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FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th A venue, Suite 100
Portland, Oregon 97266
Phone: (503) 231-6179 FAX: (503) 231-6195

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Michael S. Francis
Chief, Environmental Compliance Section
Department of the Army
U.S. Army Corps of Engineers
201 North Third Avenue
Walla Walla, WA 99362

Subject: Formal Consultation for the St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project, Umatilla County, Oregon (*FWS reference* 01EOFW00-2018-F-0234)

Dear Mr. Michael Francis

This document transmits the Fish and Wildlife Service's (Service) Biological Opinion (Opinion) proposed St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project, and the project's effects on the federally threatened bull trout (*Salvelinus confluentus*) and bull trout critical habitat (CH), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The Army Corps of Engineers' (Corps) January 26, 2018, request for consultation, with the accompanying Biological Assessment (Assessment), was received by the Service on February 1, 2018. A revised request for formal consultation was received on February 7, 2018.

The Corps determined, and the Service agrees, that the proposed action ***may affect, and is likely to adversely affect*** bull trout and/or bull trout critical habitat in the action area. This Opinion is based on information provided in the proposed action, telephone and electronic correspondence, and other sources of information.

A complete administrative record for this consultation is on file at the Service's La Grande Field Office in La Grande, Oregon.

If you, or any of your staff, have questions about this Opinion, or require more information regarding this consultation, please contact Suzanne Anderson or Marisa Meyer in our La Grande Office at (541) 962-8584.

Sincerely,

Paul Henson

Paul Henson, Ph.D.
State Supervisor

Enclosure

cc:
Anneli Colter, Army Corps of Engineers, Walla Walla, WA
John Hook, Army Corps of Engineers, Walla Walla, WA
Rebecca Viray, National Marine Fisheries Service, La Grande, OR

Endangered Species Act – Section 7 Consultation
Biological Opinion
for
St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project
Effects to Bull Trout and Bull Trout Critical Habitat
[FWS reference: 01EOFW00-2018-F-0234]

Prepared by the Oregon Fish and Wildlife Office
U.S. Fish and Wildlife Service
La Grande, Oregon

Paul Henson

Paul Henson, Ph. D, State Supervisor

03/14/18
Date

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INTRODUCTION
This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the proposed St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project, and the project's effects on the federally threatened bull trout (*Salvelinus confluentus*) and bull trout critical habitat (CH), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The Army Corps of Engineers' (Corps) January 26, 2018, request for consultation, with the accompanying Biological Assessment (Assessment), was received by the Service on February 1, 2018.

After reviewing the current status of bull trout, bull trout critical habitat, environmental baseline for the action area, effects of the proposed action, and anticipated cumulative effects, it is the Service's opinion that the St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project (proposed action) ***may affect, and is likely to adversely affect*** bull trout and CH. The project is not likely to jeopardize the continued existence of bull trout and is not likely to destroy or adversely modify bull trout critical habitat.

This Opinion is based on information provided in the Assessment, telephone and electronic correspondence, and other sources of information. A complete administrative record for this consultation is on file at the Service's La Grande Field Office in La Grande, Oregon.

Background
The purpose of the proposed action is to consolidate the transfer of existing and new mitigated irrigation water rights to a centralized point of diversion, where water from the Columbia River can be distributed to nearby farmlands. The project is needed due to an ongoing and critical groundwater shortage issue in the Lower Umatilla Basin, which is proving detrimental to farming practices.

St. Hilaire currently owns and operates an existing irrigation pumping station located at River Mile 301.7 on the middle Columbia River (Lake Wallula). Their pumping station consists of seven pumps and a 30-inch diameter cement-mortar lined steel pipeline with a total water withdrawal capacity around 61.4 cfs. The main booster station currently has two 400 horsepower and four 250 horsepower pumps. The existing pumping station provides irrigation water to JSH Farms, which includes about 4,200 acres of farmland in Umatilla County. The Corps issued an amendment in 2013 to expand the original easement area by approximately 0.32 acres (submerged area) and to extend the irrigation water intake pipeline and its appurtenant facilities 180 feet further into the Columbia River.

The total area in the St. Hilaire Brothers easement is currently 0.6 acre. The proposed action would not include any additional lands, but rather an amendment to construct and operate within the existing easement. A new easement would be issued to the East Improvement District (EID)).

Over the last decade, the State of Oregon has given support and committed resources to addressing the water shortage issue in the Lower Umatilla Basin, and specifically in the critical groundwater areas. Over the last decade, only around a third of the permitted groundwater has been allowed to be pumped by the Oregon Water Resource Department (OWRD) in the critical groundwater areas. This has resulted in thousands of acres left fallow each year. The latest effort supported by the Governor's office and state legislature, and partially funded through grant monies from OWRD, would be to bring water from the Columbia River to those areas and farmlands impacted by the water shortage. This would be accomplished through the transfer of existing, and issuance of new, mitigated Columbia River water rights.

Consultation History
This BO is based on correspondence and discussions with the Corps, National Marine Fisheries Service (NMFS), and the Service. A brief history of the consultation is included below:

- February 1, 2018 - The Service received a copy of the BA for the St. Hilaire Brothers and East Improvement District: Columbia River Pumping Station and Intake Project and request for informal consultation.
- February 7, 2018 - The Service provided comments to the Corps on the BA and recommended the project go through formal consultation.
- February 8, 2018 – The Service discussed aspects of the project with Corps and with NMFS.
- February 8, 2018 - Formal Section 7 consultation was initiated for the proposed action at the Service's La Grande Field Office and the National Marine Fisheries Service's La Grande Field Office, La Grande, Oregon.

BIOLOGICAL OPINION
The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the Service, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, the Services provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

1.0 PROPOSED ACTION
The Corps proposes to issue an amendment to an existing real estate easement held by St. Hilaire Brothers Hermiston Farm, LLC (St. Hilaire) to expand their existing irrigation pumping station located on the middle Columbia River in Umatilla County, Oregon. The amendment includes the expansion of their existing irrigation pumping station, and the construction of a new pumping station by EID within St. Hilaire's existing easement area. The new, adjacent pumping station would be owned and operated by EID, which is comprised of nine farms that own over 28,000 acres of farmland. Therefore, the Corps would issue a separate easement to the EID.

The proposed expansion of the St. Hilaire pumping station includes installation of three new pumps, a new 42-inch diameter discharge pipe, and expansion of the main booster pump station. This effort would be funded through EID and grant monies from OWRD. The proposed expansion of the existing St. Hilaire Brothers pumping station will include installation of three new pumps and a new 42-inch diameter discharge pipe, which will increase the station's withdrawal capacity from 61.4 cfs to 100 cfs. The new pumps will be housed in 42-inch diameter "cans" connected to the existing 60-inch diameter intake pipe via three 26-inch diameter steel "pup" pipes. The new section of 42-inch discharge pipe will then be connected to the pump can "pups" via a manifold. The new discharge pipe will extend south toward the shoreline and will be supported above the water on two pipe cradles, each secured to the river bed by a pair of 12.75-inch diameter steel piles.

At each new pump can location, a 60-inch diameter by 7.5-foot long section of sleeve pipe will be positioned vertically and driven a foot into the river bed using a vibratory hammer. The river bed material inside of these sleeve pipes will be suctioned out. As material is removed the pipe will be driven further down until the desired depths are achieved. Utilizing this approach will limit the total required volume of excavation to around 16 cubic yards while minimizing the impact to the existing structures. The suctioned bed material will then be side cast back into the river within the existing easement.

In order to accommodate the new pump cans, the existing station deck will be expanded approximately 15 feet to the east. The expanded portion of the station deck will be constructed using metal grates placed over a steel frame, and will be supported over the water by 16 new steel 10" H-piles. An air-burst system will also be installed to facilitate the cleaning of the existing intake screens. This system will consist of a compressor (housed in the existing upland control building), air vessel, steel air lines, control valves, and a monitoring and control system. The total overwater area covered by the expanded station deck and new discharge pipe will be approximately 538 square feet (0.012 acres), of which, approximately 404 square feet (0.009 acre) will be grated to allow for 60 percent light penetration. All new steel pilings and H piles will be installed 20 feet (or to refusal) into the substrate with a vibratory hammer. It is anticipated that each pile will require approximately 15 to 30 minutes of vibratory hammer use. The proposed 42-inch diameter discharge pipe will be trenched underground through upland as it leaves the project site, and will eventually tie into an existing irrigation pipe approximately 0.5 miles to the south. The new EID pumping station will include a new station deck, ten new pumps, a new intake pipe, four new intake screens, and a new discharge pipe. It will be designed for a withdrawal capacity of up to 200 cfs, but will only pump 100 cfs at this time. If there are any increases to the cfs withdrawal, this consultation will have to be reinitiated (as there would be effects not analyzed not in this Opinion). The new pumping station and intake will extend approximately 350 feet out from the shoreline of the Columbia River. Each of the four new intake screens will measure 5 feet in diameter by approximately 19 feet in length, and will be affixed with NMFS-approved slotted fish screen (0.069 inch openings) to insure juvenile salmonids are not impinged or entrained in the intake. The intake screens will also be equipped with an air-burst system to facilitate the cleaning of the screens and maintain the appropriate approach velocity in compliance with NMFS criteria. This air-burst system will include a compressor, an air vessel, stainless steel lines to each screen, control valves, and a monitoring and control system.

The new intake screens will be mounted on a 78-inch diameter by 70-foot long steel manifold. The manifold will be supported on five cradles, each secured to the river bed by a pair of 12.75- inch diameter steel piles. The manifold will then transition to an 84-inch diameter by 170-foot long section of intake pipe that will be supported on another four cradles, each secured by a pair of steel piles. The intake pipe will then continue another 38 feet as a second manifold. This manifold will be supported on an additional five cradles, secured between pairs of steel H-piles (W10 x 54). The manifold will connect to ten pump cans, five on each side of the manifold, through 30-inch diameter "pup" pipes. Each pump can will be 42 inches in diameter by 21 feet.

Included as part of the proposed expansion/new pumping station project, are the following mitigation measures intended to compensate for the permanent displacement of approximately 0.066 acre of aquatic habitat: (1) Approximately 0.037 acre (64 percent) of the new overwater station decks would be grated to allow for 60 percent light penetration, (2) Waterproof lighting equipped with a daylight sensor would be installed under the overwater portions of the new concrete deck (0.046 acre) at the new EID station to preclude creating habitat for salmonid predators, and (3) approximately 3,000 square feet of existing concrete and asphalt debris associated with the old Highway 30 in Boardman, Oregon (located approximately 33 miles downstream) would be removed from below the ordinary high water mark (OHWM) of the Columbia River. The removal of the existing concrete/asphalt debris would increase the available substrate area below the OHWM, therefore providing viable shallow water habitat beneficial for salmonids near the shoreline.

Removal of the concrete/asphalt debris will be conducted using an excavator operating from the roadway. The excavator will start at the far end of the proposed mitigation area and work backwards toward the shoreline, where the debris will be transferred to a dump truck and carried offsite to an appropriate upland disposal location. Removal of the concrete/asphalt debris will increase the available substrate area and open water below the OHWM of the Middle Columbia River, therefore providing viable shallow water habitat near the shoreline allowing natural recovery to occur. Water depths within the mitigation area range between 1 to 4 feet.

Except for the first half mile where the River Pump Station is on the Corps' property and the pipeline crosses the Services' property, all new infrastructure, both EID's and the private systems, will be located on properties owned by the EID members. The EID pipeline will cross both State and County roads, a set of Northern Pacific Railroad tracks, BPA and Pacific Corp transmission power lines, and a set of gas pipelines. Permits have been or are in the process of being obtained for all of these crossings. Umatilla Electric Cooperative, the sole utility serving all of the area involved, is addressing the required upgrades to their grid to handle all of these new loads.

The larger private irrigation project (LPIP), however, is not part of the federal Project, because those actions are not subject to Federal control and responsibility (40 C.F.R. § 1508.18). Additionally, the LPIP could likely proceed independent of the proposed Federal Project. The "independent utility" determination is often discussed in terms of 'but for' causation and interrelated/interdependent actions.

Regarding the scope of the proposed Federal Project, the LPIP is substantially (if not entirely) outside of Federal control and responsibility. The proposed Federal Project does not grant St. Hiliare/EID any right to use/withdraw water from the Columbia River and will not increase water withdrawals -- i.e., the LPIP consolidates the transfer of existing and new "mitigated" (bucket-for-bucket) Columbia River water rights to a single point of diversion. The State of Oregon decides where (and for what purpose) water within the state will be put to beneficial use (under state law and the Public Trust Doctrine), not the Corps or Service. St. Hiliare/EID's right to withdraw water is the result of state issued/recognized water rights. It is reasonable to believe that St. Hiliare/EID would find a way to exercise their water rights from a different location (or from groundwater) if Federal permits/approvals were denied or the state would designate a different beneficial use for such water elsewhere (consumptive or in-stream). Additionally, the LPIP is subject to numerous non-Federal actions/decisions (e.g., easements, financing, state/local permits), which are outside the control of the Corps or Service, and St. Hiliare/EID are free to modify irrigation facility designs and/or locations.

All work conducted below the OHWM of the Columbia River will occur between December 1 and February 28 of the ODFW–preferred in-water work window for the Middle Columbia River (December 1 – March 31).

