



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Eastern Washington Field Office
7421 E Appleway Blvd.
Spokane Valley, WA 99212



In Reply Refer To:
01EWF00-2021-F-0519

Michael S. Erickson
Chief, Environmental Compliance Section
Corps of Engineers, Walla Walla District
201 North Third Avenue
Walla Walla, Washington 99362-1876

Dear Mr. Erickson:

Subject: Natural Resource Management Routine Boat Dock and Ramp Maintenance

This letter transmits the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the proposed Natural Resource Management Routine Boat Dock and Ramp Maintenance program located along the Snake River in Benton, Walla Walla, Franklin, Columbia, Whitman, Garfield and Asotin Counties, Washington, and Clearwater River in Nez Perce County, Idaho, and its effects on bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat. Formal consultation on the proposed action was conducted in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your January 20, 2021, request for formal consultation was received on January 20, 2021.

The enclosed Opinion is based on information provided in the Natural Resource Management Routine Boat Dock and Ramp Maintenance Biological Assessment, additional information received by email, telephone conversations, field investigations, and other sources of information cited in the Opinion. A complete record of this consultation is on file at the Service's Eastern Washington Field Office in Spokane, Washington. An electronic copy of this Opinion will be available to the public approximately 14 days after it is finalized and signed. A list of Biological Opinions completed by the (Service) since October 1, 2017 can be found on the (Service) Environmental Conservation Online System (ECOS) website at <https://ecos.fws.gov/ecp/report/biological-opinion.html>.

INTERIOR REGION 9
COLUMBIA-PACIFIC NORTHWEST

IDAHO, MONTANA*, OREGON*, WASHINGTON

*PARTIAL

The Corps of Engineers determined the proposed action would have no effect on the yellow-billed cuckoo (*Coccyzus americanus*), Spalding's Catchfly (*Silene spaldingii*), Gray Wolf (*Canis lupus*) or designated critical habitat for the gray wolf. There is no requirement for concurrence by the Service on "no effect" determinations. Therefore, your determinations rest with the action agency.

If you have any questions regarding the enclosed Biological Opinion, our response to your concurrence request(s), or our shared responsibilities under the Act, please contact Kat Sarensen at (509) 795-4776, or katherine_sarensen@fws.gov.

Sincerely,

for Brad Thompson, State Supervisor
Washington Fish and Wildlife Office

Enclosure(s)

cc:

Corps, Walla Walla, WA (B. Trumbo)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWW00-2021-F-0519

Natural Resource Management Routine Boat Dock and Ramp
Maintenance

Benton, Walla Walla, Franklin, Columbia, Whitman, Garfield
and Asotin Counties, Washington and Nez Perce County, Idaho

Federal Action Agency:

U. S. Army Corps of Engineers, Walla Walla District

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Spokane, Washington

for Brad Thompson, State Supervisor
Washington Fish and Wildlife Office

Date

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ACRONYMS AND ABBREVIATIONS

ac	Acres
Act	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 <i>et seq.</i>)
AOR	Area of Responsibility
Assessment	Biological Assessment
C	Celsius
cf	cubic feet
CH	Critical Habitat
CHSU	Critical Habitat Subunit
CHU	Critical Habitat Unit
Corps	U.S. Army Corps of Engineers
cf	cubic feet
cfs	cubic feet per second
cy	cubic yards
DAM	Destruction or Adverse Modification
dB	Decibel
dBA	A-weighted decibel level
DO	Dissolved Oxygen
F	Fahrenheit
FMO	Foraging, Migration and Overwintering
ft	Feet
ft ²	square feet
Hz	Hertz
IDFG	Idaho Department of Fish and Game
IWW	In-water Work Window
km	Kilometer
km ²	square kilometers
MCRU	Mid- Columbia Recovery Unit
mi	Miles
m ²	square meter
mi ²	square mile
mm	Millimeter
MSMP	McNary Shoreline Management Plan
NMFS	National Marine Fisheries Service
OHWM	Ordinary High-Water Mark
Opinion	Biological Opinion
ORB	Oasis Road Bridge
Pa	Pascals
PCE	Primary Constituent Element
Project	Natural Resource Management Routine Boat Dock and Ramp Maintenance Project
re:	Reference
RKM	River Kilometer
RM	River Mile
RMS	Root Mean Square

SEL	Sound Exposure Level
Service	U.S. Fish and Wildlife Service
Services	U.S. Fish and Wildlife Service and National Marine Fisheries Service
SPL	Sound Pressure Levels
TDG	Total Dissolved Gas
TMDL	Total Maximum Daily Load
μPa	Micropascal
USFS	U. S. Forest Service
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

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1 INTRODUCTION

This document represents the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the U.S. Army Corps of Engineers' (Corps) proposed Natural Resource Management Routine Boat Dock and Ramp Maintenance program along the Mid-Columbia and Snake Rivers in Benton, Walla Walla, Franklin, Columbia, Whitman, Garfield and Asotin Counties, Washington, and the Clearwater River in Nez Perce County, Idaho. The Opinion addresses effects to bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). The Corps' January 20, 2021, request for formal consultation was received on January 20, 2021.

This Opinion is based on information provided in the October 21, 2020, Natural Resource Management Routine Boat Dock and Ramp Maintenance Biological Assessment (Assessment), February 5, 2021, Memorandum for the Record, email communications, telephone conversations, field investigations, and other sources of information as detailed below. A complete record of this consultation is on file at the Service's Eastern Washington Field Office in Spokane, Washington.

2 CONSULTATION HISTORY

The following is a summary of important events associated with this consultation:

- The Service received the Corps' Biological Assessment on October 21, 2020 with a request for informal consultation.
- The Service received additional project information on November 9, 2020, December 17, 2020, and January 7, 2021.
- The Corps requested formal consultation from the Service on January 20, 2021.
- On January 29, 2021, the Service and National Marine Fisheries Service (Services) held a call with the Corps to discuss underwater concrete pouring resulting in the Corps withdrawing this activity from their proposed action.
- On February 9, 2021, the Services received from the Corps a Memorandum for the Record documenting the changes and clarification to the proposed action since the Assessment was submitted.
- On February 18, 2021, the Service received additional clarification from the Corps regarding project-related conservation measures.
- On March 9 and 16, 2021, the Service received additional project information from the Corps relating to project sites, water drafting, conservation measures, and the pile driving window.
- On March 24, 2021, the Service received from the Corps a list of additional docks to include under the program.
- On April 9, 2021, the Service received additional project information.

3 BIOLOGICAL OPINION

4 DESCRIPTION OF THE PROPOSED ACTION

A federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas (50 CFR 402.02).

The proposed action covers routine repair and maintenance or replacement of existing boat docks and boat ramps owned and/or maintained by the U.S. Army Corps of Engineers (Corps), or maintained by a Corps contractor, within the Corps' Tri-Rivers and Lower Granite Areas of Responsibility (AOR: Figure 1). The Corps' AORs include 42 docks and 31 boat ramps with 47 lanes along the Columbia, Snake, and Clearwater Rivers in Benton, Walla Walla, Franklin, Columbia, Whitman, Garfield and Asotin Counties, Washington, and along the Clearwater River in Nez Perce County, Idaho (Table 1). Facilities not maintained by the Corps or their contractors are not included in the proposed action (Assessment, p. 2).

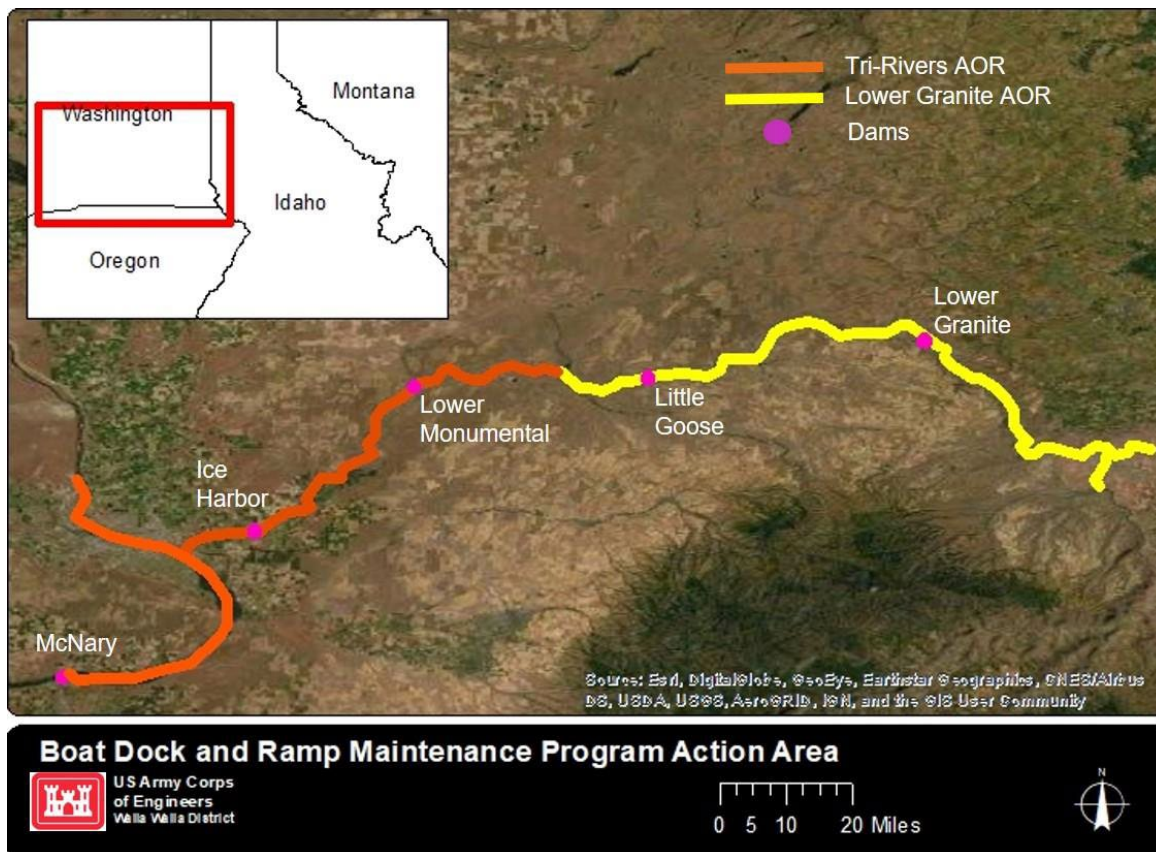


Figure 1. U.S. Army Corps of Engineers boat dock and ramp maintenance area of responsibility. Docks and ramps are located on the Snake River only.
Source: Corps 2020, p.2.

Table 1. Boat docks and ramps at 37 locations included in the proposed action. Boat docks and ramps within the Action Area that are not maintained by the Corps are not included in the programmatic.

