artificial barriers to migration are remnants of populations that once supported larger, more fecund, migratory forms.

2.2 Marine Phase

Anadromous bull trout forage and mature in the nearshore marine habitats on the Washington coast and in Puget Sound. The marine and estuarine residency period for bull trout is poorly understood. Thorpe's (1994) review found little evidence in the literature that the estuary was used for physiological adjustment or as a refuge from predation, but he did find clear evidence of a trophic advantage to estuarine residency (abundant prey). While in the estuary, native char can grow very quickly. Subadults grow from 20 to 40 mm per month and reach a length of 250 to 350 mm before their upstream migration in late summer and early fall (Kraemer 1994). During their marine residency, subadults from Dolly Varden populations on Vancouver Island gained 74 mm and adults gained 45 mm in length (Smith and Slaney 1979).

Kraemer (1994) speculated that the distribution of native char in marine waters may be closely tied to the distribution of bait fish and coincident with their spawning beaches. Char from Puget Sound have been found to prey on surf smelt, Pacific herring, Pacific sand lance, pink salmon smolts, chum salmon smolts, and a number of invertebrates (Kraemer 1994). The Quinault Indian Nation documented smelt as a prey item for native char in the Queets River. Kraemer (as cited in Nightingale and Simenstad 2001) observed that native char in estuaries typically foraged in water less than 3 meters deep and were often seen foraging in water less than 0.5 meters deep.

Anadromous migrations of bull trout have been studied in Rivers of the Olympic Peninsula in Washington. Radio-tagged bull trout from the Hoh River have migrated out into the marine environment and then back into a number of other coastal drainages, including the Queets, and Quinault Rivers, and have showed complex movement patterns within and between rivers

(Brenkman and Corbett 2005). In Alaska and British Columbia, downstream migration of Dolly Varden occurs in spring and early summer and upstream migration occurs from late spring through early winter (ADFG 1963; Armstrong 1965; Smith and Slaney 1979). In southeast Alaska, Dolly Varden spent an average of 116 days in marine waters (Armstrong 1965). Armstrong (1965) also reported that Dolly Varden migrated directly to saltwater and did not backtrack or linger in the river.

Anadromous char undertake fairly extensive marine migrations. Anadromous Dolly Varden typically stay close to the shoreline, but sometimes move up to 30 miles off shore (e.g., ADFG 1963). Dolly Varden move extensive distances in salt water, and may enter freshwater streams that are far from their natal streams (DeCicco 1992; Thorpe 1994). Kraemer (1994) has documented fish in Puget Sound as far as 25 miles from their natal stream. Marking studies used to investigate migratory patterns of Dolly Varden in southeast Alaska found marked fish in 25 different stream systems as far as 72 miles from their natal stream (Armstrong 1965). About forty percent of the marked fish appeared to migrate to other streams during the winter, but most fish remained within tens of miles of their natal streams.

Nearshore marine habitats have been significantly altered by human development (PSWQAT 2000). Construction of bulkheads and other structures have modified the nearshore areas and resulted in habitat loss that has directly affected forage fish for bull trout. Other impacts to the marine environment include alterations to water quality resulting from fish pathogens, nutrients and toxic contaminants, urbanization, and stormwater runoff from basins that feed Puget Sound. Global changes in sea level and climate may also have more widespread ramifications on these habitats, and on the Puget Sound ecosystem as a whole (Klarin et al. 1990; Thom 1992).

2.3 Food Habits

Like many fish, different life stages of bull trout feed at different trophic levels. Adult bull trout are apex piscivores, and require a large prey base and home range. Adult and subadult migratory bull trout feed primarily on various trout and salmon species, whitefish (*Prosopium* spp.), yellow perch (*Perca flavescens*), and sculpin (*Cottus* spp.). Subadult and adult migratory bull trout move throughout and between basins in search of prey. Anadromous bull trout in the Coastal-Puget Sound DPS also feed on ocean fish such as surf smelt (*Hypomesus pretiosus*) and sandlance (*Ammodytes hexapterus*). Resident and juvenile bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975; Rieman and Lukens 1979 in Rieman and McIntyre 1993; Boag 1987; Goetz 1989; Donald and Alger 1993). A recent study in the Cedar River Watershed of western Washington found bull trout diets also include aquatic insects, crayfish, and salamanders (Connor et al. 1997).