The Corps proposes the following conservation measures as part of the proposed action:

1. All heavy equipment (i.e., crane and excavator) will access the project site via existing roadways, parking areas, disturbed upland areas, and/or floating barges.
2. All steel piles will be installed with a vibratory hammer, therefore reducing potential hydroacoustic impacts to fish. No impact hammer pile driving will be required.
3. The contractor will initiate daily "soft-start" procedures to provide a warning and/or give animals near piling installation and removal activities a chance to leave the area prior to a vibratory hammer operating at full capacity; thereby, exposing fewer animals to loud underwater and airborne sounds.
4. The contractor will initiate noise from vibratory hammers for 15 seconds at reduced energy followed by a 30-second waiting period. The procedure shall be repeated two additional times.
5. All excavated/dredged materials will be suitable and approved for in- water disposal based on the Sediment Evaluation Framework.
6. A Pollution Control Plan (PCP) will be prepared by the Contractor and carried out commensurate with the scope of the project that includes the following:
   a. BMPs to confine, remove, and dispose of construction waste.
   b. Procedures to contain and control a spill of any hazardous material.
   c. Steps to cease work under high flow conditions.

7. All conditions of ODEQ's 401 Water Quality Certification will be followed.
8. Only enough supplies and equipment to complete the project will be stored on site.
9. All equipment will be inspected daily for fluid leaks, any leaks detected will be repaired before operation is resumed.
10. Before operations begin, and as often as necessary during operation, all equipment that will be used below the OHWM will be steam cleaned until all visible oil, grease, mud, and other visible contaminates are removed consistent with the Haz Mat plan.
11. Stationary power equipment operated within 150 feet of the Columbia River will be diapered to prevent leaks.
12. New pump station intake screens will be equipped with a self-monitoring system that will measure hydraulic head and reduce intake velocities as necessary to maintain an approach velocity of 0.2 feet per second (fps), in compliance with NMFS criteria.
13. New pump station intake screens will be placed more than 20 feet below the OHWM, therefore reducing potential impacts to migrating juvenile salmonids.
14. Approximately 0.037 acre (64 percent) of the new overwater station decks will be grated to allow for 60 percent light penetration.
15. Waterproof lighting equipped with a daylight sensor will be installed under the overwater portions of the new concrete deck (0.046 acre) at the new EID pumping station to provide under deck lighting during the daytime to preclude creating habitat for salmonid predators.

1.1 Action Area

Action area is defined as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purposes of this consultation, the action area is defined as an area 300 feet around and 500 feet downstream and upstream of the proposed in-water activities, intake pipe installation, and mitigation site activities. The project site is located at river mile 301.7 on the Columbia River, near Hermiston, Oregon in Umatilla County. This action area will encompass any temporary, short-term, or long-term effects of the proposed action to the bull trout and bull trout critical habitat.

2.0 STATUS OF BULL TROUT

2.1 Analytical Framework for the Jeopardy and Adverse Modification Determinations

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components: (1) the *Status of the Species*, which evaluates bull trout range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of bull trout; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on bull trout; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the bull trout current status, taking into account any cumulative 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 of the bull trout in the wild.

The jeopardy analysis in this Biological Opinion places an emphasis on consideration of the range-wide survival and recovery needs of bull trout and the role of the action area in the survival and recovery of the bull trout as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination
Section 7(a)(2) of the ESA requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification of critical habitat" was published on February 11, 2016 (81 FR 7214). The final rule became effective on March 14, 2016. The revised definition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The destruction or adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which describes the range-wide condition of designated critical habitat for the bull trout in terms of the key components of the critical habitat that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of the listed species; (2) the *Environmental Baseline*, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation/recovery of the listed species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the key components of critical habitat that provide for the conservation of the listed species, and how those impacts are likely to influence the value of the affected critical habitat units for the conservation/recovery of the listed species; and (4) Cumulative Effects, which evaluate the effects of future non-Federal activities that are reasonably certain to occur in the action area on the key components of critical habitat that provide for the conservation of the listed species and how those impacts are likely to influence the value of the affected critical habitat units for the conservation/recovery of the listed species.

For purposes of making the destruction or adverse modification determination, the effects of the proposed Federal action, together with any cumulative effects, are evaluated to determine if the value of the critical habitat rangewide for the conservation/recovery of the listed species would remain functional or would retain the current ability for the key components of the critical habitat that provide for the conservation of the listed species to be functionally re-established in areas of currently unsuitable but capable habitat

Note: Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical and biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations (81 FR 7214) discontinue use of the terms "PCEs" or "essential features" and rely exclusively on use of the term PBFs for that purpose because that term is contained in the statute. To be consistent with that shift in terminology and in recognition that the terms PBFs, PCEs, and essential habit features are synonymous in meaning, we are only referring to PBFs herein. Therefore, if a past critical habitat designation defined essential habitat features or PCEs, they will be referred to as PBFs in this document. This does not change the approach outlined above for conducting the "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features.

2.2 Status of the Species

This Opinion examines the status of bull trout and how they would be adversely affected by the proposed action. The status is the level of risk that bull trout face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value. One factor affecting the status of bull trout considered in this opinion, and aquatic habitat at large is climate change.

2.2.1 Species Description

The bull trout is a native char found in the coastal and intermountain west of North America. Dolly Varden (*Salvelinus malma*) and bull trout were previously considered a single species and were thought to have coastal and interior forms. However, Cavender (1978, entire) described morphometric, meristic and osteological characteristics of the two forms, and provided evidence of specific distinctions between the two. Despite an overlap in the geographic range of bull trout and Dolly Varden in the Puget Sound area and along the British Columbia coast, there is little evidence of introgression (Haas and McPhail 1991, p. 2191). The Columbia River Basin is considered the region of origin for the bull trout. From the Columbia, dispersal to other drainage systems was accomplished by marine migration and headwater stream capture. Behnke (2002, p. 297) postulated dispersion to drainages east of the continental divide may have occurred through the North and South Saskatchewan Rivers (Hudson Bay drainage) and the Yukon River system. Marine dispersal may have occurred from Puget Sound north to the Fraser, Skeena and Taku Rivers of British Columbia.

Bull trout have unusually large heads and mouths for salmonids. Their body colors can vary tremendously depending on their environment, but are often brownish green with lighter (often ranging from pale yellow to crimson) colored spots running along their dorsa and flanks, with spots being absent on the dorsal fin, and light colored to white under bellies. They have white leading edges on their fins, as do other species of char. Bull trout have been measured as large as 103 centimeters (41 inches) in length, with weights as high as 14.5 kilograms (32 pounds) (Fishbase 2015, p. 1). Bull trout may be migratory, moving throughout large river systems, lakes, and even the ocean in coastal populations, or they may be resident, remaining in the same stream their entire lives (Rieman and McIntyre 1993, p. 2; Brenkman and Corbett 2005, p. 1077). Migratory bull trout are typically larger than resident bull trout (FWS 1998, p. 31668).

2.1.2 Legal Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (FWS 1999a, entire). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 715-720).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (FWS 1999a, p. 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, entire; Rieman et al. 2007, entire; Porter and Nelitz. 2009, pages 4-8). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

2.1.3 Life History

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989,

p. 30; Pratt 1985, pp. 28-34). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982, p. 95).

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 141). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, pp. 15-16; Pratt 1992, pp. 6-7; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 1). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, p. 1; Ratliff and Howell 1992, p. 10).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002, p. 9) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007, p. 10). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995, Ch 2 pp. 23-24). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

2.1.4 Population Dynamics

Population Structure

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, p. 2). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Goetz 1989, p. 15). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, p. 138; Goetz 1989, p. 24), or saltwater (anadromous form) to rear as subadults and to live as adults (Brenkman and Corbett 2005, entire; McPhail and Baxter 1996, p. i; WDFW et al. 1997, p. 16). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133).

Bull trout are naturally migratory, which allows them to capitalize on temporally abundant food resources and larger downstream habitats. Resident forms may develop where barriers (either natural or manmade) occur or where foraging, migrating, or overwintering habitats for migratory fish are minimized (Brenkman and Corbett 2005, pp. 1075-1076; Goetz et al. 2004, p. 105). 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, pp. 96, 98-106). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 861-863; MBTSG 1998, p. 13; Rieman and McIntyre 1993, pp. 2-3). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993, p. 2).

Whitesel et al. (2004, p. 2) noted that although there are multiple resources that contribute to the subject, Spruell et al. (2003, entire) best summarized genetic information on bull trout population structure. Spruell et al. (2003, entire) analyzed 1,847 bull trout from 65 sampling locations, four located in three coastal drainages (Klamath, Queets, and Skagit Rivers), one in the Saskatchewan River drainage (Belly River), and 60 scattered throughout the Columbia River Basin. They concluded that there is a consistent pattern among genetic studies of bull trout, regardless of whether examining allozymes, mitochondrial DNA, or most recently microsatellite loci. Typically, the genetic pattern shows relatively little genetic variation within populations, but substantial divergence among populations. Microsatellite loci analysis supports the existence of at least three major genetically differentiated groups (or evolutionary lineages) of bull trout (Spruell et al. 2003, p. 17). They were characterized as:

1. "Coastal", including the Deschutes River and all of the Columbia River drainage downstream, as well as most coastal streams in Washington, Oregon, and British Columbia. A compelling case also exists that the Klamath Basin represents a unique evolutionary lineage within the coastal group.
2. "Snake River", which also included the John Day, Umatilla, and Walla Walla rivers. Despite close proximity of the John Day and Deschutes Rivers, a striking level of divergence between bull trout in these two systems was observed.
3. "Upper Columbia River" which includes the entire basin in Montana and northern Idaho. A tentative assignment was made by Spruell et al. (2003, p. 25) of the Saskatchewan River drainage populations (east of the continental divide), grouping them with the upper Columbia River group.

Spruell et al. (2003, p. 17) noted that within the major assemblages, populations were further subdivided, primarily at the level of major river basins. Taylor et al. (1999, entire) surveyed bull trout populations, primarily from Canada, and found a major divergence between inland and coastal populations. Costello et al. (2003, p. 328) suggested the patterns reflected the existence of two glacial refugia, consistent with the conclusions of Spruell et al. (2003, p. 26) and the biogeographic analysis of Haas and McPhail (2001, entire). Both Taylor et al. (1999, p. 1166) and Spruell et al. (2003, p. 21) concluded that the Deschutes River represented the most upstream limit of the coastal lineage in the Columbia River Basin.

More recently, the Service identified additional genetic units within the coastal and interior lineages (Ardren et al. 2011, p. 18). Based on a recommendation in the Service's 5-year review of the species' status (FWS 2008a, p. 45), the Service reanalyzed the 27 recovery units identified in the draft bull trout recovery plan (FWS 2002a, p. 48) by utilizing, in part, information from previous genetic studies and new information from additional analysis (Ardren et al. 2011, entire). In this examination, the Service applied relevant factors from the joint Service and NMFS Distinct Population Segment (DPS) policy (FWS 1996, entire) and subsequently identified six draft recovery units that contain assemblages of core areas that retain genetic and ecological integrity across the range of bull trout in the coterminous United States. These six draft recovery units were used to inform designation of critical habitat for bull trout by providing a context for deciding what habitats are essential for recovery (FWS 2010, p. 63898). The six draft recovery units identified for bull trout in the coterminous United States include: Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Saint Mary, and Upper Snake. These six draft recovery units were also identified in the Service's revised recovery plan (FWS 2015, p. vii) and designated as final recovery units.

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, p. 4). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991, entire). Burkey (1989, entire) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, entire; Burkey 1995, entire).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, p. 15; Dunham and Rieman 1999, entire; Rieman and Dunham 2000, entire). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994, pp. 189-190). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000, entire). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman and Clayton 1997, pp. 10-12; Dunham and Rieman 1999, p. 645; Spruell et al. 1999, pp. 118-120; Rieman and Dunham 2000, p. 55).

Human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999, entire). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of the bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999, entire) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000, pp. 56-57). Recent research (Whiteley et al. 2003, entire) does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho.

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 4). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, entire; Goetz 1989, pp. 23, 25; Hoelscher and Bjornn 1989, pp. 19, 25; Howell and Buchanan 1992, pp. 30, 32; Pratt 1992, entire; Rich 1996, p. 17; Rieman and McIntyre 1993, pp. 4-6; Rieman and McIntyre 1995, entire; Sedell and Everest 1991, entire; Watson and Hillman 1997, entire). Watson and Hillman (1997, pp. 247-250) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, pp. 4-6), bull trout should not be expected to simultaneously occupy all available habitats.

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, p. 2). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 2; Spruell et al. 1999, entire). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under "Diet."

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams, and spawning habitats are generally characterized by temperatures that drop below 9 °C in the fall (Fraley and Shepard 1989, p. 137; Pratt 1992, p. 5; Rieman and McIntyre 1993, p. 2).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, pp 7-8; Rieman and McIntyre 1993, p. 7). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (Buchanan and Gregory 1997, p. 4; Goetz 1989, p. 22). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996, entire) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C, within a temperature gradient of 8 °C to 15 °C. In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003, p. 900) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, p. 2; Fraley and Shepard 1989, pp. 133, 135; Rieman and McIntyre 1993, pp. 3-4; Rieman and McIntyre 1995, p. 287). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick 2002, pp. 6 and 13).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, p. 137; Goetz 1989, p. 19; Hoelscher and Bjornn 1989, p. 38; Pratt 1992, entire; Rich 1996, pp. 4-5; Sedell and Everest 1991, entire; Sexauer and James 1997, entire; Thomas 1992, pp. 4-6; Watson and Hillman 1997, p. 238). Maintaining bull trout habitat requires natural stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, pp. 5-6). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, p. 364). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, p. 141; Pratt 1992, p. 6; Pratt and Huston 1993, p. 70). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Fish growth depends on the quantity and quality of food that is eaten, and as fish grow their foraging strategy changes as their food changes, in quantity, size, or other characteristics (Quinn 2005, pp. 195-200). Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 242-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Donald and Alger 1993, pp. 241-243; Fraley and Shepard 1989, pp. 135, 138; Leathe and Graham 1982, pp. 13, 50-56). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 2001, p. 204). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 105; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997, p. 25). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, pp. 1078-1079; Goetz et al. 2004, entire).