Location¹	Dock Type²	Number	Piles	Ramp Type	Lanes
McNary Pool					
McNary Dam North Shore	NA	NA		Concrete	1
McNary Dam South Shore	F, G	2	No	Concrete	2
Hood Park	F, G	2	No	Concrete	2
Hood Park Boat Basin	F, G	1	Yes	Concrete	1
Ice Harbor Pool					
Ice Harbor North Shore	F, G	1	No	Concrete	2
Charbonneau Park	F, G	1	No	NA	NA
Charbonneau Ramp	F, G	1	Yes	Concrete	2
Levey Park	F, G	3	Yes	Concrete	1
Fishhook Park	F, G	2	Yes	Concrete	1
Lower Monumental Pool					
Windust	F, G	1	Yes	NA	NA
Matthews	F, G	1	No	Concrete	1
Devils Bench	F, G	1	Yes	Concrete	2
Ayer	F, G	1	Yes	Concrete	2
55 Mile	F, G	3	Yes	NA	NA
Texas Rapids	EZ & F, G	2	Yes	Concrete	1
Riparia	NA	NA	NA	Primitive	1
Little Goose North Shore Tailrace Portage	NA	NA	NA	Primitive	1
Little Goose Pool					
Little Goose North Shore Forebay Portage	EZ	1	NA	NA	NA
Little Goose Landing	EZ	1	Yes	Concrete	1
Central Ferry	F, W	2	Yes	Concrete	4
Willow Landing	EZ	1	No	Block/Gravel	1
Lambi Creek	NA	NA	NA	Primitive	1
Illia Landing	NA	NA	NA	Concrete	1
Lower Granite South Shore Canoe Portage	NA	NA	NA	Primitive	1
Lower Granite Pool					
Offield Landing	EZ	1	Yes	Concrete	1
Wawawai Landing	EZ	1	Yes	Block/Gravel	1
Blyton Landing	EZ	1	Yes	Concrete	1
Nisqually John Landing	EZ	2	Yes	Concrete	2
Lewis and Clark Interpretive Center	EZ	1	Yes	NA	NA
Corps Clarkston Office	EZ	1	Yes	NA	NA
Greenbelt	EZ	1	Yes	Concrete	2
Swallows	EZ	3	Yes	Concrete	4
Asotin Slough	NA	NA	NA	Block/Gravel	1
Lower Goose Pasture	NA	NA	NA	Primitive	1
Upper Goose Pasture	NA	NA	NA	Primitive	1

Source: Trumbo, B., *in litt.* 2021a

¹ Locations in **bold** are located along the Clearwater River in Idaho. The remaining occur along the Snake River.

² F = Floating; G = Light-Transmitting Grating; W = Wood; EZ = Floating EZ-Dock

The details of the Corps' routine boat dock and ramp maintenance activities are presented in greater detail below, having have been largely excerpted from the Assessment with modifications for clarity or to reflect additional information received by the Corps following submission of the Assessment.

4.1.1 Routine Dock Maintenance and Replacement Activities

There are three types of docks covered by the proposed program: floating wood, floating poly (i.e., "EZ Docks"), and floating docks with piles. The docks consist of various floating configurations, some docks that are attached to piles to keep the dock in position and other docks, not held in place by piles, that are attached to a submerged anchor and cable system to maintain their perpendicular position to shore. Docks anchored with chains are being transitioned to steel wire as needed to increase longevity. Docks with multiple sections are attached to one another with "section connection" devices, i.e., steel rings, cables, "dog bones" for EZ docks, and other brackets to allow flexibility. All docks are attached at the shoreline to a large concrete block (i.e., "shoreline anchor") with a bolting mechanism or chains. Most docks have tie-off cleats and/or kick-boards around the edges and a railing on the gangways.

Table 2. Routine maintenance activities relative to dock type with expected frequency of occurrence.

Routine Dock Maintenance Activity¹	Floating Wood	Floating Poly (EZ Dock)	Floating with Piles	Frequency²
Cleaning	X	X	X	Often
Board/Plank Replacement	X	X	X	Often
Rail and kick-board Replacement	X	X	X	Often
Gangway/Rail Welding	X	X	X	Occasional
Shoreline Anchor Repair/Replacement	X	X	X	Rare
Cleat Replacement	X	X	X	Often
Section Connection Ring/Cable Replacement	X	X	X	Occasional
Float Replacement	X	X		Rare
Pile Replacement (vibration or impact driving)	X	X	X	Rare
Anchor Replacement	X	X		Rare
Anchor Cable Replacement	X	X		Rare

Source: Excerpted from Assessment (p. 7).

¹ Actions in bold can be accomplished above water or on shore.

² Frequency intervals are as follows: "Often" (annual), "Occasional" (not annual), and "Rare" (an occurrence every few years or less).

As described in the Assessment (pp. 6 – 9), routine dock repair and maintenance activities include cleaning, welding and replacement of metal parts, board or poly deck plank maintenance or replacement with bolts or screws, shoreline anchor and dock attachment repairs, float replacement, pile replacement, and anchor and/or cable replacement. All dock repair, maintenance, or replacements, including replacement of any parts or entire sections, will remain

largely within the footprint of the existing facilities, with some minor adjustment, but the overall size of docks will be retained (Assessment, p. 68). A summary description of each maintenance activity is presented below, and the expected frequency for each activity is provided in Table 2.

Cleaning – Cleaning, typically to remove goose feces or algae, will consist of power washing and scrubbing surfaces. No cleaning agents or other additives will be used and wash water will be allowed to fall into the river. Water used for cleaning will be brought in from off-site (Trumbo, B., *in litt.* 2021b). Drafting from the adjacent river will not occur.

Board or Plank Replacement - Board and poly deck planks, including associated bolts or screws, will be tightened, re-fastened, or replaced if rotten or cracked. Board or plank replacement will be accomplished using hand tools.

Rail and Kick-board Replacement - Rails and kick-boards are attached with bolts or screws that will be tightened, re-fastened, or replaced if rotted or cracked. Rail and kick-board replacement will be accomplished using hand tools.

Gangway or Rail Welding - Gangway or rail welding will be accomplished with the structure in place or may require the removal of the gangway or railing, depending upon the extent of damage. Both structures can be removed with hand tools and the gangway may be detached from the shoreline anchor block and the dock assembly floated into shore for more extensive repairs. Gangway and rail welding does not require in-water work, but welding may occur above water.

Shoreline Anchor Repair or Replacement - Shoreline anchor block repairs include concrete patching and grouting and drilling new anchor bolt holes (in the event of a gangway replacement or extensive damage). Full concrete anchor replacement is extremely unlikely but may occur under this program. In this event, replacement will require complete anchor removal followed by pouring a replacement block and then drilling and fitting the associated gangway. Shoreline anchor repair or replacement, including concrete pours, will occur on shore and in the dry. There will be no in-water concrete pouring.

Cleat Replacement - Cleats are bolted to either the kick-boards or rails, or to the board or plank surface of docks and will be replaced with hand tools from above water.

Section Connection Ring or Cable Replacement - Section rings and cables are bolted or welded to specific points between sections and will be repaired or replaced above water with hand tools.

Float Replacement - Float replacement requires the complete dock assembly be detached from the shoreline anchor block and floated ashore. Working from shore using heavy equipment, the gangway will be removed, and the float assembly picked up to bring it ashore without damage. All replacement work will be completed on dry land and, once the float has been replaced, the dock floated back into place. Some portions of this work may occur while the dock remains in the water.

Pile Replacement - In the event that a pile must be replaced, existing piles will be cut below the substrate surface and covered or pulled/vibrated out and removed completely. Pile replacement will occur either by barge or shoreline excavator using either an impact hammer or vibratory

driver, but vibration will be used when possible. Pile driving will occur only during the winter work window, November 1 through February 28 (Trumbo, B., *in litt.* 2021c). In the event that an impact hammer is used for pile driving, elevated underwater sound pressure levels will be reduced through use of a wooden block cushion and bubble curtain. Existing piles are 8-inch in diameter, but piles may be replaced using steel H-piles or pipe piles, up to 12 inches in diameter.

Anchor Replacement - Anchors are submerged devices that hold docks in place and consist of either concrete blocks sitting on the substrate or helical screws with an approximate 6-inch diameter head and 1-inch diameter shaft inserted up to 6 feet deep into the substrate. Anchor replacement will require hoisting cables and anchors from the substrate via boat, barge, or equipment working from shore. Helical screws will be cut below the substrate surface and covered over. Replacement anchor blocks will follow the criteria defined in the McNary Shoreline Management Plan (MSMP: Assessment, Appendix A) to maintain no greater than 1-foot height to avoid creating predator habitat. Replacement anchor blocks will be lowered into place with cables attached, which will then attach to the dock. Helical screws will be drilled into place in the substrate, cables attached to the screw and to the dock. Anchor replacement requires in-water work. In-water work will occur during the in-water work window and will include fish exclusion from the work area, both of which are described in section 3.3 of this Opinion, “Conservation Measures.”

Anchor Cable Replacement - Should an anchor cable need to be replaced, but not the anchor itself, the cable will be cut at the anchor and then replaced. Anchor cable replacement may involve in-water work, for both anchor types, or the cable replacement may occur concurrent with submerged anchor replacement. In-water work will occur during the in-water work window and will include fish exclusion from the work area, both of which are described in section 3.3 of this Opinion, “Conservation Measures.”

Complete Dock Replacement - Complete dock replacement is assumed if maintenance will repair or improve 51 percent or more of the structure. Additionally, any dock may be replaced with new light-transmitting grating regardless of the amount of maintenance required. All replacement structures will be built to provide a 100 percent surface grating with a minimum of 50 percent light transmittance and will occupy the approximate footprint of the existing structure with some minor adjustment, if needed, to ensure the replacement dock meets the MSMP criteria.

Complete dock replacement will require detaching the floating docks from the shoreline anchor block and stabilizing piles or substrate anchors and floating them ashore. Docks will be picked from the water at the shoreline, and replacement docks will be assembled on shore in the dry and floated back into place. Reattaching sections and gangways will occur above water, either on land or with the dock floating in place. In the event a pile will need to be replaced, methods would follow those described above for pile replacement. In-water work will adhere to the appropriate in-water work windows with fish exclusion from the area. Additionally, replacement dock criteria will follow the MSMP criteria for new docks, which includes maintaining the existing footprint (with some minor adjustments, as necessary) and using structures that provide 100 percent surface grating with a minimum 50 percent light transmittance (Assessment, Appendix A), among other things.

4.1.2 Routine Ramp Maintenance and Replacement Activities

The proposed action covers 31 boat ramps with 47 launch lanes. The total size of the ramps/lanes is 74,170 square feet (ft²), of which approximately 18,543 ft² (25 percent) occur below the ordinary high-water mark (OHWM). Four types of boat ramps are included under the proposed action: primitive, block-and-gravel, concrete, and articulated concrete block mats. A primitive ramp is simply a gravel lane to the water for small craft that can be launched by hand. Block and gravel ramps contain a foundation of concrete blocks that are choked with gravel. Concrete ramps consist of a cast-in-place concrete pad or pre-cast slabs that have been set into place using heavy equipment. Articulated concrete ramps consist of blocks of concrete that are connected by cables to form a mat and then filled with gravel. All ramps except primitive ramps are intended for launching powered watercraft.

As described in the Assessment (pp. 12 – 13), maintenance actions on primitive, block and gravel ramps, and articulated concrete mats include filling potholes with clean gravel and occasional block replacement or resetting followed by smoothing with equipment or hand tools. Concrete ramps may develop potholes that will be repaired with mortar, commercial epoxy, or patching compound (i.e., grout). Rarely, complete concrete or block ramp replacement may be needed and is included in this programmatic. A summary description of each ramp maintenance action is presented below, and the expected frequency interval for each maintenance action for each type of ramps is provided in Table 3.