2.4 Reproductive Biology

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard et al. 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1st- to 5th-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard et al. 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998; Baxter and Hauer 2000). Surface/groundwater interaction zones, which are typically selected by bull trout for redd construction, have high dissolved oxygen, constant cold water temperatures, and increased macro-invertebrate production. Spawning sites frequently occur near cover (Brown 1992).

Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to three weeks before emerging. The total time from egg deposition to fry emergence from the gravel may exceed 220 days.

Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespans may exceed 10 to13 years (McPhail and Murray 1979; Pratt 1992; Rieman and McIntyre 1993). Adult adfluvial bull trout may live as long as 20 years, and may require as much as 20 months in the lake or reservoir habitat to facilitate adequate energy storage and gamete development before they return to spawn again (67 FR 71236).

Migratory bull trout are highly visible during spawning due to their large size and location in relatively small streams during periods of low flow. Channel complexity and cover are important components of spawning habitat to reduce both predation risk and potential for poaching.

3. Population Dynamics

Bull trout are considered to display complex metapopulation dynamics (Dunham and Rieman 1999). Size of suitable habitat patches appears to play an important role in the persistence of bull trout populations, along with habitat connectivity and human disturbance, especially road density. Analyses of spatial and temporal variation in bull trout redds indicates weak spatial clustering in patterns of abundance through time (Rieman and McIntyre 1996). Spatial heterogeneity in patterns of abundance was high, however, at a regional scale. This combination of patterns suggests that maintenance of stable regional populations may require maintenance of connected patches of high quality habitat where dispersal and demographic support can occur readily among patches (Rieman and McIntyre 1996).

The importance of maintaining the migratory life-history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson et al. 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution (Rieman and McIntyre 1993; MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993; MBTSG 1998; Nelson et al. 2002; Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998; Rieman and McIntyre 1993); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will reduce the probability of local and subpopulation extinctions. Remnant populations, that lack connectivity due to elimination of migratory forms, have a reduced likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

Lakes and reservoirs provide important refugia for bull trout. In general, lake and reservoir environments are relatively more secure from catastrophic natural events than stream systems (67 FR 71236). They provide a sanctuary for bull trout, allowing them to quickly rebound from temporary adverse effects to spawning and rearing habitat. For example, if a major wildfire burns a drainage and eliminates most or all aquatic life (a rare occurrence), bull trout sub-adults and adults that survive in the lake may return the following year to repopulate the burned drainage. This underscores the need to maintain migratory life forms and habitat connectivity in order to increase the likelihood of long-term population persistence.

4. Threats and Conservation Needs

Threats are factors that reduce a species' likelihood of survival and recovery and lead to listing under the Act. Conservation needs are ecological conditions necessary to sustain stable or increasing populations of listed species, and measures that will create these conditions. Conservation needs alleviate or reverse the effects of threats and contribute to increasing the likelihood of survival and recovery of listed species.

4.1 Reasons for Listing

Factors contributing to the decline of bull trout populations were described in the final rules for listing. They include restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, over-harvest, and poaching (Bond 1992; Thomas 1992; Rieman and McIntyre 1993; Donald and Alger 1993; WDFW 1997).

Extensive habitat loss and fragmentation of subpopulations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Road construction, grazing, and agricultural practices in the Columbia River basin have degraded habitat conditions by contributing to elevated stream temperatures, increased sedimentation and channel embeddedness, and reductions in the extent of riparian vegetation. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes (e.g., mainstem hydropower and tributary irrigation diversions) have severely limited migration of bull trout in the Columbia River basin. Competition from and hybridization with non-native trout are also considered threats to bull trout (USDI 1998; 1999).