2.1.5 Status and Distribution

The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, pp. 165-166; Bond 1992, p. 2). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992, p. 2). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, pp. 165-166; Brewin et al. 1997, entire).

Each of the following recovery units (below) is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. No new local populations have been identified and no local populations have been lost since listing.

Coastal Recovery Unit

The Coastal Recovery Unit is located within western Oregon and Washington. Major geographic regions include the Olympic Peninsula, Puget Sound, and Lower Columbia River basins. The Olympic Peninsula and Puget Sound geographic regions also include their associated marine waters (Puget Sound, Hood Canal, Strait of Juan de Fuca, and Pacific Coast), which are critical in supporting the anadromous[1] life history form, unique to the Coastal Recovery Unit. The Coastal Recovery Unit is also the only unit that overlaps with the distribution of Dolly Varden (*Salvelinus malma*) (Ardren *et al.* 2011), another native char species that looks very similar to the bull trout (Haas and McPhail 1991). The two species have likely had some level of historic introgression in this part of their range (Redenbach and Taylor 2002). The Lower Columbia River major geographic region includes the lower mainstem Columbia River, an important migratory waterway essential for providing habitat and population connectivity within this region. In the Coastal Recovery Unit, there are 21 existing bull trout core areas which have been designated, including the recently reintroduced Clackamas River population, and 4 core areas have been identified that could be re-established. Core areas within the recovery unit are distributed among these three major geographic regions (Puget Sound also includes one core area that is actually part of the lower Fraser River system in British Columbia, Canada) (FWS 2015a, p. A-1).

The current demographic status of bull trout in the Coastal Recovery Unit is variable across the unit. Populations in the Puget Sound region generally tend to have better demographic status, followed by the Olympic Peninsula, and finally the Lower Columbia River region. However, population strongholds do exist across the three regions. The Lower Skagit River and Upper Skagit River core areas in the Puget Sound region likely contain two of the most abundant bull trout populations with some of the most intact habitat within this recovery unit. The Lower Deschutes River core area in the Lower Columbia River region also contains a very abundant bull trout population and has been used as a donor stock for re-establishing the Clackamas River population (FWS 2015a, p. A-6).

Puget Sound Region
In the Puget Sound region, bull trout populations are concentrated along the eastern side of Puget Sound with most core areas concentrated in central and northern Puget Sound.

Although the Chilliwack River core area is considered part of this region, it is technically connected to the Fraser River system and is transboundary with British Columbia making its distribution unique within the region. Most core areas support a mix of anadromous and fluvial life history forms, with at least two core areas containing a natural adfluvial life history (Chilliwack River core area [Chilliwack Lake] and Chester Morse Lake core area). Overall demographic status of core areas generally improves as you move from south Puget Sound to north Puget Sound. Although comprehensive trend data are lacking, the current condition of core areas within this region are likely stable overall, although some at depressed abundances. Two core areas (Puyallup River and Stillaguamish River) contain local populations at either very low abundances (Upper Puyallup and Mowich Rivers) or that have likely become locally extirpated (Upper Deer Creek, South Fork Canyon Creek, and Greenwater River). Connectivity among and within core areas of this region is

[1] Anadromous: Life history pattern of spawning and rearing in fresh water and migrating to salt water areas to mature.

generally intact. Most core areas in this region still have significant amounts of headwater habitat within protected and relatively pristine areas (e.g., North Cascades National Park, Mount Rainier National Park, Skagit Valley Provincial Park, Manning Provincial Park, and various wilderness or recreation areas) (FWS 2015a, p. A-7).

Olympic Peninsula Region
In the Olympic Peninsula region, distribution of core areas is somewhat disjunct, with only one located on the west side of Hood Canal on the eastern side of the peninsula, two along the Strait of Juan de Fuca on the northern side of the peninsula, and three along the Pacific Coast on the western side of the peninsula. Most core areas support a mix of anadromous and fluvial life history forms, with at least one core area also supporting a natural adfluvial life history (Quinault River core area [Quinault Lake]). Demographic status of core areas is poorest in Hood Canal and Strait of Juan de Fuca, while core areas along the Pacific Coast of Washington likely have the best demographic status in this region. The connectivity between core areas in these disjunct regions is believed to be naturally low due to the geographic distance between them.

Internal connectivity is currently poor within the Skokomish River core area (Hood Canal) and is being restored in the Elwha River core area (Strait of Juan de Fuca). Most core areas in this region still have their headwater habitats within relatively protected areas (Olympic National Park and wilderness areas) (FWS 2015a, p. A-7).

Lower Columbia River Region
In the Lower Columbia River region, the majority of core areas are distributed along the Cascade Crest on the Oregon side of the Columbia River. Only two of the seven core areas in this region are in Washington. Most core areas in the region historically supported a fluvial life history form, but many are now adfluvial due to reservoir construction. However, there is at least one core area supporting a natural adfluvial life history (Odell Lake) and one supporting a natural, isolated, resident4 life history (Klickitat River [West Fork Klickitat]). Status is highly variable across this region, with one relative stronghold (Lower Deschutes core area) existing on the Oregon side of the Columbia River. The Lower Columbia River region also contains three watersheds (North Santiam River, Upper Deschutes River, and White Salmon River) that could potentially become re-established core areas within the Coastal Recovery Unit. Although the South Santiam River has been identified as a historic core area, there remains uncertainty as to whether or not historical observations of bull trout represented a self-sustaining population. Current habitat conditions in the South Santiam River are thought to be unable to support bull trout spawning and rearing. Adult abundances within the majority of core areas in this region are relatively low, generally 300 or fewer individuals.

Most core populations in this region are not only isolated from one another due to dams or natural barriers, but they are internally fragmented as a result of manmade barriers. Local populations are often disconnected from one another or from potential foraging habitat. In the Coastal Recovery Unit, adult abundance may be lowest in the Hood River and Odell Lake core areas, which each contain fewer than 100 adults. Bull trout were reintroduced in the Middle Fork Willamette River in 1990 above Hills Creek Reservoir. Successful reproduction was first documented in 2006, and has occurred each year since (FWS 2015a, p. A-8). Natural reproducing populations of bull trout are present in the McKenzie River basin (FWS 2008d, pp. 65-67). Bull trout were more recently reintroduced into the Clackamas River basin in the summer of 2011 after an extensive feasibility analysis (Shively et al. 2007, Hudson et al. 2015). Bull trout from the Lower Deschutes core area are being utilized for this reintroduction effort (FWS 2015a, p. A-8).

Klamath Recovery Unit

Bull trout in the Klamath Recovery Unit have been isolated from other bull trout populations for the past 10,000 years and are recognized as evolutionarily and genetically distinct (Minckley *et al.* 1986; Leary *et al.* 1993; Whitesel *et al.* 2004; FWS 2008a; Ardren *et al.* 2011). As such, there is no opportunity for bull trout in another recovery unit to naturally re-colonize the Klamath Recovery Unit if it were to become extirpated. The Klamath Recovery Unit lies at the southern edge of the species range and occurs in an arid portion of the range of bull trout.

Bull trout were once widespread within the Klamath River basin (Gilbert 1898; Dambacher *et al.* 1992; Ziller 1992; FWS 2002b), but habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, and past fisheries management practices have greatly reduced their distribution. Bull trout abundance also has been severely reduced, and the remaining populations are highly fragmented and vulnerable to natural or manmade factors that place them at a high risk of extirpation (FWS 2002b). The presence of nonnative brook trout (*Salvelinus fontinalis*), which compete and hybridize with bull trout, is a particular threat to bull trout persistence throughout the Klamath Recovery Unit (FWS 2015b, pp. B-3-4).

Upper Klamath Lake Core Area

The Upper Klamath Lake core area comprises two bull trout local populations (Sun Creek and Threemile Creek). These local populations likely face an increased risk of extirpation because they are isolated and not interconnected with each other. Extirpation of other local populations in the Upper Klamath Lake core area has occurred in recent times (1970s). Populations in this core area are genetically distinct from those in the other two core areas in the Klamath Recovery Unit (FWS 2008b), and in comparison, genetic variation within this core area is lowest. The two local populations have been isolated by habitat fragmentation and have experienced population bottlenecks. As such, currently unoccupied habitat is needed to restore connectivity between the two local populations and to establish additional populations. This unoccupied habitat includes canals, which now provide the only means of connectivity as migratory corridors. Providing full volitional connectivity for bull trout, however, also introduces the risk of invasion by brook trout, which are abundant in this core area.

Bull trout in the Upper Klamath Lake core area formerly occupied Annie Creek, Sevenmile Creek, Cherry Creek, and Fort Creek, but are now extirpated from these locations. The last remaining local populations, Sun Creek and Threemile Creek, have received focused attention. Brook trout have been removed from bull trout occupied reaches, and these reaches have been intentionally isolated to prevent brook trout reinvasion. As such, over the past few generations these populations have become stable and have increased in distribution and abundance. In 1996, the Threemile Creek population had approximately 50 fish that occupied a 1.4-km (0.9-mile) reach (FWS 2002b). In 2012, a mark-resight population estimate was completed in Threemile Creek, which indicated an abundance of 577 (95 percent confidence interval = 475 to 679) age-1+ fish (ODFW 2012). In addition, the length of the distribution of bull trout in Threemile Creek had increased to 2.7 km (1.7 miles) by 2012 (FWS unpublished data). Between 1989 and 2010, bull trout abundance in Sun Creek increased approximately tenfold (from approximately 133 to 1,606 age-1+ fish) and distribution increased from approximately 1.9 km (1.2 miles) to 11.2 km (7.0 miles) (Buktenica *et al.* 2013) (FWS 2015b, p. B-5)

Sycan River Core Area
The Sycan River core area is comprised of one local population, Long Creek. Long Creek likely faces greater risk of extirpation because it is the only remaining local population due to extirpation of all other historic local populations. Bull trout previously occupied Calahan Creek, Coyote Creek, and the Sycan River, but are now extirpated from these locations (Light *et al.* 1996). This core area's local population is genetically distinct from those in the other two core areas (FWS 2008b). This core area also is essential for recovery because bull trout in this core area exhibit both resident[2] and fluvial life histories, which are important for representing diverse life history expression in the Klamath Recovery Unit. Migratory bull trout are able to grow larger than their resident counterparts, resulting in greater fecundity and higher reproductive potential (Rieman and McIntyre 1993). Migratory life history forms also have been shown to be important for population persistence and resilience (Dunham *et al.* 2008).

The last remaining population (Long Creek) has received focused attention in an effort to ensure it is not also extirpated. In 2006, two weirs were removed from Long Creek, which increased the amount of occupied foraging, migratory, and overwintering (FMO) habitat by 3.2 km (2.0 miles). Bull trout currently occupy approximately 3.5 km (2.2 mi) of spawning/rearing habitat, including a portion of an unnamed tributary to upper Long Creek, and seasonally use 25.9 km (16.1 mi) of FMO habitat. Brook trout also inhabit Long Creek and have been the focus of periodic removal efforts. No recent statistically rigorous population estimate has been completed for Long Creek; however, the 2002 Draft Bull Trout Recovery Plan reported a population estimate of 842 individuals (FWS 2002b). Currently unoccupied habitat is needed to establish additional local populations, although brook trout are widespread in this core area and their management will need to be considered in future recovery efforts. In 2014, the Klamath Falls Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service) established an agreement with the U.S. Geological Survey to undertake a structured decision making process to assist with recovery planning of bull trout populations in the Sycan River core area (FWS 2015b, p. B-6).

[2] Resident: Life history pattern of residing in tributary streams for the fish's entire life without migrating.

Upper Sprague River Core Area
The Upper Sprague River core area comprises five bull trout local populations, placing the core area at an intermediate risk of extinction. The five local populations include Boulder Creek, Dixon Creek, Deming Creek, Leonard Creek, and Brownsworth Creek. These local populations may face a higher risk of extirpation because not all are interconnected. Bull trout local populations in this core area are genetically distinct from those in the other two Klamath Recovery Unit core areas (FWS 2008b). Migratory bull trout have occasionally been observed in the North Fork Sprague River (FWS 2002b). Therefore, this core area also is essential for recovery in that bull trout here exhibit a resident life history and likely a fluvial life history, which are important for conserving diverse life history expression in the Klamath Recovery Unit as discussed above for the Sycan River core area.