Table 3. Routine maintenance activities relative to ramp type with expected frequency of occurrence.

Routine Ramp Maintenance Activity¹	Primitive	Block/Gravel	Articulated Mat	Concrete	Frequency²
Fill and Smooth (Dry Land)	X	X	X		Often
Fill and Smooth (In-Water)		X	X		Rare
Block Replacement		X	X		Rare
Block Resetting		X	X	X	Occasionally
Pothole Repair		X	X	X	Often
Concrete Section Replacement				X	Rare

Source: Excerpted from Assessment (p. 12).

¹ Actions in **bold** may *not* require in-water work.

² Frequency intervals are as follows: “Often” (annual), “Occasional” (not annual), and “Rare” (an occurrence every few years or less).

Fill and Smooth - Most fill and smooth maintenance actions will occur on dry land; however, gravel may be placed below the OHWM, if needed. Gravel will be placed and smoothed with hand tools or equipment appropriate for the volume of gravel needed and will require less than 1 cubic yard (cy) of gravel per location. Maintenance of primitive ramps does not include in-water work (Assessment, p. 12).

Block Replacement or Resetting - Block replacement will require digging and removing a block or series of blocks from the substrate, replacing the block or repairing parts of blocks, and filling and smoothing with existing material and/or clean gravel. Block resetting includes repositioning, smoothing, filling, and reattaching linked blocks or slabs that have shifted out of place. Given these surfaces are hardscape, heavy equipment may be used to move or place blocks. In the event that in-water block replacement is necessary, all work will adhere to the appropriate in-water work window and will include fish exclusion from the area. Activities associated with fish exclusion are provided in section 3.3 of this Opinion, “Conservation Measures.”

Pothole Repair - Pothole repair may involve applying clean gravel to fill a hole in a block-and-gravel or articulated mat ramp followed by adjusting blocks or may include concrete grout patching. Gravel fill will be carried out as described in the “fill and smooth” section above but may require some in-water work. Concrete repair may require tools to cut or chip away rough, cracked and crumbling edges of the repair area. All loose material removed from the repair area will be collected and disposed of in accordance with state law. Concrete grout will be mixed and applied per specific product recommendations. Grout applied to the terrestrial portion of a concrete ramp will not be allowed to come in contact with water until the mix has cured sufficiently to avoid negatively impacts to aquatic areas (Assessment, p. 13). Grout applied in-water will include anti-washout admixtures and will be non-toxic and non-leeching. Grout repairs will be limited to an area up to two ft², using up to 0.5 cubic feet (cf) of grout. In-water work will adhere to the winter in-water work window or may occur when the surrounding water temperature is greater than 21 degrees Celsius. Prior to in-water work, fish will be excluded from the work area as described in section 3.3 of this Opinion, “Conservation Measures.”

Ramp Replacement - All complete ramp replacements will occur within the existing ramp footprint. Although the final ramp dimensions will depend on the location, the dimensions of each replacement ramp will be roughly the same as the existing structure. Ramp replacement will follow the steps described in the Assessment (pp. 14 – 15) with some modifications discussed during formal consultation. The first two steps involve fish exclusion (see section 3.3 of this Opinion, “Conservation Measures,” for details) and installation of a turbidity curtain. If low pool cannot be maintained, the Corps will install a turbidity curtain in concert with fish exclusion activities so that the turbidity curtain will serve a dual purpose of controlling turbidity and excluding fish from the project area during implementation.

Following fish exclusion and installation of the turbidity curtain, the Corps will work either from the shore or a barge to remove the existing, damaged ramp and any other obstructions, large rock, or debris. Although all equipment will remain largely onshore, some portions of equipment (i.e., part of the track) may have to be submerged. If so, the Corps will follow conservation measures to reduce potential contamination to aquatic resources (see section 3.3 of this Opinion, “Conservation Measures”). Following removal of the damaged ramp structure, the river bottom will be prepared for ramp replacement, which may involve probing the river bottom in the footprint of the removed concrete using depth finders, sounding rods, and direct observation to locate holes, mounds, and depressions caused by the use of the ramps. The Corps anticipates only minor fill or excavation work before placing replacement slabs, as the base material is generally intact and of the appropriate smoothness and grade. However, the

excavator will drag a large steel beam, or similar equipment, across the gravel to level it, if necessary, and the gravel may be compacted with a roller or other mechanical device to provide a solid foundation for the replacement concrete slabs.

The replacement ramp will be comprised of either precast concrete slabs or blocks. Articulated concrete mats will also be replaced with concrete slabs or blocks. In-water concrete pouring is not included in the proposed action (Corps 2021, p. 1), and replacement slabs will be manufactured onsite and in the dry by pouring concrete into molds, and the concrete reinforced with wire mesh, fiber, and/or rebar. Eye bolts will also be installed to allow for anchoring of the slabs. Concrete will be allowed to cure for approximately 7 days to cure to a strength that would allow them to be lifted which, as described in the Assessment (p. 13), is beyond the 24-48 hour period generally required to cure concrete beyond the point that negative interaction with aquatic resources may occur. Once cured, the concrete slabs will be moved via an excavator or mobile crane and placed on the smoothed gravel base. The slabs will be anchored, as needed, by running stainless steel cable through the eyebolts and then securing the cables into the permanent support piles and infrastructure of the boat dock.

Replacing a block and gravel ramp will involve excavating the old blocks, grading and stockpiling any useable existing fill, replacing blocks, and filling them over with salvaged material and any new clean gravel required. The Corps anticipates less than 10 cy total of imported fill of which 3 cy or less will be placed in-water at any one site, or per project.

5 TERM OF THE PROGRAMMATIC

The duration of the proposed action is twenty years. Following ten years of implementation, the Corps will provide to the Service a report summarizing all repair and replacement activities to date taken under the programmatic, including number of piles replaced. The Corps will provide a second report at 20 years.

6 CONSERVATION MEASURES

The Assessment identifies a number of Impact Minimization Measures to minimize or avoid impacts to bull trout and their designated critical habitat. The following is largely excerpted from the Assessment (pp. 68-69), with minor edits to improve clarity, and the list has been updated to reflect modifications following the submission of the final Assessment and the information provided in the Corps' Addendum (Corps 2020, entire, 2021, entire; Trumbo, B., *in litt.* 2021d,e).

1. No net increase in the number of Corps owned/maintained docks within the Action Area.
2. Complete dock or ramp replacements will occupy the approximate original footprint. "Approximate" refers to replacement parts or docks that may not precisely match the exact existing dimensions, but overall size will be maintained. For the purposes of this Opinion, the Service assumes the overall size of docks and ramps will be maintained within 1 or 2 ft².

3. Complete dock replacements will follow McNary Shoreline Management Plan criteria as closely as possible, while accommodating the existing architecture of the structures, to minimize effects on juvenile Act-listed salmonids (Appendix A).
4. In-water work will adhere to one of two identified work windows (Table 4). The winter window occurs November 1 through February 28 and a summer window occurs whenever when the water temperature in backwater areas is above 21 degrees Celsius (C: 73 degrees Fahrenheit (F)). Pile driving will only occur during the winter work window.

Table 4. Timeframes for Proposed Maintenance and Replacement Actions.

Action	Work-Window**
Dock Maintenance and Replacement	
Cleaning	Year-Round
Board/Plank Replacement	Year-Round
Rail and Kick-Board Replacement	Year-Round
Gangway/Rail Welding	Year-Round
Shoreline Anchor Repair/Replacement	Year-Round
Cleat Replacement	Year-Round
Section Connection Ring/Cable Replacement	Year-Round
Float Replacement	Year-Round
Pile Replacement	In-Water Work Window (IWW)* ¹
Anchor Replacement	IWW*
Anchor Cable Replacement	IWW*
Complete Dock Replacement	Year-Round for float-in, float-out sections and assembled docks IWW* when piles or anchors and cables must be replaced
Ramp Maintenance and Replacement	
Fill and Smooth	Year-Round for terrestrial activities IWW* for in-water activity
Block Replacement/Resetting	Year-Round for terrestrial activities IWW* for in-water activity
Pothole Repair	Year-Round for terrestrial activities IWW* for in-water activity
Concrete Section Replacement	Year-Round for terrestrial activities IWW* for in-water activity
Complete Ramp Replacement	Year-Round for terrestrial activities IWW* for in-water activity

Source: Modified from the Assessment, pp. 16 – 17.

*In-Water Work Windows: 1 November to 28 February or in a summer timeframe when water temperature in backwater boat basins is 73 degrees Fahrenheit (21 degrees Celsius) or higher.

¹ The Corps has committed to restrict pile driving to the winter work window (Trumbo, B., *in litt.* 2021c.).

5. The Corps will coordinate minimum pool with the Corps Reservoir Control Center prior to in-water work. Lowering the water level will minimize the extent of work area that will occur in-water, thus minimizing effects to Act-listed fish.
6. All shoreline anchor, dock and ramp replacements will fit within the original footprint.
7. As piles need replacing, anchor and cable stay systems will be prioritized.
8. Replacement piles will be made of steel to reduce the need to replace piles in the future.
9. All equipment access, materials staging, and terrestrial activities will occur via existing roadways, parking areas, disturbed upland areas, and/or upon floating barges.
10. Vibratory hammer will be prioritized for pile driving, but impact hammer may occur. The Corps has determined that the number of piles installed using impact pile driving will not exceed 40 piles, approximately 2 piles per year over the 20-year program. In the event a drop hammer is used to pile driving, a bubble curtains will be used to attenuate the percussion. Wood blocks will be used for all impact pile driving.
11. All oil-filled operational equipment and fuel operated equipment will be inspected for fluid leaks prior to near- or in-water work, and any leaks detected will be repaired before operation is resumed.
12. Before operations begin, all equipment that will be used below the OHWM will be cleaned to remove all visible contaminants, particularly lubricants.
13. In-water work will include fish exclusion prior to commencement. The Corps will use a seine to herd fish out of and exclude them from the work area. Fish exclusion will occur prior to in-water anchor replacement or movement, anchor cable replacement, complete dock replacement, in-water boat ramp replacement or resetting, in-water boat ramp pothole repair, and for in-water boat ramp replacement. Fish exclusion is described in the Assessment (p. 14) relative to the full ramp replacement, but this Opinion assumes the Corps will follow the same process for fish exclusion relative to other activities where in-water work is required. Fish exclusion activities will be performed by Corps personnel and will include the following steps:
 - a. Lower the reservoir to the minimum operating pool. If low pool cannot be maintained, a turbidity curtain will be placed behind the seine to ensure that fish herded from the work area cannot re-enter.
 - b. Seine the immediate work area with a fine mesh seine net, and push salmonids and other aquatic life from the shoreline out prior to any in-water work. Fish exclusion will be limited to the extent necessary to perform repairs or replacements, the approximate complete ramp footprint being the maximum area excluded.
 - c. Corps personnel will start in the middle at the top of the existing boat ramp and move down the ramp extending the net forward and to the sides. The net is long

enough that it will provide a continuous barrier preventing fish from moving back into the ramp or repair area after it has passed over the area.