Wildfire in the dry forests of the interior Columbia Basin also presents a substantive threat to bull trout populations. Although bull trout evolved with wildfire, and can benefit from it, fire suppression in some areas has altered fire regimes so drastically that they no longer resemble historic fire regimes in which bull trout evolved (Rieman et al. 1997b; Rieman and Clayton 1997; Gresswell 1999). Species that have narrow habitat requirements, such as bull trout, that inhabit degraded and fragmented aquatic systems are considered vulnerable to fire and fire-related disturbance (Dunham et al. 2003b). In this context, wildfire could threaten long-term persistence of bull trout because it exerts selection pressures different than those that produced the phenotypes and genotypes present today.

4.2 New Threats

No new threats since listing have been specifically identified at the range-wide scale, but previously identified threats, or new threats at the local scale, may not have been fully appreciated. Examples include the proposed introduction of northern pike (*Esox lucius*) as a sport fish in Montana and expansion of the range of whirling disease (*Myxobolus cerebralus*).

4.3 Conservation Needs

Conservation needs are measures necessary to redress the threats that led to the listing of a species. As described in the "habitat" sections above, the habitat conservation needs of bull trout are often generally expressed as the need to provide the four "Cs"; cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics, including abundant large wood and undercut banks, and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote long-term conservation of bull trout.

In addition to habitat conservation needs, other needs are associated with sustaining population dynamics. These conservation needs include: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range; (2) preserve the diversity of life-history strategies; and (3) maintain genetic and phenotypic diversity across the range. Each of these needs is described below in more detail. These conservation needs apply to bull trout at multiple scales ranging from the coterminous listing down to local populations.

4.3.1 *Interconnected Populations*. Maintaining multiple bull trout populations distributed and interconnected throughout their current range will also provide a mechanism for spreading the risk of extinction from stochastic events (Rieman and McIntyre 1993; Rieman and Allendorf 2001; Spruell et al. 1999; Healey and Prince 1995; Hard 1995). Bull trout still occur widely, but in reduced numbers, across most portions of their historical range. Within this broad distribution, significant declines and local extinctions have occurred. Current patterns in distribution and other empirical evidence indicate that further declines and local extinctions are likely (Rieman et al. 1997a; Spruell et al. 2003; Rieman and Allendorf 2001; Dunham and Rieman 1999). Maintenance of widespread and interconnected populations improves the chances that declining populations can be "rescued" from extinction by immigrants from more robust populations, or if local extinctions occur, that recolonization will follow.

Preservation of interconnected populations and multiple life histories enable bull trout to persist through natural disturbance events, such as large fires. Bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes in habitats susceptible to large fires may be to restore aquatic habitat structure and life-history complexity of populations in these areas (Gresswell 1999).

The spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids (Rieman and Clayton 1997). For example, Rieman et al. (1997b) studied bull trout and redband trout (*Oncorhynchus mykiss*) responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires, after areas within the watersheds had experienced debris flows, fish became reestablished in many reaches. In some instances, fish densities were higher than those present before the fires even in streams that were not burned (Rieman et al. 1997b). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997; Rieman et al.1997b).

In terms of conserving bull trout, the appropriate strategy to reduce the risk of fires on bull trout habitat is to emphasize the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

4.3.2 *Life-History Diversity*. Bull trout populations exhibit multiple life-history forms, including migratory forms, throughout the range of the species (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life-history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life-history strategies help to maintain the stability and persistence of bull trout populations in the face of environmental changes. Migratory bull trout may enhance persistence of metapopulations due to their high fecundity, large size, and dispersal across space and time, which promotes recolonization should resident populations suffer a catastrophic loss (Frissell 1997; Rieman and McIntyre 1993; MBTSG 1998).