The Upper Sprague River core area population of bull trout has experienced a decline from historic levels, although less is known about historic occupancy in this core area. Bull trout are reported to have historically occupied the South Fork Sprague River, but are now extirpated from this location (Buchanan *et al.* 1997). The remaining five populations have received focused attention. Both brown trout (*Salmo trutta*) and brook trout co-occur with bull trout and exist in adjacent habitats. Efforts have been made to increase connectivity of existing bull trout populations by replacing culverts that create barriers. Thus, over the past few generations, these populations have likely been stable and increased in distribution. Population abundance has been estimated recently for Boulder Creek (372 + 62 percent; Hartill and Jacobs 2007), Dixon Creek (20 + 60 percent; Hartill and Jacobs 2007), Deming Creek (1,316 + 342; Moore 2006), and Leonard Creek (363 + 37 percent; Hartill and Jacobs 2007). No statistically rigorous population estimate has been completed for the Brownsworth Creek local population; however, the 2002 Draft Bull Trout Recovery Plan reported a population estimate of 964 individuals (FWS 2002b). Additional local populations need to be established in currently unoccupied habitat within the Upper Sprague River core area, although brook trout are widespread in this core area and will need to be considered in future recovery efforts (FWS 2015b, p. B-7).

Mid-Columbia Recovery Unit
The Mid-Columbia RU comprises 24 bull trout core areas, as well as 2 historically occupied core areas and 1 research needs area. The Mid-C RU is recognized as an area where bull trout have co-evolved with salmon, steelhead, lamprey, and other fish populations. Reduced fish numbers due to historic overfishing and land management changes have caused changes in nutrient abundance for resident migratory fish like the bull trout. The recovery unit is located within eastern Washington, eastern Oregon, and portions of central Idaho. Major drainages include the Methow River, Wenatchee River, Yakima River, John Day River, Umatilla River, Walla Walla River, Grande Ronde River, Imnaha River, Clearwater River, and smaller drainages along the Snake River and Columbia River FWS 2015c, p. C-1).

The Mid-Columbia RU can be divided into four geographic regions the Lower Mid-Columbia, which includes all core areas that flow into the Columbia River below its confluence with the Snake River; 2) the Upper Mid-Columbia, which includes all core areas that flow into the Columbia River above its confluence with the Snake River; 3) the Lower

Snake, which includes all core areas that flow into the Snake River between its confluence with the Columbia River and Hells Canyon Dam; and 4) the Mid-Snake, which includes all core areas in the Mid-C RU that flow into the Snake River above Hells Canyon Dam. These geographic regions are composed of neighboring core areas that share similar bull trout genetic, geographic (hydrographic), and/or habitat characteristics. Conserving bull trout in geographic regions allows for the maintenance of broad representation of genetic diversity, provides neighboring core areas with potential source populations in the event of local extirpations, and provides a broad array of options among neighboring core areas to contribute recovery under uncertain environmental change FWS 2015c, pp. C-1-2).

The current demographic status of bull trout in the Mid-Columbia Recovery Unit is highly variable at both the RU and geographic region scale. Some core areas, such as the Umatilla, Asotin, and Powder Rivers, contain populations so depressed they are likely suffering from the deleterious effects of small population size. Conversely, strongholds do exist within the recovery unit, predominantly in the Lower Snake geographic area. Populations in the Imnaha, Little Minam, Clearwater, and Wenaha Rivers are likely some of the most abundant. These populations are all completely or partially within the bounds of protected wilderness areas and have some of the most intact habitat in the recovery unit. Status in some core areas is relatively unknown, but all indications in these core areas suggest population trends are declining, particularly in the core areas of the John Day Basin (FWS 2015c, p. C-5).

Lower Mid-Columbia Region

In the Lower Mid-Columbia Region, core areas are distributed along the western portion of the Blue Mountains in Oregon and Washington. Only one of the six core areas is located completely in Washington. Demographic status is highly variable throughout the region. Status is the poorest in the Umatilla and Middle Fork John Day Core Areas. However, the Walla Walla River core area contains nearly pristine habitats in the headwater spawning areas and supports the most abundant populations in the region. Most core areas support both a resident and fluvial life history; however, recent evidence suggests a significant decline in the resident and fluvial life history in the Umatilla River and John Day core areas respectively. Connectivity between the core areas of the Lower Mid-Columbia Region is unlikely given conditions in the connecting FMO habitats. Connection between the Umatilla, Walla Walla and Touchet core areas is uncommon but has been documented, and connectivity is possible between core areas in the John Day Basin. Connectivity between the John Day core areas and Umatilla/Walla Walla/Touchet core areas is unlikely (FWS 2015c, pp. C-5-6).

Upper Mid-Columbia Region

In the Upper Mid-Columbia Region, core areas are distributed along the eastern side of the Cascade Mountains in Central Washington. This area contains four core areas (Yakima, Wenatchee, Entiat, and Methow), the Lake Chelan historic core area, and the Chelan River, Okanogan River, and Columbia River FMO areas. The core area populations are generally considered migratory, though they currently express both migratory (fluvial and adfluvial) and resident forms. Residents are located both above and below natural barriers (*i.e.*, Early Winters Creek above a natural falls; and Ahtanum in the Yakima likely due to long lack of connectivity from irrigation withdrawal). In terms of uniqueness and connectivity, the genetics baseline, radio-telemetry, and PIT tag studies identified unique local populations in all core areas. Movement patterns within the core areas; between the lower river, lakes, and other core areas; and between the Chelan, Okanogan, and Columbia River FMO occurs regularly for some of the Wenatchee, Entiat, and Methow core area populations. This type of connectivity has been displayed by one or more fish, typically in non-spawning movements within FMO. More recently, connectivity has been observed between the Entiat and Yakima core areas by a juvenile bull trout tagged in the Entiat moving in to the Yakima at Prosser Dam and returning at an adult size back to the Entiat. Genetics baselines identify unique populations in all four core areas FWS 2015c, p. C-6).

The demographic status is variable in the Upper-Mid Columbia region and ranges from good to very poor. The U.S. Fish and Wildlife Service (Service) 2008 5-year Review and Conservation Status Assessment described the Methow and Yakima at risk, with a rapidly declining trend. The Entiat was listed at risk with a stable trend, and the Wenatchee as having a potential risk, and with a stable trend. Currently, the Entiat is considered to be declining rapidly due to much reduced redd counts. The Wenatchee is able to exhibit all freshwater life histories with connectivity to Lake Wenatchee, the Wenatchee River and all its local populations, and to the Columbia River and/or other core areas in the region. In the Yakima core area some populations exhibit life history forms different from what they were historically. Migration between local populations and to and from spawning habitat is generally prevented or impeded by headwater storage dams on irrigation reservoirs, connectivity between tributaries and reservoirs, and within lower portions of spawning and rearing habitat and the mainstem Yakima River due to changed flow patterns, low instream flows, high water temperatures, and other habitat impediments. Currently, the connectivity in the Yakima Core area is truncated to the degree that not all populations are able to contribute gene flow to a functional metapopulation (FWS 2015c, pp. C-6-7)

Lower Snake Region
Demographic status is variable within the Lower Snake Region. Although trend data are lacking, several core areas in the Grande Ronde Basin and the Imnaha core area are thought to be stable. The upper Grande Ronde Core Area is the exception where population abundance is considered depressed. Wenaha, Little Minam, and Imnaha are strongholds (as mentioned above), as are most core areas in the Clearwater River basin. Most core areas contain populations that express both a resident and fluvial life history strategy. There is potential that some bull trout in the upper Wallowa River are adfluvial. There is potential for connectivity between core areas in the Grande Ronde basin, however conditions in FMO are limiting (FWS 2015c, p. C-7).

Middle Snake Region
In the Middle Snake Region, core areas are distributed along both sides of the Snake River above Hells Canyon Dam. The Powder River and Pine Creek basins are in Oregon and Indian Creek and Wildhorse Creek are on the Idaho side of the Snake River. Demographic status of the core areas is poorest in the Powder River Core Area where populations are highly fragmented and severely depressed. The East Pine Creek population in the Pine-Indian- Wildhorse core area is likely the most abundant within the region. Populations in

both core areas primarily express a resident life history strategy; however, some evidence suggests a migratory life history still exists in the Pine Creek-Indian-Wildhorse core area. Connectivity is severely impaired in the Middle Snake Region. Dams, diversions and temperature barriers prevent movement among populations and between core areas. Brownlee Dam isolates bull trout in Wildhorse Creek from other populations (FWS 2015c, p. C-7).

Columbia Headwaters Recovery Unit

The Columbia Headwaters Recovery Unit (CHRU) includes western Montana, northern Idaho, and the northeastern corner of Washington. Major drainages include the Clark Fork River basin and its Flathead River contribution, the Kootenai River basin, and the Coeur d'Alene Lake basin. In this implementation plan for the CHRU we have slightly reorganized the structure from the 2002 Draft Recovery Plan, based on latest available science and fish passage improvements that have rejoined previously fragmented habitats. We now identify 35 bull trout core areas (compared to 47 in 2002) for this recovery unit. Fifteen of the 35 are referred to as "complex" core areas as they represent large interconnected habitats, each containing multiple spawning streams considered to host separate and largely genetically identifiable local populations. The 15 complex core areas contain the majority of individual bull trout and the bulk of the designated critical habitat (FWS 2010).

However, somewhat unique to this recovery unit is the additional presence of 20 smaller core areas, each represented by a single local population. These "simple" core areas are found in remote glaciated headwater basins, often in Glacier National Park or federally-designated wilderness areas, but occasionally also in headwater valley bottoms. Many simple core areas are upstream of waterfalls or other natural barriers to fish migration. In these simple core areas bull trout have apparently persisted for thousands of years despite small populations and isolated existence. As such, simple core areas meet the criteria for core area designation and continue to be valued for their uniqueness, despite limitations of size and scope. Collectively, the 20 simple core areas contain less than 3 percent of the total bull trout core area habitat in the CHRU, but represent significant genetic and life history diversity (Meeuwig *et al.* 2010). Throughout this recovery unit implementation plan, we often separate our analyses to distinguish between complex and simple core areas, both in respect to threats as well as recovery actions (FWS 2015d, pp. D-1-2).

In order to effectively manage the RUIP structure in this large and diverse landscape, the core areas have been separated into the following five natural geographic assemblages.

Upper Clark Fork Geographic Region

Starting at the Clark Fork River headwaters, the *Upper Clark Fork Geographic Region* comprises seven complex core areas, each of which occupies one or more major watersheds contributing to the Clark Fork basin (*i.e.*, Upper Clark Fork River, Rock Creek, Blackfoot River, Clearwater River and Lakes, Bitterroot River, West Fork Bitterroot River, and Middle Clark Fork River core areas) (FWS 2015d, p. D-2).

Lower Clark Fork Geographic Region
The seven headwater core areas flow into the *Lower Clark Fork Geographic Region*, which comprises two complex core areas, Lake Pend Oreille and Priest Lake. Because of the systematic and jurisdictional complexity (three States and a Tribal entity) and the current degree of migratory fragmentation caused by five mainstem dams, the threats and recovery actions in the Lake Pend Oreille (LPO) core area are very complex and are described in three parts. LPO-A is upstream of Cabinet Gorge Dam, almost entirely in Montana, and includes the mainstem Clark Fork River upstream to the confluence of the Flathead River as well as the portions of the lower Flathead River (*e.g.*, Jocko River) on the Flathead Indian Reservation. LPO-B is the Pend Oreille lake basin proper and its tributaries, extending between Albeni Falls Dam downstream from the outlet of Lake Pend Oreille and Cabinet Gorge Dam just upstream of the lake; almost entirely in Idaho. LPO-C is the lower basin (*i.e.*, lower Pend Oreille River), downstream of Albeni Falls Dam to Boundary Dam (1 mile upstream from the Canadian border) and bisected by Box Canyon Dam; including portions of Idaho, eastern Washington, and the Kalispel Reservation (FWS 2015d, p. D-2).

Historically, and for current purposes of bull trout recovery, migratory connectivity among these separate fragments into a single entity remains a primary objective.

Flathead Geographic Region
The *Flathead Geographic Region* includes a major portion of northwestern Montana upstream of Kerr Dam on the outlet of Flathead Lake. The complex core area of Flathead Lake is the hub of this area, but other complex core areas isolated by dams are Hungry Horse Reservoir (formerly South Fork Flathead River) and Swan Lake. Within the glaciated basins of the Flathead River headwaters are 19 simple core areas, many of which lie in Glacier National Park or the Bob Marshall and Great Bear Wilderness areas and some of which are isolated by natural barriers or other features (FWS 2015d, p. D-2).

Kootenai Geographic Region
To the northwest of the Flathead, in an entirely separate watershed, lies the *Kootenai Geographic Region*. The Kootenai is a uniquely patterned river system that originates in southeastern British Columbia, Canada. It dips, in a horseshoe configuration, into northwest Montana and north Idaho before turning north again to re-enter British Columbia and eventually join the Columbia River headwaters in British Columbia. The *Kootenai Geographic Region* contains two complex core areas (Lake Koocanusa and the Kootenai River) bisected since the 1970's by Libby Dam, and also a single naturally isolated simple core area (Bull Lake). Bull trout in both of the complex core areas retain strong migratory connections to populations in British Columbia (FWS 2015d, p. D-3).

Coeur d'Alene Geographic Region
Finally, the *Coeur d'Alene Geographic Region* consists of a single, large complex core area centered on Coeur d'Alene Lake. It is grouped into the CHRU for purposes of physical and ecological similarity (adfluvial bull trout life history and nonanadromous linkage) rather than due to watershed connectivity with the rest of the CHRU, as it flows into the mid-Columbia River far downstream of the Clark Fork and Kootenai systems (FWS 2015d, p. D-3).