- d. Turbidity curtains will be used during full ramp replacements to control turbidity and to prevent fish from re-entering the work area following fish exclusion activities.
14. During cleaning activities, potable water will be used to supply pressure washing equipment. No water drafting from the rivers will occur.
15. All concrete dust, debris, and unused concrete mixture will be collected and disposed of appropriately in an offsite location. All equipment associated with concrete repair and replacement actions will be cleaned off site, away from waters with Act-listed fishes and critical habitat.
16. Any debris removed during project implementation will be hauled by dump truck to a recycler or approved disposal location.
17. There will be no in-water concrete pouring. Only cured, prefabricated concrete slabs will be placed below the OHWM during ramp repair or replacement. Only cement grout may come into contact with water.
18. Cement grout, used for ramp repairs, will be mixed with anti-washout additives to minimize transmission to the surrounding water.

7 ACTION AREA

The Action Area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area for the proposed project is determined by the extent of all potential impacts from repair and maintenance activities and considers impacts to both the terrestrial and aquatic environment. In delineating the Action Area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on these environments.

The project will occur within existing recreational boating facilities within the Corps' Tri-Rivers and Lower Granite AORs. Within this larger area, the Corps currently maintains responsibility for routine repair and maintenance of 42 docks with a total of 74 piles and 31 ramps with a total of 47 lanes. These facilities are located primarily along the mainstem of the lower Snake River, but also includes 1 boat dock and 2 boat ramps on the Mid-Columbia River and 2 primitive boat ramps on the lower Clearwater River. There is one dock located at the confluence of the Clearwater and Snake Rivers, at the Lewis and Clark Interpretive Center. Project implementation is expected to cause temporary increases in noise and water quality impacts (i.e., sediment, turbidity, and chemical contamination). However, because the increases in sediment/turbidity and chemical contamination impacts are expected to be localized within several feet of the work site, whereas the zone of impact associated with noise levels is expected to be significantly larger, the extent of the Action Area in both the terrestrial and aquatic

environments is defined by the extent of elevated noise levels. Due to the fact that access to each facility occurs via existing roads, where the limited vehicle use will contribute marginally to background conditions, we do not consider access routes in this analysis.

7.1 Terrestrial Environment

Terrestrial activities include staging and onshore repair and maintenance at existing recreational facilities, and the furthest-reaching project-related effects are expected to arise from noise associated with the operation of impact equipment, at sites with piles, and from heavy equipment (i.e., excavator, concrete saw, etc.), at sites without piles. Facilities with docks but lacking piles include McNary Dam North Shore, McNary South Shore, Hood Park, Ice Harbor North Shore, Charbonneau Park, Levey Park Courtesy Docks, Matthews, Little Goose North Shore Forebay Portage, and Willow Landing (9 of 37 facilities: see Table 1).

Typical noise for construction equipment was obtained from Chapter 7.0, Construction Noise Impact Assessment, of Washington State Department of Transportation (WSDOT) Biological Assessment Preparation Manual (2014). Typical construction equipment produces sound pressure levels (SPLs) at 50 feet ranging from 74 decibels (dB), reference: 20 micropascal (re: μPa), for a welder or flatbed truck to 90 dB for a concrete saw (assumes noise is constant). Impact pile driving noise varies with the size and composition of the pile, with documented SPL ranging between 95 and 115 dBA¹ at 50 feet. The upper end represents the maximum noise level documented from driving 30-inch piles (WSDOT 2014, p. 7.14). For the purposes of this Opinion, we use 110 dB as the upper extent because the maximum pile size in the project area is 12-inch and impact pile drivers produce a maximum noise level of 110 dB (WSDOT 2014, p. 7.12). When combined with other construction noise and using the rules for combining construction equipment (WSDOT 2014, p. 7.16), we expect the upper extent of noise will be 110dB at 50 feet at facilities with piles and 93 dB at facilities without piles, attenuating at a rate of 6 dB per 50 feet until reaching ambient noise levels (WSDOT 2014, p. 7.8).

Ambient noise levels vary across the Action Area. Background noise of facilities near large population centers is much higher than background noise in remote locations where noise will be driven primarily by nearby traffic patterns. Traffic noise will be greater near freeways with higher traffic volume and vehicle speed than in areas where there is little traffic or where vehicle speed is typically lower. To determine the furthest reaching effects, we conservatively estimate an ambient noise level of 57.3 dB (WSDOT 2014, p. 7.10) and hard surface in the surrounding landscape. For facilities with piles, where impact pile driving may occur, construction noise attenuates to ambient noise at 25,600 feet (ft) from source, or 4.92 miles (mi). At facilities without piles, we assume combined construction-related noise of 93 dB at 50 feet, attenuating to background at 3200 ft, or 0.61 mi. These are conservative estimates, as natural conditions such as topography, vegetation, and temperature can reduce the distance at which noise attenuates to ambient or background level.

¹ The use of dBA denotes that sound levels, generally described in decibels (dB), have been frequency-weighted to approximate human hearing.

7.2 Aquatic Environment

Within the aquatic environment, the proposed action includes activities within the footprint of the existing structures, including over-water structures, anchors and cables, pilings, and boat ramps. The effects of underwater noise is expected to stem from saws (e.g., cutting submerged anchors and cables), barges and pile-driving. Of these effects, we anticipate the farthest-reaching extent will stem from underwater noise associated with pile driving; however, pile driving will not occur in all locations. Therefore, the portion of the aquatic environment included in the Action Area will vary, where pile driving determines the extent of the Action Area at facilities with piles and noise associated with underwater saws determines the extent of the Action Area where piles are absent. At facilities lacking docks, we anticipate very little underwater noise, primarily that associated with ramp repair, which is not expected to rise above the level associated with underwater saws. At sites with no docks and only primitive ramps (see Table 1), where there will be no in-water work (see Table 3), i.e., Riparia, Little Goose North Shore Tailrace Portage, Lambi Creek, Lower Granite South Shore Canoe Portage, Lower Goose Pasture and Upper Goose Pasture (6 of 37 facilities), we expect very little in-water noise.

Underwater noise associated with pile driving depends on the size and type of pile, and the technique used to drive the piles. In determining the extent of the aquatic Action Area, we assume impact hammer driving, although the Corps estimates that no more than 40 of the 72 piles will be installed via impact hammer (Trumbo, B., *in litt.* 2021e). Underwater sound production from impact pile driving is not available for the lower Snake River, so we conservatively assume impact pile driving 12-inch steel piles is expected to produce peak sound pressure (dB_{peak}) of 200 dB at 10 meters, or 187 dB_{RMS} ; (root mean square (calculated by dividing the energy by the duration, as a means of averaging units over time), re: 1 μPa), the documented noise produced from driving 16-inch steel piles in the Yakima River (Laughlin 2004, p. 9).

Ambient underwater noise in the lower Snake River are affected by boat, barge, and train traffic and the presence of dams, with higher ambient noise nearer dams (Assessment, p. 58). While the WSDOT (2014, p. 7.35) estimates ambient sound in deep freshwater lakes or deep slow moving rivers at approximately 120 dB_{RMS} , similar to marine levels near developed shorelines, the Corps has documented ambient SPLs near Ice Harbor Dam range between 105 and 155 dB (re: 1 μPa) with most locations document 106 dB (Assessment, p. 58). To be consistent with local data, we assume background conditions of 106 dB throughout the lower Snake and Clearwater Rivers. The distance at which impact pile driving (assumes SPL of 187 dB_{RMS}) is expected to attenuate to ambient levels (i.e., 106 dB_{RMS}) is estimated at 2,511 km, or 145 miles, assuming open water conditions. This is a very conservative estimate, as sound transmission is affected by bottom topography, flow, water level, sediment type and the presence of underwater structures. Transmission is also restricted by the presence of surrounding landforms; thus, underwater sound transmission is limited to the furthest straight-line distance (i.e., “line-of-sight”) and will not extend beyond the nearest riverbanks or bends in the river. Underwater sound propagated in boat basins are expected to be largely constrained by the landforms surrounding the basin, with limited extent to the adjacent river.

8 ANALYTICAL FRAMEWORK FOR THE JEOPARDY

8.1 Jeopardy Determination

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this Biological Opinion relies on the following four components:

1. The *Status of the Species*, which evaluates the species' range-wide condition relative to its reproduction, numbers, and distribution, the factors responsible for that condition, and its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;
2. The *Environmental Baseline*, which evaluates the condition of the species in the Action Area relative to its reproduction, numbers, and distribution without the consequences of the proposed action, the factors responsible for that condition, and the relationship of the Action Area to the survival and recovery of the species;
3. The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the conservation role of the Action Area for the species; and
4. *Cumulative Effects*, which evaluates the consequences of future, non-federal activities reasonably certain to occur in the Action Area on the species, and how those impacts are likely to influence the conservation role of the Action Area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed federal action in the context of the species' current range-wide 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 species in the wild. The key to making this finding is clearly establishing the role of the Action Area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

8.2 Adverse Modification Determination

A final rule revising the regulatory definition of "destruction or adverse modification" (DAM) of critical habitat (CH) was published on August 27, 2019 (84 FR 44976). The final rule became effective on October 28, 2019. The revised definition states:

"Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

In accordance with policy and regulation, the destruction or adverse modification determination in this Biological Opinion relies on the following components:

1. The *Status of Critical Habitat*, which describes the range-wide condition of the CH in terms of essential habitat features, primary constituent elements, or physical and biological features that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the CH as a whole for the conservation/recovery of the listed species;
2. The *Environmental Baseline*, which refers to the current condition of CH in the Action Area absent the consequences to CH caused by the proposed action, the factors responsible for that condition, and the conservation value of CH in the Action Area for the conservation/recovery of the listed species;
3. The *Effects of the Action*, which represents all consequences to CH that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the conservation value of the affected CH; and
4. *Cumulative Effects*, which represent the consequences to CH of future, non-federal activities that are reasonably certain to occur in the Action Area and how those impacts are likely to influence the conservation value of the affected CH.

For purposes of making the DAM determination, the Service evaluates if the consequences of the proposed federal action on CH, taken together with cumulative effects, when added to the current range-wide condition of CH, are likely to impair or preclude the capacity of CH as a whole to serve its intended function for the conservation of the listed species. The key to making this finding is clearly establishing the role of CH in the Action Area relative to the value of CH as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role.

9 STATUS OF THE SPECIES: Bull Trout

The bull trout was initially listed in 1998, and then listed as a threatened species in the coterminous United States in 1999. Throughout its range, 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, incidental angler harvest, entrainment, and introduced non-native species (64 FR 58910 [Nov. 1, 1999]). Since the listing of bull trout, there has been very little change in the general distribution of bull trout in the coterminous United States, and we are not aware that any known, occupied bull trout Core Areas have been extirpated (USFWS 2015a, p. iii).

The 2015 recovery plan for bull trout identifies six proposed recovery units within the listed range of the species (USFWS 2015a, p. 33). Each of the recovery units are further organized

into multiple bull trout Core Areas, which are mapped as non-overlapping watershed-based polygons, and each Core Area includes one or more local populations. Within the coterminous United States, we currently recognize 109 occupied Core Areas, which comprise 600 or more local populations of bull trout (USFWS 2015a, p. 34). Core areas are functionally similar to bull trout metapopulations, in that bull trout within a Core Area are much more likely to interact, both spatially and temporally, than are bull trout from separate Core Areas.