4.3.3 *Genetic and Phenotypic Diversity*. Genetic diversity promotes both short-term fitness of populations and long-term persistence of a species by increasing the likelihood that the species is able to survive changing environmental conditions. This beneficial effect can be displayed both within and among populations. Within a genetically diverse local population of bull trout, different individuals may have various alleles that confer different abilities to survive and reproduce under different environmental conditions (Leary et al. 1993; Spruell et al. 1999; Hard 1995). If environmental conditions change due to natural processes or human activities, different allele combinations already present in the population may be favored, and the population may persist with only a change in allele frequencies. A genetically homogeneous population that has lost variation due to inbreeding or genetic drift may be unable to respond to environmental change and be extirpated. The prospect of local extirpation highlights the importance of genetic diversity among local populations. Recolonization of locations where extirpations have occurred may be promoted if immigrants are available that possess alleles that confer an advantage in variable environmental conditions. Extending this reasoning to the entire range of the species, reduction in rangewide genetic diversity of bull trout through the loss of local populations can reduce the species ability to respond to changing conditions, leading to a higher likelihood of extinction (Rieman and McIntyre 1993; Leary et al. 1993; Spruell et al. 1999; Hard 1995; Rieman and Allendorf 2001).

Barriers to migration are an important factor influencing patterns of genetic variability in bull trout (Spruell et al. 2003; Costello et al. 2003). Although barriers increase the vulnerability of isolated populations to stochastic factors, they also insulate these populations from the homogenizing effects of gene flow. If isolated populations were founded by ancestors with rare alleles, genetic drift, unimpeded by gene flow, can lead to fixation of these rare alleles. Subsequent downstream migration from these isolated populations may be important in maintaining the evolutionary potential of metapopulations, because they provide inputs of genetic diversity (Costello et al. 2003).

The amount of genetic variation necessary for a population to adapt to a changing environment can be estimated using the concept of effective population size (N_e). Effective population size is the average number of individuals in a population which are assumed to contribute genes equally to the succeeding generation. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population.

Specific benchmarks for bull trout have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, called VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). Using the estimate that N_e for bull trout is between 0.5 and 1.0 times the mean number of adults spawning annually, Rieman and Allendorf (2001) concluded that (1) an average of 100 adults spawning each year would be required to minimize risks of inbreeding in a population, and (2) an average of 1,000 adults is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1,000 spawners may also be reached with a collection of local populations among which gene flow occurs.

Bull trout populations tend to show relatively little genetic variation within populations, but substantial divergence among populations (e.g., Spruell et al. 2003). For example, Spruell et al. (1999) found that bull trout at five different spawning sites within a tributary drainage of Lake Pend Oreille, Idaho, were differentiated based on genetic analyses (microsatellite DNA), indicating fidelity to spawning sites and relatively low rates of gene flow among sites. This type of genetic structuring indicates limited gene flow among bull trout populations, which may encourage local adaptation within individual populations (Spruell et al. 1999; Healey and Prince 1995; Hard 1995; Rieman and McIntyre 1993).

Current information on the distribution of genetic diversity within and among bull trout populations is based on molecular characteristics of individual genes. While such analyses are extremely useful, they may not reflect variability in traits whose expression is dependent on interactions among many genes and the environment (Hard 1995, Reed and Frankham 2001; but see Pfrender et al. 2000). Therefore, the maintenance of phenotypic variability (e.g., variability in body size and form, foraging efficiency, and timing of migrations, spawning, and maturation) may be best achieved by conserving populations, their habitats, and opportunities for the species to take advantage of habitat diversity (Healey and Prince 1995; Hard 1995).

Local adaptation may be extensive in bull trout because populations experience a wide variety of environmental conditions across the species' distribution, and because populations exhibit considerable genetic differentiation. Thus, conserving many populations across their range is essential to adequately protect the genetic and phenotypic diversity of bull trout (Hard 1995; Healey and Prince 1995; Taylor et al.1999; Rieman and McIntyre 1993; Spruell et al. 1999; Leary et al. 1993; Rieman and Allendorf 2001). If genetic and phenotypic diversity is lost, changes in habitats and prevailing environmental conditions could increase the likelihood of bull trout suffering reductions in numbers, reproductive capacity, and distribution.