Upper Snake Recovery Unit

The Upper Snake Recovery Unit includes portions of central Idaho, northern Nevada, and eastern Oregon. Major drainages include the Salmon River, Malheur River, Jarbidge River, Little Lost River, Boise River, Payette River, and the Weiser River. The Upper Snake Recovery Unit contains 22 bull trout core areas within 7 geographic regions or major watersheds: Salmon River (10 core areas, 123 local populations), Boise River (2 core areas, 29 local populations), Payette River (5 core areas, 25 local populations), Little Lost River (1 core area, 10 local populations), Malheur River (2 core areas, 8 local populations), Jarbidge River (1 core area, 6 local populations), and Weiser River (1 core area, 5 local populations). The Upper Snake Recovery Unit includes a total of 206 local populations, with almost 60 percent being present in the Salmon River watershed (FWS 2015e, p. E-1).

Three major bull trout life history expressions are present in the Upper Snake Recovery Unit, adfluvial[3], fluvial[4], and resident populations. Large areas of intact habitat exist primarily in the Salmon drainage, as this is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation uses or instream barriers. Bull trout in the Salmon basin share a genetic past with bull trout elsewhere in the Upper Snake Recovery Unit. Historically, the Upper Snake Recovery Unit is believed to have largely supported the fluvial life history form; however, many core areas are now isolated or have become fragmented watersheds, resulting in replacement of the fluvial life history with resident or adfluvial forms. The Weiser River, Squaw Creek, Pahsimeroi River, and North Fork Payette River core areas contain only resident populations of bull trout (FWS 2015e, pp. E-1-2).

Salmon River

The Salmon River basin represents one of the few basins that are still free-flowing down to the Snake River. The core areas in the Salmon River basin do not have any major dams and a large extent (approximately 89 percent) is federally managed, with large portions of the Middle Fork Salmon River and Middle Fork Salmon River - Chamberlain core areas occurring within the Frank Church River of No Return Wilderness. Most core areas in the Salmon River basin contain large populations with many occupied stream segments. The Salmon River basin contains 10 of the 22 core areas in the Upper Snake Recovery Unit and contains the majority of the occupied habitat. Over 70 percent of occupied habitat in the Upper Snake Recovery Unit occurs in the Salmon River basin as well as 123 of the 206 local populations. Connectivity between core areas in the Salmon River basin is intact; therefore it is possible for fish in the mainstem Salmon to migrate to almost any Salmon River core area or even the Snake River.

Connectivity within Salmon River basin core areas is mostly intact except for the Pahsimeroi River and portions of the Lemhi River. The Upper Salmon River, Lake Creek, and Opal Lake core areas contain adfluvial populations of bull trout, while most of the

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[3] Adfluvial: Life history pattern of spawning and rearing in tributary streams and migrating to lakes or reservoirs to mature.

[4] Fluvial: Life history pattern of spawning and rearing in tributary streams and migrating to larger rivers to mature.

remaining core areas contain fluvial populations; only the Pahsimeroi contains strictly resident populations. Most core areas appear to have increasing or stable trends but trends are not known in the Pahsimeroi, Lake Creek, or Opal Lake core areas. The Idaho Department of Fish and Game reported trend data from 7 of the 10 core areas. This trend data indicated that populations were stable or increasing in the Upper Salmon River, Lemhi River, Middle Salmon River-Chamberlain, Little Lost River, and the South Fork Salmon River (IDFG 2008). Trends were stable or decreasing in the Little-Lower Salmon River, Middle Fork Salmon River, and the Middle Salmon River-Panther (IDFG 2008).

Boise River
In the Boise River basin, two large dams are impassable barriers to upstream fish movement: Anderson Ranch Dam on the South Fork Boise River, and Arrowrock Dam on the mainstem Boise River. Fish in Anderson Ranch Reservoir have access to the South Fork Boise River upstream of the dam. Fish in Arrowrock Reservoir have access to the North Fork Boise River, Middle Fork Boise River, and lower South Fork Boise River. The Boise River basin contains 2 of the 22 core areas in the Upper Snake Recovery Unit. The core areas in the Boise River basin account for roughly 12 percent of occupied habitat in the Upper Snake Recovery Unit and contain 29 of the 206 local populations. Approximately 90 percent of both Arrowrock and Anderson Ranch core areas are federally owned; most lands are managed by the Forest Service, with some portions occurring in designated wilderness areas. Both the Arrowrock core area and the Anderson Ranch core area are isolated from other core areas. Both core areas contain fluvial bull trout that exhibit adfluvial characteristics and numerous resident populations. The Idaho Department of Fish and Game in 2014 determined that the Anderson Ranch core area had an increasing trend while trends in the Arrowrock core area is unknown (FWS 2015e).

Payette River
The Payette River basin contains three major dams that are impassable barriers to fish: Deadwood Dam on the Deadwood River, Cascade Dam on the North Fork Payette River, and Black Canyon Reservoir on the Payette River. Only the Upper South Fork Payette River and the Middle Fork Payette River still have connectivity, the remaining core areas are isolated from each other due to dams. Both fluvial and adfluvial life history expression are still present in the Payette River basin but only resident populations are present in the Squaw Creek and North Fork Payette River core areas. The Payette River basin contains 5 of the 22 core areas and 25 of the 206 local populations in the recovery unit. Less than 9 percent of occupied habitat in the recovery unit is in this basin. Approximately 60 percent of the lands in the core areas are federally owned and the majority is managed by the Forest Service. Trend data are lacking and the current condition of the various core areas is unknown, but there is concern due to the current isolation of three (North Fork Payette River, Squaw Creek, Deadwood River) of the five core areas; the presence of only resident local populations in two (North Fork Payette River, Squaw Creek) of the five core areas; and the relatively low numbers present in the North Fork core area (FWS 2015e, p. E-8).

Jarbidge River
The Jarbidge River core area contains two major fish barriers along the Bruneau River: the Buckaroo diversion and C. J. Strike Reservoir. Bull trout are not known to migrate down to

the Snake River. There is one core area in the basin, with populations in the Jarbidge River; this watershed does not contain any barriers. Approximately 89 percent of the Jarbidge core area is federally owned. Most lands are managed by either the Forest Service or Bureau of Land Management. A large portion of the core area is within the Bruneau-Jarbidge Wilderness area. A tracking study has documented bull trout population connectivity among many of the local populations, in particular between West Fork Jarbidge River and Pine Creek. Movement between the East and West Fork Jarbidge River has also been documented; therefore both resident and fluvial populations are present. The core area contains six local populations and 3 percent of the occupied habitat in the recovery unit. Trend data are lacking within this core area (FWS 2015e, p. E-9).

Little Lost River

The Little Lost River basin is unique in that the watershed is within a naturally occurring hydrologic sink and has no connectivity with other drainages. A small fluvial population of bull trout may still exist, but it appears that most populations are predominantly resident populations. There is one core area in the Little Lost basin, and approximately 89 percent of it is federally owned by either the Forest Service or Bureau of Land Management. The core area contains 10 local populations and less than 3 percent of the occupied habitat in the recovery unit. The current trend condition of this core area is likely stable, with most bull trout residing in Upper Sawmill Canyon (IDFG 2014).

Malheur River

The Malheur River basin contains major dams that are impassable to fish. The largest are Warm Springs Dam, impounding Warm Springs Reservoir on the mainstem Malheur River, and Agency Valley Dam, impounding Beulah Reservoir on the North Fork Malheur. The dams result in two core areas that are isolated from each other and from other core areas. Local populations in the two core areas are limited to habitat in the upper watersheds. The Malheur River basin contains 2 of the 22 core areas and 8 of the 206 local populations in the recovery unit. Fluvial and resident populations are present in both core areas while adfluvial populations are present in the North Fork Malheur. This basin contains less than 3 percent of the occupied habitat in the recovery unit, and approximately 60 percent of lands in the two core areas are federally owned. Trend data indicates that populations are declining in both core areas (FWS 2015e, p. E-9).

Weiser River

The Weiser River basin contains local populations that are limited to habitat in the upper watersheds. The Weiser River basin contains only a single core area that consists of 5 of the 206 local populations in the recovery unit. Local populations occur in only three stream complexes in the upper watershed: 1) Upper Hornet Creek, 2) East Fork Weiser River, and 3) Upper Little Weiser River. These local populations include only resident life histories. This basin contains less than 2 percent of the occupied habitat in the recovery unit, and approximately 44 percent of lands are federally owned. Trend data from the Idaho Department of Fish and Game indicate that the populations in the Weiser core area are increasing (IDFG 2014) but it is considered vulnerable because local populations are isolated and likely do not express migratory life histories (FWS 2015e, p.E-10).

St. Mary Recovery Unit

The Saint Mary Recovery Unit is located in northwest Montana east of the Continental Divide and includes the U.S. portions of the Saint Mary River basin, from its headwaters to the international boundary with Canada at the 49th parallel. The watershed and the bull trout population are linked to downstream aquatic resources in southern Alberta, Canada; the U.S. portion includes headwater spawning and rearing (SR) habitat in the tributaries and a portion of the foraging, migrating, and overwintering (FMO) habitat in the mainstem of the Saint Mary River and Saint Mary lakes (Mogen and Kaeding 2001).

The Saint Mary Recovery Unit comprises four core areas; only one (Saint Mary River) is a complex core area with five described local bull trout populations (Divide, Boulder, Kennedy, Otatso, and Lee Creeks). Roughly half of the linear extent of available FMO habitat in the mainstem Saint Mary system (between Saint Mary Falls at the upstream end and the downstream Canadian border) is comprised of Saint Mary and Lower Saint Mary Lakes, with the remainder in the Saint Mary River. The other three core areas (Slide Lakes, Cracker Lake, and Red Eagle Lake) are simple core areas. Slide Lakes and Cracker Lake occur upstream of seasonal or permanent barriers and are comprised of genetically isolated single local bull trout populations, wholly within Glacier National Park, Montana. In the case of Red Eagle Lake, physical isolation does not occur, but consistent with other lakes in the adjacent Columbia Headwaters Recovery Unit, there is likely some degree of spatial separation from downstream Saint Mary Lake. As noted, the extent of isolation has been identified as a research need (FWS 2015f, p. F-1).

Bull trout in the Saint Mary River complex core area are documented to exhibit primarily the migratory fluvial life history form (Mogen and Kaeding 2005a, 2005b), but there is doubtless some occupancy (though less well documented) of Saint Mary Lakes, suggesting a partly adfluvial adaptation. Since lake trout and northern pike are both native to the Saint Mary River system (headwaters of the South Saskatchewan River drainage draining to Hudson Bay), the conventional wisdom is that these large piscivores historically outcompeted bull trout in the lacustrine environment (Donald and Alger 1993, Martinez *et al.* 2009), resulting in a primarily fluvial niche and existence for bull trout in this system. This is an untested hypothesis and additional research into this aspect is needed (FWS 2015f, p. F-3).

Bull trout populations in the simple core areas of the three headwater lake systems (Slide, Cracker, and Red Eagle Lakes) are, by definition, adfluvial; there are also resident life history components in portions of the Saint Mary River system such as Lower Otatso Creek (Mogen and Kaeding 2005a), further exemplifying the overall life history diversity typical of bull trout. Mogen and Kaeding (2001) reported that bull trout continue to inhabit nearly all suitable habitats accessible to them in the Saint Mary River basin in the United States. The possible exception is portions of Divide Creek, which appears to be intermittently occupied despite a lack of permanent migratory barriers, possibly due to low population size and erratic year class production (FWS 2015f, p. F-3).

It should be noted that bull trout are found in minor portions of two additional U.S. watersheds (Belly and Waterton rivers) that were once included in the original draft recovery plan (FWS 2002) but are no longer considered core areas in the final recovery plan (FWS 2015) and are not addressed in that document. In Alberta, Canada, the Saint Mary River bull trout population is considered at "high risk," while the Belly River is rated as "at risk" (ACA 2009). In the Belly River drainage, which enters the South Saskatchewan system downstream of the Saint Mary River in Alberta, some bull trout spawning is known to occur on either side of the international boundary. These waters are in the drainage immediately west of the Saint Mary River headwaters. However, the U.S. range of this population constitutes only a minor headwater migratory SR segment of an otherwise wholly Canadian population, extending less than 1 mile (0.6 km) into backcountry waters of Glacier National Park. The Belly River population is otherwise totally dependent on management within Canadian jurisdiction, with no natural migratory connection to the Saint Mary (FWS 2015f, p. F-3).

Current status of bull trout in the Saint Mary River core area (U.S.) is considered strong (Mogen 2013). Migratory bull trout redd counts are conducted annually in the two major SR streams, Boulder and Kennedy creeks. Boulder Creek redd counts have ranged from 33 to 66 in the past decade, with the last 4 counts all 53 or higher. Kennedy Creek redd counts are less robust, ranging from 5 to 25 over the last decade, with a 2014 count of 20 (FWS 2015f, p. F-3).

Generally, the demographic status of the Saint Mary River core area is believed to be good, with the exception of the Divide Creek local population. In this local population, there is evidence that a combination of ongoing habitat manipulation (Smillie and Ellerbroek 1991,F-5 NPS 1992) resulting in occasional historical passage issues, combined with low and erratic recruitment (DeHaan *et al.* 2011) has caused concern for the continuing existence of the local population.