The Service has also identified a number of marine or mainstem riverine habitat areas outside of bull trout Core Areas that provide foraging, migration, and overwintering (FMO) habitat that may be shared by bull trout originating from multiple Core Areas. These shared FMO areas support the viability of bull trout populations by contributing to successful overwintering survival and dispersal among Core Areas (USFWS 2015a, p. 35). The proposed project will occur within the Mid-Columbia River, lower Snake River, and lower Clearwater River shared FMO habitats.

For a detailed account of bull trout biology, life history, threats, demography, and conservation needs, refer to Appendix B: Status of the Species - Bull Trout.

10 STATUS OF DESIGNATED CRITICAL HABITAT: Bull Trout

On October 18, 2010, the Service issued a final revised critical habitat designation for the bull trout (70 FR 63898). The critical habitat designation includes 32 critical habitat units (CHUs) in six proposed Recovery Units located throughout the coterminous range of the bull trout in Washington, Oregon, Idaho, Montana, and Nevada. The species' final recovery plan (USFWS 2015a) formally designated these Recovery Units. Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) FMO habitat. The conservation role of bull trout critical habitat is to support viable Core Area populations (75 FR 63943). CHUs generally encompass one or more Core Areas and may include FMO habitats, outside of Core Areas, that are important to the survival and recovery of bull trout.

The final rule excludes some critical habitat segments. Critical habitat does not include: 1) waters adjacent to non-federal lands covered by legally operative incidental take permits for Habitat Conservation Plans issued under the 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 inclusion would impair their relationship with the Service; or, 3) waters where impacts to national security have been identified (75 FR 63898).

Bull trout have more specific habitat requirements than most other salmonids (USFWS 2010a,b). The predominant habitat components influencing their distribution and abundance include water temperature, cover, channel form and stability, spawning and rearing substrate conditions, and

migratory corridors. The Primary Constituent Elements (PCEs) of bull trout critical habitat, as revised in 2010, are (USFWS 2010a,b):

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 (36°F to 59°F), 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; and,
9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout, *Salvelinus fontinalis*); or competing (e.g., brown trout, *Salmo trutta*) species that, if present, are adequately temporally and spatially isolated from bull trout. For a detailed reference account of the status of designated bull trout critical habitat, refer to Appendix C: Status of Designated Critical Habitat - Bull Trout.

11 ENVIRONMENTAL BASELINE: Bull Trout and Designated Bull Trout Critical Habitat

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

12 CURRENT CONDITION OF THE SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

Bull trout in the Action Area, as a whole, are made up of individual migratory bull trout from multiple local populations that have converged within the mainstem Mid-Columbia, lower Snake, and lower Clearwater Rivers. To understand the status of the bull trout in the Action Area, it is necessary to discuss bull trout in the broader area, including the Mid-Columbia Recovery Unit (MCRU), Core Areas associated with the Action Area, and CHUs. This section analyzes the current condition of the bull trout in the Action Area, the factors responsible for that condition, and the intended role of the Action Area in the conservation of the bull trout in the MCRU.

The proposed activities will occur within the Corps' Tri-Rivers and Lower Granite Natural Resource Management AORs, which extend along the mid-Columbia River from McNary Dam to the Hanford Reach at Richland, Washington, and along the lower Snake and lower Clearwater Rivers from their mouths upstream to encompass the area of inundation created by Lower Granite Dam (Figure 1). Within this broader area, migratory bull trout are present throughout the year. Migratory life history forms of bull trout are key to the persistence and genetic diversity of each Core Area across the range, as well as throughout the Action Area.

For each Core Area, the Service discusses the status and trend based on existing information on population estimates, redd counts or other demographic data combined with existing threats identified as impacting the long-term persistence of bull trout (USFWS 1998a). Where data is available, the status of a Core Area has been categorized as Depressed (i.e., the population size is small or historic, experiencing substantial threats, and/or has a long-term declining trend in population/redd counts) or Stable (i.e., the Core Area has long-term stable, consistent or increasing population numbers or redd counts and/or has few threats impacting population persistence). Additionally, Core Area trend may be reported as Declining (i.e., population numbers or redd counts are reducing/declining in the last 7 years); Stable (i.e., no indication of population change in the last 7 to 10 years); or Increasing (i.e., population numbers or redd

counts have been improving/increasing in recent years). Critical habitat is discussed in the context of CHUs within the Action Area (USFWS 2010a) and is characterized based on function (USFWS 1998b).

12.1.1 Status of the Species in the Action Area

The MCRU includes portions of central Idaho, eastern Washington, and eastern Oregon (USFWS 2015a,b) and is divided into four geographic regions: 1) 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 MCRU that flow into the Snake River above Hells Canyon Dam. The Corps' Tri-Rivers and Lower Granite AORs overlap portions of the Lower Mid-Columbia, Upper Mid-Columbia, and lower Snake River geographic regions. Major drainages of the MCRU 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. The current demographic status of bull trout in the MCRU is highly variable at both the recovery unit and geographic region scale (ODFW 2005 and USFWS 2015b). Bull trout are estimated to have occupied about 60 percent of the Columbia Basin and presently occur in only about 45 percent of their historic range. Bull trout throughout this Recovery Unit co-existed with salmon, steelhead, and in some areas, lamprey (USFWS 2015b).

The MCRU encompasses 24 Core Areas, two historically occupied areas, and one research needs area. Some Core Areas, such as the Umatilla River and Asotin Creek contain very small, threatened populations while other Core Areas, such as those found in the Imnaha, Clearwater, and Wenatchee River basins are strong. The stronghold populations tend to occur within intact habitat areas, such as wilderness areas and protected forestlands. While spawning and rearing habitats occur in the extreme upper reaches of the major tributaries, FMO habitats for bull trout generally occurs in the mainstem of larger rivers and in the middle to lower reaches of major tributaries. The MRCU includes seven segments of shared foraging, migration, and overwintering (FMO) habitat. These include the Mid-Columbia River, Snake River, John Day River, Clearwater River, Grande Ronde River, Okanogan River, and Lower Chelan River. FMO habitat is defined as relatively large streams and mainstem rivers, including lakes or reservoirs, estuaries, and nearshore environments, where subadult and adult migratory bull trout forage, migrate, mature, or overwinter (USFWS 2015b, p. C-2). This habitat, typically downstream from spawning and rearing habitat, contains all the physical elements to meet critical overwintering, spawning migration, and subadult and adult rearing needs. There are no Core Areas overlapping the Action Area, rather, the Action Area overlaps portions of the Mid-Columbia, Snake River, and Clearwater River shared FMO habitats. These shared FMO areas, as well as the Action Area within these FMO areas, support the viability of bull trout populations by contributing to successful overwintering survival and dispersal among Core Areas (USFWS 2015a, p. 35).

Any foraging, migrating, or over-wintering bull trout that occur within the Action Area represent adult or subadult bull trout that originate from, or potentially interact with, the local populations within the major tributaries in proximity to the Action Area. Local populations from the Walla Walla River, Umatilla River, Tucannon River, Asotin Creek, and Imnaha River have been documented within the Action Area, and bull trout from the Clearwater River and Grande Ronde River Core Areas likely utilize the Action Area in small numbers, but there is no evidence of bull trout from the Touchet River, Yakima River, Wenatchee River, Methow River or any of the John Day River Core Areas utilizing the Action Area (USFWS 2010b, p. 439; Barrows et al. 2016). Bull trout originating in the Entiat River Core Area have been documented at Priest Rapids dam and moving into the Yakima River, and we assume a small number could be present in the Action Area; however, local data supporting the spatial presence or quantity of bull trout in the mainstream Columbia River in the Pasco, Washington area (i.e., upstream of the Snake River confluence) is not well documented (Anglin et al. 2012).

In general, subadult bull trout migrate from their respective spawning and rearing subbasins to the Mid-Columbia and lower Snake River during the fall/winter (from October to February), and to some extent during the spring/early summer (April to June) (Barrows et al. 2016). Movement from some subbasins to the mainstem has been documented during other months, but this appears to be less common (Barrows et al. 2016). Upstream movements within the mainstem river corridor were most common during the spring and summer (from March to September), and less frequent from October to November. Downstream movements were documented in the mainstem during all months (Barrows et al. 2016). Downstream passage timing for bull trout includes the time period when the juvenile fish bypass systems at the dams are shut down, leaving the turbines and adult fish ladders as the remaining downstream passage routes (Barrows et al. 2016).

Movement patterns within shared FMO habitat vary by population (Barrows et al. 2016). Most bull trout, upon entering the mainstem Snake and Columbia Rivers, move downstream of their respective spawning and rearing subbasins, but some have been documented moving upstream. Bull trout have been documented traveling the Columbia River as far as 240 river kilometers (RKM) downstream and 130 RKM upstream from the mouth of their natal subbasin (Barrows et al. 2016, p. 20). Some bull trout have been documented moving from the mainstem Columbia and Snake Rivers and into non-natal streams to overwinter. Some populations, such as the Imnaha, display high fidelity to fixed overwinter sites (i.e., displaying little movement during winter), which synonymous with overwintering observations in other study areas (Jackober et al. 1998; Schoby 2006). Conversely, bull trout from other populations, such as the Walla Walla, have been documented moving continuously while in shared FMO habitats. Although bull trout have been documented moving both upstream and downstream of all 13 dams with fish passage facilities along the mainstem Columbia and Snake Rivers (Barrows et al. 2016), including all dams within the Action Area, fish passage facilities are not designed for migratory bull trout. Movement may be discouraged or delayed at dams (delays have been documented at McNary, Little Goose, and Lower Granite dams), and the extent of passage failures, injuries, or deaths is unknown (Barrows et al. 2016). While year-round occupancy by bull trout has been observed (Barrows et al. 2016, p. 15), stream temperatures are often prohibitive during the warmest times of the years; thus, occupancy is more common from late fall through late spring.

Bull trout in the Columbia and Snake Rivers have been documented using deep, slow water habitat, but use of near-shore, shallow water habitat is less known. In large lakes, bull trout generally occur in deeper water habitat, moving into littoral zones to forage (see Goetz 1989). Although this has not been specifically documented in the Columbia or Snake Rivers, adult migratory bull trout are piscivorous (Fraley and Shepard 1989) and may move into shallower areas to forage on smaller salmonids or warm-water fish species (Kahler et al. 2000, p. 13; Benjamin et al. 2020, p. 4131). Vertical occupancy also appears tied to dominance and predation risk where larger bull trout tend to occupy shallower waters than smaller conspecifics (Gutowsky et al. 2013, p. 368), but occupancy of shallow depths generally occurs at night (Gutowsky et al. 2013, p. 368; see Al-Chokhachy et al. 2010). In terms of migratory movement, limited studies suggest pre-spawning bull trout migrate more often during the day while in the Columbia River, switching to nighttime migration upon entering spawning tributaries (Nelson et al. 2012, p. 57). Within both tributaries and mainstem, out-migration tends to occur more frequently at night.

Throughout the MCRU, consistent primary threats from upland/riparian land management, habitat loss, fish passage barriers, the introduction of non-native species (e.g. brook trout), and water quality and quantity exist (USFWS 2015b). Altered flow regimes, sedimentation rates, bank erosion and reduced channel complexity all reduce the quality of bull trout habitat. Declining salmon and steelhead populations could also negatively impact bull trout populations by reducing the number of juvenile salmon and steelhead that bull trout might prey on, and deprives the aquatic environment of marine-derived nutrients. Barriers between isolated populations continue to be a limiting factor for most of the bull trout subpopulations in the Columbia Basin.