Based on this information about the life history and conservation needs of bull trout, the Service concludes that each subpopulation or local population is an important genetic, phenotypic, and geographic component of its respective interim recovery unit. Adverse effects that compromise the persistence of a bull trout subpopulation or local population can reduce the distribution, as well as the phenotypic and genetic diversity of the unit.

4.4 Recovery Planning

Recovery plans developed by the Service typically contain the most detailed articulation of the conservation needs of listed species. The goal of the draft recovery plan for bull trout is to ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distributed across the species' native range.

The recovery of bull trout will depend on the reduction of the adverse effects from dams, logging, agricultural practices, road building, urbanization, fisheries management, and by remedying legacy effects from past activities. Other general conservation needs described in the draft recovery plan, but not mentioned in the preceding paragraphs, include:

- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout
- Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve those goals
- Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout (USFWS 2002).

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APPENDIX B: Projects subject to prior Section 7 consultation in the Chewuch Watershed that may have resulted in effects on bull trout or their habitat.*

Project Name	FWS Reference	Date
Doe Timber Sale	1-3-96-I-0333 1-3-98-CR-0132 -134	June 21, 1996 March 3 1998
Burgett Timber Sale	1-3-98-CR-0132 -134	March 3, 1998
Livestock Grazing (Cub Creek and Fawn allotments)	1-3-98-I-0394 to 0398	August 24, 1998
Winthrop Administrative Site Land Exchange	1-3-99-I-0190	February 9, 1999
Skyline Irrigation Company operations	1-3-99-F-1321 - 1323	September 29, 1999
Cub Creek Road Closures	1-3-01-I-0003	November 1, 2000
Ongoing activities and new actions	1-3-01-I-0072, 0074-0077	December 29, 2000
Thirty Mile Bridge	1-3-01-I-1785	July 1, 2001
Thirty Mile Memorial	1-3-02-I-0767	March 13, 2002
Thirty Mile Bridge Replacement	1-9-03-F-W0243	May 28, 2003
Skyline Ditch Company Special Use Permit Amendment	1-9-03-F-W0225	April 5, 2003
Hazard tree felling along 30-Mile Road	1-9-05-I-W0008 and 1-9-05-I-W0194	April 15, 2005
Chewuch Water Lease	1-9-05-I-W0339	August 5, 2005
Chewuch Diversion Dam Fish Passage Renovation	1-9-05-F-W0385	September 29, 2005
Tiffany, Ramsey, and East Chewuch Allotment Management Plan Revisions	13260-2006-I-0016	December 8, 2005
Eightmile Vegetation Management	13260-2006-I-0099	March 22, 2006
North Leroy Borrow Pit	13260-2006-I-0221	June 13, 2006
Fulton Diversion Dam Fish Passage Renovation	13260-2006-P-0025	October 31, 2006
Tripod Fire Salvage Project	13260-2007-I-0130	June 22, 2007
West Chewuch Road Relocation	13260-2007-I-0192	September 27, 2007
Fulton Diversion Ditch Piping and Rip Rap Repair	13260-2008-I-0013	November 7, 2007
Chewuch Diversion Dam Modification	13260-2008-F-0138	October 1, 2008
Fulton Diversion Dam Repair	13260-2009-I-0018	November 3, 2008
Cub Creek Bridge/Culvert	13260-2009-I-0090	April 27, 2009
Fulton Streambank Protection Repair	13260-2009-F-0116	July 13, 2009

Project Name	**FWS Reference**	**Date**
Twentymile Creek Ford Gradient Restoration (ARBO)	13260-2008-F-0138	August 26, 2009
Cub Allotment Management Plan Renewal	13260-2009-F-0128	September 28, 2009

* This list does not include projects that were determined to have “no effect” on bull trout, or projects that were covered under the Programmatic for Selected Forest Management Activities (USFWS ref. 1-9-2003-I-W0102, 1-09-2005-I-W0172, and 13260-2008-I-0133). This programmatic covers only activities that result in “not likely to adversely affect” determinations, based on conformance with specific design criteria.