While less is known about the demographic status of the three simple cores where redd counts are not conducted, all three appear to be self-sustaining and fluctuating within known historical population demographic bounds. Of the three simple core areas, demographic status in Slide Lakes and Cracker Lake appear to be functioning appropriately, but the demographic status in Red Eagle Lake is less well documented and believed to be less robust (FWS 2015f, p. F-3).

2.1.6 Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, pp. 2-3; Schill 1992, p. 42; Thomas 1992, entire; Ziller 1992, entire; Rieman and McIntyre 1993, p. 1; Newton and Pribyl 1994, pp. 4-5; McPhail and Baxter 1996, p. 1). Several local extirpations have been documented, beginning in the 1950s (Rode 1990, pp. 26-32; Ratliff and Howell 1992, entire; Donald and Alger 1993, entire; Goetz 1994, p. 1; Newton and Pribyl 1994, pp. 8-9; Light et al. 1996, pp. 6-7; Buchanan et al. 1997, p. 15; WDFW 1998, pp. 2-3). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Rode 1990, p. 32). Bull trout have been functionally extirpated (i.e., few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (FWS 1998, pp. 31651-31652).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include the effects of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987, entire; Chamberlain et al. 1991, entire; Furniss et al. 1991, entire; Meehan 1991, entire; Nehlsen et al. 1991, entire; Sedell and Everest 1991, entire; Craig and Wissmar 1993pp, 18-19; Henjum et al. 1994, pp. 5-6; McIntosh et al. 1994, entire; Wissmar et al. 1994, entire; MBTSG 1995a, p. 1; MBTSG 1995b. pp. i-ii; MBTSG 1995c, pp. i-ii; MBTSG 1995d, p. 22; MBTSG 1995e, p. i; MBTSG 1996a, p. i-ii; MBTSG 1996b, p. i; MBTSG 1996c, p. i; MBTSG 1996d, p. i; MBTSG 1996e, p. i; MBTSG 1996f, p. 11; Light et al. 1996, pp. 6-7; USDA and USDI 1995, p. 2).

2.1.7 Emerging Threats

Climate change was not addressed as a known threat when bull trout was listed. The 2015 bull trout recovery plan and RUIPs summarize the threat of climate change and acknowledges that some extant bull trout core area habitats will likely change (and may be lost) over time due to anthropogenic climate change effects, and use of best available information will ensure future conservation efforts that offer the greatest long-term benefit to sustain bull trout and their required coldwater habitats (FWS 2015, p. vii, and pp. 17-20, FWS 2015a-f).

Global climate change and the related warming of global climate have been well documented (IPCC 2007, entire; ISAB 2007, entire; Combes 2003, entire). Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007, p. 253; Battin et al. 2007, p. 6720), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, entire; Hari et al. 2006, entire; Rieman et al. 2007, entire). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (Magnuson et al. 2000, p. 1743). The range of many species has shifted poleward and elevationally upward. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006, entire).

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 seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007, pp. 15-17). For example, stream gauge data from western Washington over the past 5 to 25 years indicate a marked increasing trend in water temperatures in most major rivers.

Climate change has the potential to profoundly alter the aquatic ecosystems upon which the bull trout depends via alterations in water yield, peak flows, and stream temperature, and an increase in the frequency and magnitude of catastrophic wildfires in adjacent terrestrial habitats (Bisson et al. 2003, pp 216-217).

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact 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 other chars. Ground water temperature is 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 (Baxter 1997, p. 82). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer drier areas such as are found on the eastside of the Cascade Mountains. Bisson et al. (2003, pp. 216-217) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate. 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, pp. 218-219).

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-warming impacts to lakes will likely lead to longer periods of thermal stratification and coldwater fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (Shuter and Meisner 1992. p. 11).

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 are related to 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, p. 6720). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species. Although lower elevation river reaches are not expected to experience as severe an impact from alterations in stream hydrology, they are unlikely to provide suitably cold temperatures for bull trout spawning, incubation and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations. Thermal refugia are important for providing bull trout with patches of suitable habitat during migration through or to make feeding forays into areas with greater than optimal temperatures.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007, p 7) although the scale of that variation may exceed that of States. For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (ISAB 2007, p. 13; Battin et al. 2007, p. 6722; Rieman et al. 2007, pp. 1558-1561). In streams and rivers with temperatures approaching or at the upper limit of allowable water temperatures, there is little if any likelihood that bull trout will be able to adapt to or avoid the effects of climate change/warming. There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As its distribution contracts, patch size decreases and connectivity is truncated, bull trout populations that may be currently connected may face increasing isolation, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007, pp. 1559-1560). Due to variations in land form and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently degraded water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

The ability to assign the effects of gradual global climate change to bull trout or to a specific location on the ground is beyond our technical capabilities at this time.

2.1.8 Conservation Needs
The 2015 recovery plan for bull trout established the primary strategy for recovery of bull trout in the coterminous United States: (1) conserve bull trout so that they are geographically widespread across representative habitats and demographically stable1 in six recovery units; (2) effectively manage and ameliorate the primary threats in each of six recovery units at the core area scale such that bull trout are not likely to become endangered in the foreseeable future; (3) build upon the numerous and ongoing conservation actions implemented on behalf of bull trout since their listing in 1999, and improve our understanding of how various threat factors potentially affect the species; (4) use that information to work cooperatively with our partners to design, fund, prioritize, and implement effective conservation actions in those areas that offer the greatest long-term benefit to sustain bull trout and where recovery can be achieved; and (5) apply adaptive management principles to implementing the bull trout recovery program to account for new information (FWS 2015, p. v.).

Information presented in prior draft recovery plans published in 2002 and 2004 (FWS 2002a, 2004, 2004a) have served to identify recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

The 2015 recovery plan (FWS 2015) integrates new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and integrates and updates previous bull trout recovery planning efforts across the range of the single DPS listed under the Act.

The Service has developed a recovery approach that: (1) focuses on the identification of and effective management of known and remaining threat factors to bull trout in each core area; (2) acknowledges that some extant bull trout core area habitats will likely change (and may be lost) over time; and (3) identifies and focuses recovery actions in those areas where success is likely to meet our goal of ensuring the certainty of conservation of genetic diversity, life history features, and broad geographical representation of remaining bull trout populations so that the protections of the Act are no longer necessary (FWS 2015, p. 45-46).

To implement the recovery strategy, the 2015 recovery plan establishes categories of recovery actions for each of the six Recovery Units (FWS 2015, p. 50-51):

1. Protect, restore, and maintain suitable habitat conditions for bull trout.
2. Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.
3. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.
4. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

Bull trout recovery is based on a geographical hierarchical approach. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. The single DPS is subdivided into six biologically-based recover units: (1) Coastal Recovery Unit; (2) Klamath Recovery Unit; (3) Mid-Columbia Recovery Unit; (4) Upper Snake Recovery Unit; (5) Columbia Headwaters Recovery Unit; and (6) Saint Mary Recovery Unit (FWS 2015, p. 23). A viable recovery unit should demonstrate that the three primary principles of biodiversity have been met: representation (conserving the genetic makeup of the species); resiliency (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to withstand catastrophic events) (FWS 2015, p. 33).

Each of the six recovery units contain multiple bull trout core areas, 116 total, which are non-overlapping watershed-based polygons, and each core area includes one or more local populations. Currently there are 109 occupied core areas, which comprise 611 local populations (FWS 2015, p. 3). There are also six core areas where bull trout historically occurred but are now extirpated, and one research needs area where bull trout were known to occur historically, but their current presence and use of the area are uncertain (FWS 2015, p. 3).Core areas can be further described as complex or simple (FWS 2015, p. 3-4). Complex core areas contain multiple local bull trout populations, are found in large watersheds, have multiple life history forms, and have migratory connectivity between spawning and rearing habitat and foraging, migration, and overwintering habitats (FMO). Simple core areas are those that contain one bull trout local population. Simple core areas are small in scope, isolated from other core areas by natural barriers, and may contain unique genetic or life history adaptations.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system (FWS 2015, p. 73). A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (e.g., those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

Population Units

The final recovery plan (FWS 2015) designates six bull trout recovery units as described above. These units replace the 5 interim recovery units previously identified (FWS 1999a). The Service will address the conservation of these final recovery units in our section 7(a)(2) analysis for proposed Federal actions. The recovery plan (FWS 2015, identified threats and factors affecting the bull trout within these units. A detailed description of recovery implementation for each recovery unit is provided in separate recovery unit implementation plans (RUIPs)(FWS 2015a-f), which identify conservation actions and recommendations needed for each core area, forage/ migration/ overwinter (FMO) areas, historical core areas, and research needs areas and are herein incorporated by reference.

Tribal Conservation Activities

Many tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

2.3 Status of Bull Trout Critical Habitat

2.3.1 Current legal status of critical habitat

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (USFWS 2010a, entire); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Coastal, Klamath, Mid-Columbia, Upper Snake, Columbia Headwaters and St. Mary's Recovery Unit population segments. Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

The final rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in

Table 1. Stream/Shoreline Distance and Reservoir/Lake Area Designated as Bull Trout Critical Habitat.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir/Lake Acres	Reservoir/Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon[1]	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho[2]	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total[3]	19,729.0	31,750.8	488,251.7	197,589.2

[1]No shore line is included in Oregon
[2]Pine Creek Drainage which falls within Oregon
[3]Total of freshwater streams: 18,975

several areas not occupied at the time of listing. No unoccupied habitat was included in the2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the FWS; or 3) waters where impacts to national security have been identified (FWS 2010a, p. 63903). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

2.3.2 The Physical and Biological Features (PBFs)

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (FWS 2010, p. 63898). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the revised rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with physical and biological features (PBFs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

Physical and Biological Features for Bull Trout

Within the designated critical habitat areas, the PBFs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the PBFs, as described within FWS 2010, are essential for the conservation of bull trout. A summary of those PBFs follows.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
2. Migration 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 that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.
5. Water temperatures ranging from 2 °C to 15 °C, with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
6. In spawning and rearing areas, substrate 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 of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PBF's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PBF to address the presence of nonnative predatory or competitive fish species. Although this PBF applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PBFs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PBFs 1 and 6. Additionally, all except PBF 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full- pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean low low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by no longer serving the intended conservation role for the species or retaining those PBFs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PBFs to such an extent that the conservation value of critical habitat is appreciably reduced (FWS 2010, pp. 63898:63943; FWS 2004a, pp. 140-193; FWS 2004b, pp. 69-114). The Service's evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (FWS and NMFS 1998, Ch. 4 p. 39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (FWS 2010, pp. 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (FWS 2010, pp. 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (Ratliff and Howell 1992, entire; Schill 1992, p. 40; Thomas 1992, p. 28; Buchanan et al. 1997, p. vii; Rieman et al. 1997, pp. 15-16; Quigley and Arbelbide 1997, pp. 1176-1177). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (FWS 1998, pp. 31648-31649; FWS 1999b, p. 17111).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PBFs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat
One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PBFs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Many of the PBFs for bull trout may be affected by the presence of toxics and/or increased water temperatures within the environment. The effects will vary greatly depending on a number of factors which include which toxic substance is present, the amount of temperature increase, the likelihood that critical habitat would be affected (probability), and the severity and intensity of any effects that might occur (magnitude).

The ability to assign the effects of gradual global climate change bull trout critical habitat or to a specific location on the ground is beyond our technical capabilities at this time.

3.0 ENVIRONMENTAL BASELINE
The preamble to the implementing regulations for section 7 (51 FR 19932; third paragraph, left column) contemplates that the evaluation of "...the present environment in which the species or critical habitat exists, as well as the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat...will serve as the baseline for determining the effects of the action on the species or critical habitat." The regulations at 50 CFR 402.02 define the environmental baseline to include "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process."

The analyses presented in this section supplement the above *Status of the Species* and *Status of Critical Habitat* evaluations by focusing on the current condition of the bull trout and its critical habitat in the action area, the factors responsible for that condition (inclusive of the factors cited above in the regulatory definition of environmental baseline), and the role the action area plays in the survival and recovery of the bull trout and in the recovery support function of designated critical habitat. Relevant factors on lands surrounding the action area that are influencing the condition of the bull trout and its critical habitat were also considered in completing the status and baseline evaluations herein.

Among the most important of these are the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors, poor water quality, angler harvest and poaching, and entrainment. Land management activities that contribute to habitat degradation and fragmentation include the recent and past effects from dams and other diversion structures, forest management practices, livestock grazing, agriculture, road construction and maintenance, mining, and urban and rural development. Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest.

3.1 Status of Bull Trout in the Action Area

The number of bull trout that may be present in or near the action area during the timing of the proposed action is difficult to determine based on available data. High winter river flows in the Columbia River make the detection of bull trout very difficult. Bull trout are known to use the Columbia River as over wintering area (Nelson et al. 2011), but prefer to over winter in tributaries to the Columbia River. Bull trout in the various tributary river basins along the Columbia River are primarily fluvial migrants that overwinter in the middle or lower mainstem sections of river basins (BioAnalysts, Inc. 2002, Nelson 2004, Starcevich et al. 2012). The closest known local bull trout populations to the action area occur in the North Fork Umatilla River and North Fork Meacham Creek (FWS 2010). The mouth of the Umatilla River is located approximately 10 miles downstream of the action area below McNary Dam. Bull trout population and redd counts have been variable and show a declining trend in this river basin since the mid 1990's to the present (ODFW 2005, FWS 2010). Additional known bull trout populations occur approximately 20 miles upstream on the Columbia River in the Walla Walla River basin where the most recent population data indicate bull trout population trends are increasing (ODFW 2005). Movement of bull trout population in both of these river basins is hindered by poor water quality and instream diversions and dams (ODFW 2005). Given this information, the Service anticipates adult and subadult bull trout may occur in the action area during Project activities. There is no bull trout spawning habitat in the action area, therefore, no bull trout eggs, fry or juveniles are expected in the action area.