12.1.2 Mainstem Mid-Columbia, Lower Snake, and Lower Clearwater Rivers

The mainstem Mid-Columbia River Basin portion of the MCRU encompasses areas of the mainstem Columbia River from John Day Dam to the Canadian border; however, the Corps' AORs are limited to the mainstem Mid-Columbia River from McNary Dam and including impounded waters forming Lake Wallula, which extends to approximately the Hanford Reach near Richland, Washington (Figure 1). McNary Dam also impounds the lower Snake River to Ice Harbor Dam. McNary Dam is located downstream of the Snake River confluence and upstream of the confluence of the Umatilla River. The Walla Walla River enters the Columbia River between McNary dam and the Snake River. Bull trout from the Walla Walla River Core Area (3 local populations) have been documented within the Action Area, but multiple lines of evidence suggest bull trout from the Touchet River Core Area, a tributary to the Walla Walla River, do not occur in the Columbia River. Bull trout from Core Areas outside of the Action Area, the Umatilla (one local population) and Entiat (two local populations) Core Areas, may also utilize portions of the mainstem Mid-Columbia River.

Table 5. Total bull trout PIT tag detections at Columbia River Systems dams from 2006 - August 2018.

Dam	Total # detected (range per year)	Size Range at tagging (mm)	Watershed tagged, if known
Bonneville	2 (0 - 1)	180 - 193	50% Hood River 50% White Salmon River
John Day	0	N/A	N/A
McNary	6 (0 - 3)	144 - 314	25% Tucannon River 75% Walla Walla River
Ice Harbor	2 (0 - 2)	233 - 234	100% Tucannon River
Lower Monumental	9 (0 - 4)	234 - 370	22% Unknown origin 78% Walla Walla River
Little Goose	18 (0 - 5)	179 - 580	38% Tucannon River 72% Unknown origin
Lower Granite	14 (0 - 9)	265 - 410	8% Tucannon River 92% Unknown origin

(Source: PTAGIS, cited in USFWS 2020, p. 129)

The lower Snake River Basin of the MCRU includes the Snake River from its mouth at the confluence with the Columbia River upstream to the confluence of the Salmon River; however, the Corps' AOR is limited to the upstream extent of Lower Granite Lake, which is comprised of the portion of the lower Snake River impounded by Lower Granite Dam. Four dams are located within the lower Snake River portion of the Action Area: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams. The Snake River between Lower Granite Dam and the confluence with the Columbia River includes three impoundments created by Little Goose, Lower Monumental, and Ice Harbor Dams. The Tucannon River enters the Snake River in the lower portion of Lower Monumental Reservoir. Asotin Creek and the Clearwater River enter the Snake River upstream of Lower Granite Dam. The lower Snake River geographic region supports six Core Areas for bull trout: four in the Clearwater River Basin, the Tucannon River, and Asotin Creek. Bull trout from the Tucannon River Core Area, and to a much lesser degree, the Asotin Core Area, have been documented in the lower Snake River. Bull trout from the Imnaha River Core Area, located outside of the Action Area, have also been documented in the lower Snake River, and it is believed that bull trout from the Clearwater River and Grande Ronde River Core Areas may also utilize the lower Snake River, but use has not been documented and use patterns are unknown (Barrows et al. 2016). A few bull trout have been documented moving from the lower Snake River into the Columbia River (Anglin et al. 2012, p. 3).

The Clearwater River Basin of the MCRU extends from the mouth near Lewiston, Idaho to the east across Idaho, although the Corps' AOR overlaps a very small portion, approximately 7 river miles of the lower Clearwater. The Clearwater River Basin supports four Core Areas of bull trout: South Fork Clearwater River, North Fork Clearwater River, Lochsa River, and the Selway River. There are no local populations of bull trout in the lower Clearwater River (USFWS 2015b, p. C-3). The lower Clearwater River is part of the Clearwater River shared FMO that provides essential FMO habitat and connectivity between Core Areas (USFWS 2015b, pp. C-3, C-321), but use of the Snake River by migratory bull trout from the Clearwater River has not

been demonstrated (Barrows et al. 2016). Since there are no barriers to downstream movement into the Snake River, it is expected that bull trout from the Clearwater River Basin may be present in the lower Snake River at low numbers.

Table 6. Bull trout observations at passage facilities at the Lower Columbia and Snake River Dams

Bull Trout Observations between 1991 and 2014 at lower Snake River Dams		Bull Trout Observations between 2005 and 2014 at two Lower Columbia River Dams	
Dam Facility	Total number (range per year for adult ladders only)	Dam Facility	Total number (range per year)
Ice Harbor	4 (0-3)	McNary	2 (0-2)
Lower Monumental	179 (2-47)	Priest Rapids	42 (0-9)
Little Goose	570 (3-161)		
Lower Granite	36 (0-8)		

(Adapted from Barrows et al. 2016, Appendix A)

Bull trout density in the Action Area is unknown. Bull trout use of the mid-Columbia and lower Snake River has been documented from observations in the fish ladders, PIT tag detections in the fish ladders and juvenile bypass systems, through various research projects, through PIT tag detections from bull trout entering the mainstem from tributary subbasins, and through anecdotal accounts (Barrows et al. 2016). In many cases, it is unknown from which populations or Core Areas these bull trout originate (Table 5). Therefore, total observations at the dams that influence the Action Area are summarized below (Table 6). While bull trout have been documented at the lower Snake River dams and facilities, the exact number of bull trout at the facilities remains unknown, and it is likely the numbers below are low in relation to total numbers of bull trout present in the mid-Columbia and Snake Rivers.

12.1.3 Status of Core Areas Associated with the Action Area

The following sections provide additional information for Core Areas that may contribute to bull trout presence in the Action Area.

12.1.3.1 *Walla Walla River and Touchet Core Areas*

McNary Dam is located just downstream of the Walla Walla River confluence with the Columbia River. The Walla Walla River headwaters drain from the western slopes of the Blue Mountains in northeastern Oregon/southeastern Washington to its confluence with the Columbia River at approximately river mile (RM) 316. Major tributaries include the Touchet River (a separate Core Area), Mill Creek, and the South Fork of the Walla Walla River (South Fork). The North Fork Walla Walla River (North Fork) and Yellowhawk Creek are smaller tributaries

within this Core Area. Headwater spawning areas contain nearly pristine habitats and support the most abundant populations in the region. The Walla Walla River Core Area contains three local populations in upper Mill Creek, Low Creek, and the South Fork Walla Walla River.

Primary threats within the Walla Walla River Core Area include dewatering/low flows that result in seasonal barriers; water quality impairments from multiple sources (e.g., agricultural practices and urban development), elevated water temperatures, and structural passage barriers to migration (USFWS 2015b; 2008). Other threats include predation by smallmouth bass and walleye in FMO habitat, as well as competition by hatchery origin rainbow trout and brown trout. Entrainment at diversions and passage barriers, as well as temperature barriers and low flows, prevent bull trout from moving freely between spawning habitat and FMO habitat. Improving connectivity among local populations and between Core Areas throughout the Walla Walla River watershed and the mainstem Columbia River is critical to maintaining redundancy and supporting resiliency of bull trout in the Walla Walla River Core Area (USFWS 2015b; Schaller et al. 2014).

While the South Fork Walla Walla and Mill Creek currently support sizable populations of bull trout, including multiple life history expressions (Schaller et al. 2014), redd counts over the last 15 years have indicated notable declines in abundance (USFWS 2015b; Anglin et al. 2008a,b). Between 2001 and 2012, redd counts in the South Fork Walla Walla declined from over 400 to 100. Populations in Mill Creek also declined as much as 63 percent between 2006 and 2010 (USFWS 2015b; Howell and Sankovich 2012, Howell et al. 2018). Several reports attribute declines in population to loss or reduced numbers of large migratory bull trout throughout the Basin (USFWS 2015b; Schaller et al. 2014; Barrows et al. 2016).

Bull trout migrations in the Walla Walla River Core Area are relatively well-documented (Barrows et al. 2016; Al-Chokhachy and Budy 2007, 2008; Al-Chokhachy et al. 2005, 2009; Budy et al. 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012; Bowerman and Budy 2012; Bowerman 2013; Hemmingsen et al. 2001a,b,c,d, 2002). Bull trout entering the Columbia River range between sub-adults (> 200 millimeters [mm]) and small adults (< 350 mm) (Anglin et al. 2008b, 2009a,b, 2010; Barrows et al. 2012a,b). Downstream movements to the mainstem Walla Walla River or Columbia River typically begin in March and continue as surface flows decrease and water temperatures increase in June through August (Schaller et al. 2014; Koch 2014). Downstream migration resumes during fall and winter into lower subbasin reaches (i.e., lower one-third of the subbasin) and into the mainstem Columbia River through February (Barrows et al. 2016). Mobile tracking data from acoustic-tagged bull trout indicated that bull trout were actively moving while occupying the mainstem Columbia River corridor (Barrows et al. 2016).

Bull trout return to the Walla Walla River and into upper tributaries between March through June, generally peaking in April and May. However, only 54 percent of the acoustic-tagged bull trout that entered the Columbia River subsequently returned to the mouth of the Walla Walla River. To reach overwintering areas after spawning, bull trout make rapid, incremental downstream movements as far as the mainstem Columbia River from September through February (Barrows et al. 2016). As previously mentioned, bull trout from the Walla Walla basin do not appear to establish fixed winter ranges while in the mainstem, instead continuously move throughout the corridor.

Although precise survival estimates for Walla Walla bull trout that enter the mainstem Columbia River are unknown, limited data suggests few bull trout that enter the mainstem return to the subbasin (Barrows et al. 2016). Between 2005 and 2009, the Corps funded the installation and operation of a PIT detection array near the mouth of the Walla Walla River to estimate the number of Walla Walla subbasin bull trout that were using the Columbia River (Anglin et al. 2008b, 2009a,b, 2010; Barrows et al. 2012a,b). Eighty-nine PIT-tagged bull trout were detected moving downstream past the PIT array from October through February, peaking in November and December during most migration years. Sixteen (18 percent) were subsequently detected returning to ascend the Walla Walla River, of which only two (13 percent) reached headwater spawning areas. Only one (1 percent) of the 89 individual bull trout detected at the Oasis Road Bridge (ORB) PIT array has migrated to the Columbia River multiple times. PIT tags from six (7 percent) of the individual bull trout detected at the ORB PIT array were subsequently recovered on avian nesting colonies on islands in the mainstem Columbia River (Barrows et al. 2016). One bull trout was recaptured within the Umatilla River Subbasin. The ultimate fates of 66 (74 percent) of the 89 PIT-tagged bull trout that were detected at the ORB PIT array are unknown, but they did not return to ascend the Walla Walla River (Barrows et al. 2016). Data from PIT-tagged bull trout indicate that bull trout use the mainstem Columbia River year-round and likely interact frequently with McNary Dam and other dams throughout the Columbia River. Walla Walla subbasin bull trout have been documented upstream as far as Priest Rapids Dam, and at Lower Monumental dam on the lower Snake River (Table 5).

A tributary to the Walla Walla River, the Touchet River Core Area drains the northern and northwestern portions of the Walla Walla Basin before entering the lower mainstem Walla Walla River about 21.6 miles upstream of the Columbia River near the community of Touchet, Washington. Several studies looked extensively at bull trout spawning and early life history in the Touchet River Core Area (Mendel et al. 1999, 2000, 2001; Mahoney et al. 2012). Both fluvial migratory and resident forms are present throughout. However, recent telemetry and PIT tag data indicate migratory bull trout in the Touchet River Core Area remain within the overall Walla Walla Basin, foraging and overwintering in the lower Touchet River drainage or mainstem Walla Walla River, and do not migrate into the Columbia River (Schaller et al. 2014). While there are no barriers to movement of Touchet River bull trout into the Columbia River, available data indicate unlikely use by this Core Area (Barrows et al. 2016).

12.1.3.2 Umatilla Core Area

Umatilla River Basin headwaters drain from the coniferous forested, western slopes of the Blue Mountains in northeastern Oregon through steep volcanic canyons, rolling foothills, and broad alluvial lowlands before eventually reaching the Columbia River at about RM 292 below McNary Dam (USFWS 2002a). The recovery plan (USFWS 2015b) identified one local population, the upper Umatilla Complex that includes the North Fork and South Fork Umatilla Rivers, although spawning has only been documented in the North Fork Umatilla River. The Umatilla River contains both resident and fluvial bull trout. In 2008, the population was estimated between 50 to 250 individuals, but the trend in abundance was unknown (USFWS 2008a, p. 69). Redd counts between 2009 and 2013 resulted in an annual average of 19 redds (USFWS 2015b), suggesting the Core Area is likely depressed (i.e., the population size is small or historic, experiencing substantial threats, and/or has a long-term declining trend in

population/redd counts). Despite the population status, between 2006 and 2015, four bull trout were observed in McNary Dam ladders, based on visual counts and PIT detections (Bonneville et al. 2017), and connection between the Umatilla, Walla Walla, and Touchet River Core Areas has been documented (USFWS 2015b, p. C-5). Given the detections at McNary Dam and connectivity to neighboring populations, it is possible bull trout from the Umatilla Core Area may be present in the Action Area, albeit at very low densities.

Threats to bull trout in this Core Area include inadequate stream flows as a result of irrigation dams and diversions (Anglin et al. 2008a), water temperatures (USFS 2001a, Contor et al. 2007), water quality impairment from multiple sources (e.g., agricultural practices, grazing practices, urban development, etc.), dewatering/low flows, passage barriers to migration, development (e.g., urbanization and transportation networks) (USFWS 2008a), and threats from non-native species (i.e., brook trout) (USFWS 2015b, p. C-8). This population is considered high risk of negative effects from increased water temperatures and loss of habitat associated with climate change (USFWS 2015b, p. C-11).

12.1.3.3 Entiat River Core Area

The Entiat River is located in Chelan County and drains an area of approximately 1,085 square kilometers (km²: 419 square miles (mi²)) (NPCC 2004a; Andonaegui 1999). Flowing southeasterly the Entiat River enters the Columbia River near the town of Entiat, approximately 32 kilometers (km) (20 miles) upstream from Wenatchee at RM 484 of the Columbia River (USFS 2017). Due to the small size of the watershed, bull trout habitat and carrying capacity is limited in the Entiat River Core Area. Unique to the Entiat River Core Area, as much as 90 percent of the population uses the mainstem Columbia River for FMO (USFWS 2015b). The Entiat Core Area supports two local populations of bull trout: one in the upper mainstem Entiat River and one in the Mad River. Since 2000, the number of redds in the mainstem has fluctuated widely between 1 and 50 (Nelson 2014, p. 27). Within the Mad River, redd counts have varied from 7 to 52, continuing this trend through 2012 (USFS 2003, p. 1; Nelson 2014, p. 27). In 2008, the Entiat Core Area was listed as Stable, but at risk (USFWS 2008a, p. 35). The low numbers of spawning migratory bull trout in the Entiat Core Area increases the risk of extirpation from stochastic events.

Sub-adults move out of the Entiat in both the spring (peak in April – June) and fall (peaks in October - December) and have been documented moving upstream of Wells Dam, downstream into the Wenatchee (Nelson et al. 2011; Nelson 2014, p. i) and Yakima Rivers, staying for up to 9 months and moving back to the spawning grounds in the Entiat River (USFWS 2015b, p. C-6). Returning spawners begin staging at the mouth of the Entiat River in May and June (Nelson 2014 p. i) and return to the Columbia River following the spawning period from September - December. Given the known movement to the nearby Yakima River, it is possible some small number of bull trout may also move into the lower Snake River, but this has not been documented.

Legacy and ongoing land management actions have negatively affected bull trout habitat and have included timber harvest and fire suppression, irrigation diversions, grazing, and overfishing. The Entiat River is also subject to anchor ice scour in winter and flooding during spring and fall

rainstorms, which combined with fire, irrigation, and grazing impacts has led to increased loss of habitat complexity. The low numbers of spawning migratory bull trout in the Entiat Core Area increases the risk of extirpation from stochastic events, and loss of connectivity between Core Areas in this region of the Columbia River (upstream of the Action Area) have impacted bull trout population resiliency. High variations in annual redd counts, high risk of extirpation from stochastic events, and reduced connectivity with other Core Areas classifies the Entiat River Core Area as depressed for this Opinion.

12.1.3.4 Yakima, Wenatchee, and Methow Core Areas

The Yakima River Basin is located in south central Washington, draining approximately 15,900 km² (6,155 mi²) into the Columbia River (NPCC 2004b; WDFW 1997a). The Yakima River flows southeasterly from its headwaters in the Cascade Mountains to its confluence with the Columbia River at RM 333 (NPCC 2004b). Bull trout populations are distributed across the Yakima River Core Area in 15 local populations, but populations appear to be declining and three populations are considered functionally extirpated. Only populations in South Fork Tieton appear stable with average annual redd counts ranging from 137 to 207 on average (USFWS 2015b). Historic and ongoing land use including irrigation and agriculture has altered the Yakima River Core Area (USFWS 2015b). The Yakima River Basin's water supply is over-allocated, and reservoir storage and flow releases are highly regulated, emphasizing irrigation and flood control obligations above all other functions. Storage reservoirs and associated dams have restricted connectivity and movement between populations in the Core Area, as well as limiting downstream movement to the mainstem Columbia River (USFWS 2015b). In addition, altered flow regimes have increased water temperatures in the lower Basin. The effects of the highly altered flow regime on the bull trout and its designated critical habitat include mortality, reduction of prey, disruption of aquatic functions, and poor habitat connectivity that impairs or prevents bull trout from accessing spawning tributaries and limits FMO opportunities, and impacts to water quality and quantity. Other threats facing populations of bull trout in the Yakima Core Area include legacy impacts of transportation infrastructure, grazing, non-native species introductions, and small population size (USFWS 2015b). It is likely that historically, the mainstem Columbia River provided valuable overwintering and foraging areas for bull trout from the Basin (Barrows et al. 2016). To date, there is no documentation of bull trout from the Yakima Core Area moving from the headwaters into the mainstem Columbia River but the movement of bull trout in this Core Area to the Columbia River has not been well-studied (Barrows et al. 2016). The impediments to passage and very low abundance of Yakima Core Area bull trout suggest the number of bull trout that may enter the Columbia River is very limited, thus, occurrence within the Action Area appears unlikely.

The Wenatchee Basin is located in Chelan County and encompasses approximately 3,551 km² (1,371 mi²) in central Washington (NPCC 2004a; Andonaegui 2001). The Wenatchee River drains into the Columbia River at RM 470 near the town of Wenatchee (NPCC 2004a). There are seven local populations in tributaries of the Wenatchee River. Overall, the trend for the Wenatchee Core Area seems to be stable and suggests a slightly increasing trend, although most of the stable trend is due to a single local population in the Chiwawa River. The Wenatchee River Core Area exhibits multiple life history patterns and is one of the most diverse populations in the MCRU (USFWS 2015b). Local populations consist of a migratory form that migrates

from spawning areas near the crest of the Cascade Mountains to Lake Wenatchee, the mainstem Wenatchee, the Columbia River and back to other Core Areas to forage and overwinter. A small percentage (15 to 20 percent) is estimated to migrate long distances, including into other Core Area, for foraging or overwintering and may migrate back to spawning areas annually, semi-annually, or every few years (USFWS 2006; Kelly Ringel et al. 2014; BioAnalysts 2004; Nelson and Nelle 2008; Stevenson et al. 2009). Across the Wenatchee Core Area, threats to bull trout include habitat loss, historical land use practices including timber harvest, water withdrawals, fish management, and lost connectivity (USFWS 2015b). Although passage is possible, passage is hindered by a number of dams between the mouth of the Wenatchee River and the lower Snake River. Bull trout from this Core Area have not been documented in Lake Wallula or in the lower Snake River and we do not anticipate bull trout from this Core Area in the Action Area.

The Methow River Core Area is located in Okanogan County and drains an area of approximately 4,895 square kilometers (km²) (1,890 mi²) (NPCC 2004a). The confluence of the mouth of the Methow River with the Columbia River is at RKM 843 (RM 524) near Pateros in north central Washington. In the Methow River Core Area, bull trout persist at low numbers, in ten small, fragmented, local populations (DeHaan and Neibauer 2012). As many as 15 to 20 percent of bull trout in this Core Area migrate between other Core Areas and to the mainstem Columbia River annually (USFWS 2015b; USFWS 2006; Nelson and Nelle 2008; Kelly Ringel et al. 2014; BioAnalysts 2004; Stevenson et al. 2009). Both legacy and ongoing threats continue to impact bull trout populations in the Methow Core Area. Management actions such as fire suppression and timber harvesting have changed much of the area to an unnatural high-intensity fire regime with increased fire burned areas, where high-intensity summer rainstorms and rain on snow events can accelerate rates of erosion. Forest management on both National Forest and private timber lands, agriculture operations, fish management at the Winthrop National Fish Hatchery, and numerous irrigation diversions have both legacy and current ongoing impacts affecting the Core Area. Connectivity between Core Areas from dam operations impact persistence of bull trout in the Core Area (USFWS 2015b), and early fall movement of sub-adult bull trout may be impacted in the Twisp River, Lost River, and mainstem Methow River because of seasonal dry or subsurface flow reaches (Nelson and Johnson 2012; LGL and Douglas PUD 2008). Bull trout from the Methow Core Area have not been documented in the lower Snake River. Although passage is possible, yet impeded by multiple dams between the mouth of the Methow and the lower Snake River, the small population size and smaller portion that might migrate to the Columbia River suggests Methow bull trout use of the lower Snake River or Lake Wallula is either very minimal or unlikely. We do not anticipate bull trout from this Core Area in the action Area.

12.1.3.5 Tucannon Core Area

The Tucannon River originates in the Wenaha-Tucannon Wilderness Area of the Blue Mountains in southeastern Washington and drains approximately 1,303 km² (503 mi²) (CCD 2004; Faler et al. 2008). The Tucannon River enters into the Snake River at RM 62, upstream of Lower Monumental Dam and downstream of Little Goose Dam (USFWS 2000). Several tributaries feed the Tucannon River, including Pataha, Kellogg, Willow, Tumalum, Cummins, and Panjab Creeks (CCD 2004; Bilhimer et al. 2010; Anchor 2011).