3.2 Status of Bull Trout Critical Habitat in the Action Area

The action area is located within the bull trout Umatilla River critical habitat unit in the mid-Columbia recovery unit. The Columbia River within this critical habitat unit is important foraging, migration, and over wintering habitat for subadult and adult bull trout (PBF 2). The habitat conditions at the action area do not appear to support preferable habitat conditions for bull trout due to lack of in/over water structures, sandy substrates, and operational disturbance activities at the pumping stations. The shoreline at the project site consists of a steep, sparsely vegetated rip-rap streambank that provides little aquatic habitat complexity. The general topography within the area ranges from relatively level uplands to steep sloping streambanks along the river.

Specifically at the Project site, there are several separate pump station facilities adjacent to the existing irrigation pump station expansion along the Columbia River shoreline. The shoreline, shallow water habitat, and natural vegetation is altered with in-water structures, rock, and riprap. The hydrological dam has created reservoir conditions in the action area, with daily fluctuations in water level. Several irrigation pump stations withdraw water for agricultural purposes and are adjacent to the proposed Project site. Water will continue to be withdrawn using the existing facilities whether or not the pump station and new intake pump station is expanded. The existing water withdrawals are part of the current environmental baseline for the site. The transfer and consolidation of existing water rights, change in point of diversion and new water withdrawals associated with the Project will require instream flow augmentation under the jurisdiction of the OWRD and will result in an overall "zero net increase" in water withdrawals from the Columbia River.

4.0 EFFECTS OF THE ACTION ON THE SPECIES AND DESIGNATED CRITICAL HABITATS

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

At times there are other activities that may be interrelated or interdependent with the proposed action under consideration that could result in additional effects to federally-listed species or their habitat that must be considered along with the action. An interrelated activity is an activity that is part of the proposed action and depends on the action for its justification. An interdependent activity is an activity that has no independent utility apart from the proposed action.

In determining whether the proposed action is likely to jeopardize the recovery and survival of a federally-listed species, the Service analyzes effects of the action and the effects of other activities that are interrelated or interdependent with the action in context with the environmental baseline. All activities under the proposed action are evaluated against and added to the environmental baseline.

4.1 Direct and Indirect Effects to Bull Trout

Effects to bull trout from the Project are largely dependent on the likelihood of fish occurring within the action area, the scope and scale of the excavation activity, and the life stage of the fish. The Service believes there will be very few, if any, adult and/or subadult bull trout present within the action area during Project activities. The Service does not anticipate bull trout egg, fry or juveniles within the action area. Project activities implemented near or below the water's edge can potentially cause the most direct and indirect effects to bull trout. Timing and construction activities can also cause potential effects to species from in-water work. Lethal and sub-lethal effects are often unavoidable where in-water work cannot be conducted at a time or in a manner when the species is not present.

4.1.1 Entrainment

Entrainment may occur if bull trout are trapped in the bucket of the excavator during excavation of in-water substrates at the action area and the proposed mitigation site. The potential for entrainment is largely dependent on the likelihood of fish occurring within the excavation area, the scope and scale of the excavation activity, and the life stage of the fish.

Given the proposed timing of in-water work (December 1 – February 28), location of proposed excavation activities (i.e., near the shoreline), use of an open bucket excavator, and relatively slow speed of excavation; it is reasonably certain that the risk of injury or death of bull trout from proposed excavation activities will be minimal, although not discountable. Adult and sub-adult bull trout (if present) will likely avoid the excavation area.

4.1.2 Sediment/Turbidity
Short-term, localized project-related increases in background turbidity levels will likely occur as a result of proposed excavation and piling installation activities below the OHWM and during the removal of asphalt debris from the proposed mitigation site. Near and instream construction activities required for the proposed action will result in an increase in suspended sediment and possibly contaminants that will cause sub-adult and adult fish to move away from the action area. The soft-start project procedures are also expected to cause bull trout to move away before full construction mode.

Bull trout exposed to suspended sediment are likely to experience gill abrasion, decreased feeding, stress, or be unable to use the action area for a short time, depending on the severity of the suspended sediment release; however, exposure duration is a critical determinant of physical or behavioral turbidity effects. In addition, bull trout have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to seasonal high pulse exposures.

Given the existing substrate conditions (primarily sand), proposed side-casting of excavated substrates (to prevent the loss of native substrate and maintain the slope contour for foraging habitat), timing of in-water work (December 1 – February 28), proposed excavation techniques, and use of a vibratory hammer for piling installation (minimized noise disturbance, less potential for injury to bull trout), it is anticipated that any project related increases in background turbidity will be very limited and highly localized. As such, short-term increases in background turbidity resulting from temporary work below the OHWM are not expected to result in long-term adverse effects to bull trout, or significant net change in function of the in-stream habitat. While increases in turbidity can adversely affect bull trout, it is likely that most fish will move away from this disturbance rather quickly if they have the ability to do so. This is particularly true of adult and subadult bull trout who exhibit extreme sensitivity to sedimentation.

4.1.3 Chemical Contamination
Equipment operating near and over the river channel within the action area and proposed mitigation site represent potential sources of chemical contamination. Accidental spills of construction materials or petroleum products would adversely affect water quality and potentially impact bull trout. Development and implementation of a Pollution Control Plan (PCP) that will include containment measures and spill response for construction-related chemical hazards will significantly reduce the likelihood for chemical releases within the action area.

4.1.4 Alteration of Substrates
The proposed project will result in the alteration of in-water substrates associated with excavation and installation of the new pump cans and pilings and the work at the

mitigation site. Proposed project activities at the pumping station will require approximately 1,028 cubic yards of permanent fill, and 398 cubic yards of permanent removal below the OHWM of the Columbia River, resulting in a net fill of 630 cubic yards (covering an area of 0.066 acre). Sediment (i.e., sand) removed during excavation activities will be side-cast back into the river immediately adjacent to the excavation area in order to prevent the loss of native substrate and maintain the slope contour for foraging habitat. As discussed above, to offset the displacement of shallow water habitat along the shoreline, proposed mitigation activities will include the removal of approximately 0.069 acre of existing in-water concrete and asphalt debris from below the OHWM of Middle Columbia River. The resulting exposed substrates (sand and cobble) under the removed debris will be left in place. The debris removal will expose the native substrate and provide for improved salmonid feeding habitat.

The removal of the 1,028 cubic yards of sediment is expected to produce turbidity (at no more than 10 percent above background levels, tested every 4 hours, per Oregon Department of Environmental Quality (ODEQ) requirements) from the project site as far downstream as 500 feet. This level of turbidity is expected to be less than would otherwise occur because of the following BMPs. We anticipate that adult and subadult bull trout migrating through this area would experience gill abrasion, disorientation, etc., but they will only be exposed for a short period of time. Minor gill abrasion is common in systems that flood in the winter and salmonids are known to heal quickly at the expected levels (NMFS 2011). Therefore, any adverse effects are expected to be temporary and are not expected to result in injury or death of any adult or subadult bull trout.

Forage quantity for bull trout may be temporarily reduced within the immediate in-water work area as benthic organisms become disturbed by piling installation and excavation; however, recolonization of benthic organisms will likely occur within a month following project completion (NMFS 2009).

Given the existing baseline conditions and substrates (primarily course sand), proposed timing of in-water work (outside the peak migration stages), relative size of the action area, and proposed excavation techniques; it is reasonably certain that the proposed alteration of existing substrates will not result in long-term adverse effects to bull trout or their designated critical habitat.

4.4.5 Hydroacoustics

Sound generated by pile driving can affect fish in several ways including behavioral modifications, physical injuries, and ultimately, mortality from those injuries. Pile driving activities can increase underwater ambient noise, pressure, and water particle motion (Carlson et al. 2001, Popper and Hasting 2009). These increases may cause sub-lethal and/or lethal effects on bull trout in the immediate vicinity of this activity. A host of sub-lethal effects to fish have been documented under experimental conditions with pile driving activities (Carlson et al. 2001, Hastings and Popper 2005, Popper and Hastings 2009), including, but not limited to, physical injury (e.g., auditory damage, tissue/vessel damage, blood gases increases) and behavioral changes (e.g., interference with migration/movement, foraging, predator avoidance). Lethal effects (immediate or delayed mortality) can also occur depending on the fish species/life stage, site specific activities, the intensity of the sound, the distance to the fish, and the physical characteristics and mass of the individual fish (Hastings and Popper 2005).

The use of a vibratory hammer is proposed for the installation of all pilings. Compared to impact hammers, vibratory hammers produce sounds of lower intensity, with a rapid repetition rate and longer duration, and with more energy in the lower frequencies (15-26 Hertz (Carlson et al. 2001), therefore, minimizing the anticipated effects to bull trout. The total sound energy imparted by a vibrating hammer can be comparable to impact hammers but since that energy is created over a longer period of time the wave energy is less at any given time, thus causing less injury or impact to nearby fish. During an Oregon study on the use of a vibrating hammer to drive 9-inch diameter x 60-foot long steel piles, Carlson et al. (2001) determined it was unlikely for this activity to cause avoidance response by juvenile salmonids beyond the immediate vicinity (approximately 20-30 feet) from the pile driving site because they did not appear to be bothered enough by the sound at that distance.

NMFS's current pile driving thresholds for "physical injury" to fish include a peak pressure of 206 decibel (dB) and an accumulated sound exposure level (SEL) of 187 dB for fish greater than 2 grams, and 183 dB for fish less than 2 grams. In addition, a 150 dB (root mean squared average or RMS average) "harassment" threshold is applied for potential behavioral effects. Therefore, we expect any bull trout present in the action area to move away from the area instead of sustaining injury. Moving away from an activity like this is not expected to result in death or injury because bull trout routinely change position and locations.

Average unattenuated sound pressures for vibratory driver installation of 12-inch steel pipe and H-type piles can be as much as 171 dB, 155 RMS average and 150 SEL (Caltrans 2015). Using the NMFS Pile Driving Impacts Calculator and associated technical guidance (NMFS 2016), this results in no instantaneous impacts and no cumulative impacts to adult fish (2 grams or greater) outside an 18 meter radius or to juvenile fish (less than 2 grams) outside a 22 meter radius of the pile being driven, assuming a full work day of continuous pile driving (See Appendix A of the Corps BA for more information).
If bull trout were to be present in the action area during pile driving they would be subject to potential injury were they to remain within 22 meters of a pile being driven for sufficient time for repeated small effects to result in injury. However, several authors have suggested that fish attempt to evade areas of high sound pressure (Engås et al. 1996, Engås and Løkkeborg 2002, Slotte et al. 2004, all summarized in Hastings and Popper 2005) and fish that were present would not be expected to remain in the work area. Bull trout present in the action area may have adverse behavioral responses to the sounds of pile driving, including avoidance, but it would be unlikely that this response would be sufficient to alter the fitness of any individual bull trout because any avoidance to the action area is expected to short in duration.

Given the low frequencies, short-term/intermittent nature of the vibratory hammer use (likely up to 2 to 4 hours per day, over the course of an 8 to 10 hour day and proposed conservation measures (i.e., timing of in-water work and daily "soft-start" procedures), it is reasonably certain that impacts to bull trout resulting from vibratory hammer use during piling installation will not result in injury or long-term adverse behavioral effects to either adult or subadult bull trout. The proposed use of a vibratory hammer is anticipated to result in few, if any, sub-lethal and no lethal effects to bull trout. This is based on the low number of subadults and adults that are expected to be within the action area during the in-water work period. Short-term displacement or disturbance of bull trout (e.g., from foraging, resting, or moving through project area) may also be due to equipment and construction noise and/or human presence.

4.4.6 Water Withdrawal

Any water withdrawal or other alteration of streamflow has the potential to impair spawning, migration, feeding, or other essential behavioral patterns of fish. However, the purpose of the proposed Project is to allow the consolidation and transfer of existing and new "mitigated" water rights to a central point of diversion for irrigation needs. As detailed in the proposed action section, the project is associated with the transfer of existing surface irrigation water rights totaling 200 cfs. In addition, the OWRD will require the issuance of 94.11 cfs of new mitigated in-stream water rights. Per the OWRD requirements, the water withdrawal mitigations will result in a "zero" net reduction of instream surface flows from the Columbia River, and thus no effects. If at any time the mitigated flows are not met, irrigation withdrawals will cease. Based on the requirements and conditions of the water rights with OWRD, the Service does not anticipate the transfer and new issuance of water withdrawal permits will result in any reduction in instream surface flow, or result in effects to bull trout in the action area.

Given that the additional water withdrawals will be transferred from existing pumping stations, and that the new water rights will be fully mitigated (i.e., the amount of water withdrawn at the project site will be conserved at or above the withdrawal site); it is anticipated that the proposed additional water withdrawals will have no adverse effects on bull trout or their habitat because the overall amount of water diverted from the river will not change, but will be diverted at one location instead of several. Additionally, the project site provides the same habitat function for bull trout and bull trout critical habitat as the other point locations where water is diverted. Upon project completion, the intake pumps will be operated consistent with state water rights and will typically be in operation during the months of April through October. The maximum allowable water withdrawal rates for the St. Hilaire Brothers and EID pumping stations will be 100 cfs (61.4 existing and 38.6 transferred) and 200 cfs, respectively.

4.4.7 Fish Passage

The proposed new EID pumping station will extend approximately 350 feet out from the shoreline of the Columbia River, and will include installation of an 84-inch diameter by 170-foot long section of intake pipe that will be affixed with four new intake screens (each measuring 5 feet in diameter by approximately 19 feet in length). The new intake pipe will be located along the bottom of the river channel and the new intake screens will be affixed with NMFS-approved slotted fish screen (0.069 inch openings) to insure juvenile salmonids are not impinged or entrained in the intake during pumping operations. The intake screens will also be equipped with an air-burst system to facilitate the cleaning of the screens and maintain the appropriate approach velocity in compliance with NMFS criteria. In addition, given that migrating juvenile salmonids prefer near-shoreline habitats (Simenstad et al. 1982; Healey 1998; Brennan et al. 2004), the proposed distance of the intake screens from the shoreline (approximately 350 feet) should make it less likely to affect migrating juvenile salmonids by eliminating possible shoreline attraction flows.

Based on the proposed depth of the intake pipes (greater than 20 feet), the design (in compliance with NMFS criteria) of the intake, and the width of the Columbia River at the project site (approximately 1 mile wide), it is anticipated that the effects of the proposed project on juvenile fish passage will be minimal. Juvenile bull trout are not expected to occur within the proposed action area (only subadult and adult bull trout) due to the size and flow of the river ; therefore, there is very little potential for impingement of bull trout because larger bull trout are unlikely to become impinged.

4.4.8 Predation

Given the lack of complex habitat structure within the action area, introduction of the new in-water and over-water structures may provide overhead cover and velocity refuge that can attract predators such as northern pikeminnow (*Ptychocheilus oregonensis*), smallmouth bass (*Micropterus dolomieui*), largemouth bass (*M. salmoides*), and piscivorous birds. Proposed mitigation measures to offset the increased overwater cover will include grating approximately 0.037 acre (64 percent) of the new overwater station decks to allow for 60 percent light penetration, and installing waterproof lighting equipped with a daylight sensor under portions of the new concrete deck (0.046 acre) at the proposed EID station to detract predators.

The environmental baseline with the project action area has been degraded by development and human activity, and provides very little foraging and shoaling habitat for bull trout. Therefore, given the existing baseline conditions within the action area and the proposed mitigation measures, it is anticipated that while potential effects of the new in-water/ over-water structures on salmonid predation will be minimal. Juvenile bull trout are not be expected to occur within the proposed action area (only subadult and adult bull trout) due to the size and flow of the river; therefore, there would be no potential for increased predation on bull trout.

4.2 Effects of the Action on Bull Trout Critical Habitat

The proposed action is expected to have a short-term, but limited, adverse effect on PBF 2 (i.e., Migration 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), but to no other PBFs.

Access to migration habitat may be disrupted during construction of the proposed action. The proposed project would drive pipe, H-type, and sheets piles into the substrate of the Middle Columbia River. Noise from the driving of piles would create a temporary disturbance causing fish to avoid the work area. This disturbance would be temporary in nature, limited to the duration of the work window and the daily timing of construction activities and would be unlikely to pose an impediment to bull trout migration. This temporarily intermittent disruption of migration habitat is expected to impact the bull trout CH by temporarily rendering the action area unsuitable for bull trout use.

Water quality will be adversely affected by instream and near stream construction projects. The proposed project would result in short-term, localized increases in turbidity as a result of excavation and the driving of piles and the mitigation site. Given the existing substrate conditions (primarily sand), proposed side-casting of excavated substrates, timing of in-water work (December 1 - February 28), proposed excavation techniques and management practices (e.g., ramp up, etc.), and use of a vibratory hammer for piling installation, it is anticipated the any project related increases in background turbidity will be very limited and highly localized. This limited and highly localized increase in background turbidity will impact bull trout CH by temporarily rendering the action area unsuitable for bull trout use.

In addition, the presence of equipment instream or near lakeshore adds some degree of risk of contamination from lubricants, antifreeze, and hydraulic fluids. These risks are greatly reduced by conservation measures contained in the proposed action and pollution control plan (such as daily leak inspection of equipment, extremal removal of contaminants from equipment used below OHWM, and diapering of equipment within 150 feet of the Columbia River).

There will be short term disturbance of the substrate from the excavations and installation of new pump cans and pilings, but this will be temporary in nature and would not be expected to permanently alter the character of the substrate in the Middle Columbia River. In general, the environmental baseline within the action area has been degraded by development and human activity, and provides very little habitat complexity for bull trout (PBF 4). Given the existing, degraded baseline conditions and substrates (primarily course sand), proposed timing of in-water work (outside the peak migration stages), relative size of the action area, proposed excavation techniques, and use of a vibratory hammer for piling installation, it is reasonably certain that the proposed alteration of existing substrates will not result in long-term adverse effects to the manner in which bull trout use the habitat within the action area.

The proposed project would result in the withdrawal of up to 294 cfs of water from the Middle Columbia River during the months of April through October. Given these water withdrawals will be transferred from existing pumping stations, and that the new water rights will be fully mitigated at or above the point of diversion, we anticipate that the proposed water withdrawals will have negligible effects on the quantity of water available in the Columbia River. Therefore, this project is not likely to adversely affect bull trout water quantity (PBF 8).

Given the above anticipated effects to bull trout critical habitat, the Service has determined that the proposed action will not adversely modify bull trout critical habitat.

4.3 Effects of Interrelated and interdependent Actions

Interrelated actions are those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Both interdependent and interrelated activities are assessed by applying the "but for" test, which asks whether any action and its associated impacts would occur "but for" the action. No interrelated and/or interdependent actions are expected to result from the proposed action because irrigation water rights transferred in association with the proposed action would continue to withdraw instream flow regardless of the expansion and installation of the new intake and pump station.

4.4 Summary of Effect Analysis

Although there is not likely to be many bull trout within the action area, the Service anticipates at least a few individuals (adults and/or subadults) will experience some level of adverse effect from project activities related to increased sediment and turbidity and hydroacoustics. Migration and foraging may be temporarily disrupted and bull trout may be injured or killed. However, the number of bull trout predicted to be injured or killed as result from the proposed action is small and the spatial scope of that injury will not have a meaningful impact on reproduction, numbers or distribution of bull trout. These adverse effects to bull trout and its critical habitat will be minimized, to the extent possible, by implementing conservation measure as listed in the BA.

5.0 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. The Service assumes that future non-Federal, state, and private activities will continue at similar intensities as in recent years.

Major effects to listed resources in the action area are primarily the result of urban development, the construction of the FCRPS, agriculture, and associated water diversion and water control activities. Additional effects to the Middle Columbia River would result from an increase in recreational and commercial use of the area. Recreation in the area includes fishing, hunting, boating, bird watching, and swimming, while commercial activities are dominated by year round barge traffic.

Future actions that may contribute to cumulative effects include additional residential development along the Columbia River, although the terrain, land ownership, and zoning may limit the extent of development. Increased impervious surfaces could add to runoff that may contribute additional oils, pesticides, fertilizers, and hazardous wastes to fish-bearing waters, including the action area.

When considered together, these cumulative effects are likely to have a small negative effect on bull trout population abundance, productivity, and some short-term negative effects on spatial structure (short-term blockages of fish passage). Similarly, the condition of critical habitat PBF will be slightly degraded by the cumulative effects.

6.0 CONCLUSION

After reviewing the current status of the bull trout and bull trout critical habitat, the environmental baseline within the action area, the direct and indirect effects of the proposed action, and cumulative effects, it is Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of bull trout or result in the destruction or adverse modification of bull trout critical habitat.

The Service reached these conclusions for the following reasons:

- In-water work windows, timing, and duration of projects are expected to minimize direct and indirect effects to bull trout from project activities such that very few individuals are expected to be injured.
- Conservation measures incorporated into the proposed action are expected to minimize direct and indirect effects to bull trout from project activities.
- Only short-term adverse effects to aquatic and terrestrial habitats are anticipated (e.g., water quality, channel dynamics, and overall watershed conditions and functions), including bull trout critical habitat.
- The amount of injured or killed bull trout predicted to result from the proposed action is small and the spatial scope of that injury will not have a meaningful impact on reproduction, numbers or distribution of bull trout.
- The conservation measures described in the proposed action are expected to minimize the extent and duration of habitat effects, such that it is unlikely that the function or conservation role of the critical habitat will be adversely affected in the long-term by the proposed activity.

7.0 INCIDENTAL TAKE STATEMENT

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 the 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 that create the likelihood of injury to listed species 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, carrying out of an otherwise lawful activity.

Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, take that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

7.1 Amount or Extent of Take
Although the Service anticipates a low number of bull trout may be incidentally harmed and harassed as a result of the proposed action, the amount of take is difficult to determine because the presence and number of bull trout is difficult to ascertain within the action area. Detecting an impaired or dead individual is highly unlikely in this area because of the depth of the project and the river's flow. For instance, an injured fish would be extremely difficult to find in order to quantify incidental take. Therefore, even though incidental take is expected to occur, sufficient data are not available to enable the Service to determine an exact number of individuals that may be taken under the proposed action. However, the Service is quantifying incidental take in the form of a conservative estimate based on similar past actions.

The Service anticipates that bull trout may be incidentally taken as a result of the pile installation during project implementation. There is also potential for limited incidental take of bull trout from the implementation of the other project-related construction activities resulting from short-term increases in hydroacoustics, sedimentation, turbidity, and/or chemical contamination that may affect essential behavioral patterns and/or physiologic processes. Given the short duration of the construction activities and the degraded quality of the action area, the Service anticipates few adult and/or subadult bull trout (and no juvenile bull trout) would be in the area during construction. If any individuals are injured, it would be a subset of those that are present. The timing of the project also reduces the likelihood and number of bull trout anticipated in the action area. Therefore, the amount of take for bull trout, regardless of the life stage (i.e., sub-adult or adult) for all project-related activities is limited to ten individuals as sub-lethal take through harm and harassment and zero individuals through any manner of lethal take.

7.2 Effect of the Take
In the accompanying Opinion, the Service determined that the level of incidental take is not likely to result in jeopardy to bull trout analyzed under this Opinion because very few bull trout are likely to occur in the action area during the ODFW preferred in-water work period. Any take of bull trout will affect the local population and will not have species-wide population or critical habitat effects.

7.3 Reasonable and Prudent Measures
Regulations (50 CFR 402.02) implementing section 7 of the ESA 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 federally-listed species or resulting in the destruction or adverse modification of designated or proposed critical habitat. Reasonable and prudent measures are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). Terms and conditions implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply. The Service believes the following

Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take bull trout.

The Corps shall:

1. To the extent possible, monitor any detectable adverse effects to bull trout during the proposed action.

7.4 Terms and Conditions

The measures described below are non-discretionary, and must be undertaken by the Corps or, if an applicant is involved, must become binding conditions of any funding provided to the applicant, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require an applicant to adhere to the terms and conditions of the incidental take statement through funding conditions, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to Service as specified in the incidental take statement.

1. To implement reasonable and prudent measure #1 (effects to bull trout), the Corps shall ensure that during the project implementation, any observed adverse effects to bull trout that may occur from these activities will be documented and reported to the Service. Contact the Service's La Grande Field Office immediately to report your observations, especially if they are related to bull trout. Any verbal communications with this office must be followed-up with a written communication describing the observations in detail within 3 business days of the observation(s).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize or eliminate 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 reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking, and review with the Service the need for possible modification of the project's reasonable and prudent measures.

7.5 Reporting Requirements

The following are monitoring and reporting requirements under this Opinion:

1. Monitor the overall extent of incidental take of bull trout to ensure the authorized amount of take for the species is not exceeded during the implementation of the proposed action.
2. All documented project inspection records, reports, and plans must be made available for review by the Service upon request.
3. Monitor the proposed action to ensure compliance with the conservation measures addressed in the BA and other requirements addressed in the Opinion.

4. Notify the Service's Division of Law Enforcement in Wilsonville, Oregon, at 503-682-6131 when a federally-listed species is found dead, injured, or sick at the time when the proposed action, covered under the BO, is being implemented. Instructions for proper handling and disposition of the species will be issued by the Division of Law Enforcement. Care must be taken in handling: (A) sick or injured individuals to ensure effective treatment and care and (B) a dead specimen to preserve biological material in the best possible state. The Service has the responsibility to ensure that information relative to the date, time, location, and possible cause of injury or death of each individual is recorded and provided to the Division of Law Enforcement.
5. A final project report must be submitted 60 days after completion of the proposed action documenting any project-related effects to the bull trout and/or bull trout critical habitat. Send the report to the address below with the following reference number.

   USFWS - La Grande Field Office
   La Grande Field Supervisor
   3502 Highway 30
   La Grande, Oregon 97814
   Reference Number: 01EOFW00-2018-F-0234

7.6 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA 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 bull trout or bull trout critical habitat, to help implement recovery plans, or to develop information.

1. Notify the Service's La Grande Field Office of any bull trout observations during project implementation.

8.0 REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal action 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 on listed species or designated critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that are likely to be affected by the action.

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