Current and historical land uses throughout the Basin include dry and irrigated cropland, livestock rangeland, logging, recreation, and low yield mining (CCD 2004). Much of the headwaters on the mainstem Tucannon River remain in public ownership under management of the U.S. Forest Service (USFS) and the Washington Department of Fish and Game (WDFW) (e.g., the Wooten Wildlife Area). Bull trout still occupy most of their historic range in the Tucannon River watershed, and prior to 2000 the population of the Core Area was considered relatively large (USFWS 2010b). Genetic analyses indicate there are currently five local populations of bull trout, and possibly a sixth, within the Core Area of the Tucannon River watershed (USFWS 2008a; Kassler et al. 2013). These local populations have been considered fairly isolated from local populations in other regional tributaries, such as the Walla Walla River, Clearwater River, and Asotin Creek (USFWS 2010a). Both resident and migratory forms of bull trout still occur in the Tucannon River watershed (Martin et al. 1992; WDFW 1997b) and recent data indicate that migratory bull trout from the Tucannon River use the mainstem Snake River (Underwood et al. 1995; WDFW 1997b; Faler et al. 2008; Bretz 2011; D. Wills, pers. comm. 2014, cited in USFWS 2020). Migration to the mainstem typically occurs from October to June for both adults and subadults, and spawning migrations typically occur from March to July.

Between 2000 and 2007, redd counts and capture records suggest that populations in the Tucannon River underwent a noticeable decline. The average number of redds documented annually in the upper watershed dropped from over 100 during the early 2000s to less than 20 by 2007 (Mendel et al. 2006; Bretz 2011), while the number of migrating bull trout documented annually at the Tucannon Hatchery trap declined from over 250 to approximately 50 during the same time period (Mendel et al. 2006; Bretz 2011). Many of the bull trout captured in 2007 were also considered in poor health with new or recent injuries (cuts and scrapes) around their heads and gills. The cause(s) of these declines and the poor condition of some of the captured fish are unknown, although two large fires occurred in the Tucannon River watershed during the mid-2000s that resulted in higher sediment delivery to streams in the Core Area (USFWS 2008a).

Over this time, the declines of bull trout may have coincided with a reduction in migratory fish due to fish age (older fish died after spawning) or as a result of seasonal migration barriers preventing returns (Bretz 2011, p. 19). Loss of nutrients and a declining prey base from dwindling anadromous salmonid populations, and physical (e.g., dams, fences, nets, weirs) or temperature barriers in the mainstem Tucannon River and its tributaries are also likely contributing factors (CCD 2004, p. 136). More recent information indicates the Tucannon River population may have rebounded somewhat since 2007, with over 230 bull trout observed during trapping and survey activities in 2013 (WDFW 2014, p. 7) and recent redd count data. However, it is still unclear if the populations have stabilized.

The local populations of bull trout within the Tucannon River watershed can still generally move freely among their natal streams (Deeds 2008, p. 14). However, several partial, seasonal or potential barriers exist throughout the Basin and dams on the Snake River hinder bull trout movement between Core Areas. The Tucannon Hatchery trap, located at RKM 58 (RM 36), is a partial barrier to bull trout movements during the trapping season from January to September (Bumgarner and Engle 2020). In addition, rock and debris dams on several Tucannon River tributaries have been known to block migration of bull trout in the watershed (Faler et al. 2008).

Other ongoing threats include flood control, irrigation withdrawals, livestock grazing, logging, hydropower production, management of non-native fish species, recreation, urbanization, and transportation networks (USFWS 2008a; Anchor 2011).

Bull trout from the Tucannon River Core Area routinely use the mainstem Snake River and are known to occur in the Action Area (Tables 5 and 6). Limited evidence from radio and PIT-tags found between 6 and 29 percent of bull trout captured in the Tucannon River entered the reservoir-influenced section of the lower Tucannon or the mainstem lower Snake River between 2002 and 2009 (Barrows et al. 2016, p. 84), but annual estimates of bull trout entering the lower Snake River, and thus, the Action Area, are unknown. Although difficulties with tracking bull trout in the lower Snake River has hindered estimates of use and movement patterns, at least one bull trout from the Tucannon subbasin has been documented at McNary Dam on the Columbia River (Table 5).

12.1.3.6 Asotin Core Area

Originating out of the Blue Mountains in southeastern Washington, Asotin Creek drains a total area of approximately 83 km² (32 mi²) and includes 524 km (326 mi) of perennial and intermittent streams (Kuttel 2002, p. 79). Asotin Creek enters the Snake River near Clarkston, Washington at RKM 234 (RM 145), approximately 56 km (35 mi) upstream of Lower Granite Dam (Kuttel 2002, p. 14; Barrows et al. 2016). Within the Asotin Creek Core Area, there is one known local bull trout population in North Fork Asotin Creek, which includes Cougar Creek (Kassler and Mendel 2008; J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130). Abundance information and redd count data indicate that the population is very small and likely at critical levels (Martin et al. 1992; Underwood et al. 1995; Mendel et al. 2006; J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130; Barrows et al. 2016). Redd counts in North Fork Asotin and Cougar Creeks ranged from 10 to 13 in survey years 2005, 2006, and 2012 (J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130). Current data suggest that the population consists of both resident and migratory forms of bull trout in the Asotin Creek Core Area (Kassler and Mendel 2008; Mayer and Schuck 2004; Mayer et al. 2006; Crawford et al. 2011; Barrows et al. 2016). However, data also suggests that instream conditions may seasonally limit movement of migratory bull trout in the Basin (Barrows et al. 2016).

Legacy effects of livestock grazing, forest practices, transportation, and recreation negatively affect water quality, sedimentation, and channel complexity throughout the Core Area (Kuttel 2002). Extensive flood damage to the channel and riparian zone in the mid-1990s are still apparent in George Creek (Ullman and Barber 2009). Many of these effects in the tributaries are being addressed through watershed planning and implementation processes and other mechanisms (WDFW 2006a; Ullman and Barber 2009; Middle Snake Watershed Planning Unit 2011; Ecology 2011). The quality of FMO in the Snake River as well as habitat in the headwaters are likely to be important to the persistence of bull trout in Asotin Creek.

While studies have shown movement of bull trout throughout the Asotin Creek Core Area (Barrows et al. 2016), low instream flows, intermittent flows with areas of subsurface flows, and a partial to full passage barrier at Headgate Dam (RM 9 [RKM 6]) negatively impact the persistence of migratory bull trout and reduce connectivity between tributaries within the Core

Area. Migration to the Snake River has been documented in both spring and fall for subadults, but also in both October and May for adults (Barrows 2016, p. 173). Few bull trout from the Asotin Core Area have been documented in the Snake River in recent years due to few tagging or genetic studies within the Basin. In 2016, a single bull trout from North Fork Asotin was documented at the fish passage facilities at Lower Granite Dam (T. Marsh, pers. comm. 2017, cited in USFWS 2020, p. 131). Due to the small population size of bull trout in the Asotin Core Area, the total number of bull trout using the lower Snake River is expected to be very low.

12.1.3.7 Grande Ronde and Imnaha Core Areas

The Grande Ronde River originates from the Blue Mountains of northeast Oregon and southeast Washington, flowing generally northeast to join the Snake River at RM169, approximately 20 miles upstream of Asotin, Washington. Divided into three watershed areas, the Upper Grande Ronde, Lower Grande Ronde, and Wallowa, the Grande Ronde subbasin drains much of the northeast corner of Oregon and approximately 341 square miles of southeast Washington. The Grande Ronde River subbasin supports four Core Areas, with 17 local populations. Three of the Core Areas and at least seven of the local populations support migratory bull trout (Barrows et al. 2016, p. 96). Populations in the Little Minam and Wenaha River support some of the most abundant populations in the lower Snake River geographic region, but the population in the Upper Grande Ronde River is considered depressed (USFWS 2015b, p. C-7), threatened by livestock grazing, forest practices, and connectivity barriers caused by low flows and high water temperatures (USFWS 2015b, p. C-32). Use of the mainstem Snake River by migratory bull trout from the Grande Ronde River Core Areas has not been directly observed, however sampling near the mouth suggests it is likely. There is no documentation of interactions with mainstem Snake River dams (Barrow et al. 2016). However, given several populations express migratory life histories, the Service expects that small numbers of bull trout from Grande Ronde Core Areas may use the mainstem Snake River seasonally for foraging, migration, and overwintering purposes. It is unclear whether these individuals occur within the Action Area, which begins 24 miles downstream, but the presence of strong populations in the Core Area, connectedness, large migratory distances of bull trout and the large proportion of bull trout of unknown origin at lower Snake River dams suggests Grande Ronde basin bull trout use of the Action Area may be likely (Table 5).

The Imnaha River subbasin supports one Core Area with eight local populations (USFWS 2015b, p. C-33). The Core Area supports both resident and migratory bull trout and is considered one of the most stable populations in the MCRU, along with the Wenaha (tributary to the Grande Ronde), Wenatchee, and Clearwater River basins populations (USFWS 2015b, p. C-8). The Service identified no primary threats associated with this population (USFWS 2015b, p. C-33). Sub-adult bull trout move into the lower Snake River mostly in the fall (Barrows et al. 2016, p.103). Adult bull trout move into the lower Snake River shortly after spawning and continue into January (Barrows et al. 2016, p.103). Approximately 800 to 1200 adult bull trout return from the lower Snake River to the Imnaha River each year, and radiotelemetry indicates bull trout use the lower Snake River between the Imnaha River upstream to Hells Canyon Dam (Barrows et al. 2016). Interactions with mainstem lower Snake River dams are largely unknown, and none have been detected at the PIT detection arrays on any of the four lower Snake River

dams (Barrows et al. 2016). However, from 2006 to 2011, 12 bull trout were collected at the Little Goose Dam juvenile fish facility, and samples were taken for genetic analysis. One of those samples was determined to be from the Imnaha River, indicating at least some use of the Action Area.

12.1.3.8 Clearwater Core Areas

The Clearwater River Basin is located east of Lewiston, Idaho, and extends from the Snake River confluence at Lewiston on the west to headwaters in the Bitterroot Mountains along the Idaho-Montana border. The Action Area includes the lower Clearwater River from approximately 5 miles upstream from Lewiston, Idaho to the confluence with the lower Snake River. Historic records of bull trout use and abundance in the lower Clearwater River are lacking, presumably because bull trout were considered a nuisance species and because records were not actively maintained (CBBTTAT 1998, cited in Ecovista et al. 2003, p. 322), but bull trout presence in the lower Clearwater River is thought to be minimal. In 2008, the service ranked bull trout in the Clearwater River as declining (USFWS 2008a, p. 33). Clear Creek, a tributary to the Lower-Middle Clearwater River, was previously reported to potentially support spawning and rearing habitat for bull trout (USFWS 2002b, p. 39), but spawning and rearing has not been documented in Clear Creek or any other tributary streams in the Lower and Middle Fork Clearwater River watersheds (USFWS 2015b, p. C-3, 2014, p. 4). In 1999, a few bull trout were documented in the Upper Potlatch River, but none were found in the middle or lower drainage nor were any found in subsequent studies (Cochner et al. 1996, p. 124; Cochner et al. 2002, p. 62). Continued surveys by the Idaho Department of Fish and Game (IDFG) in lower Clearwater River tributaries have failed to capture any bull trout (B. Bowersox, IDFG, pers. comm. 2021). Since operations began in 1989, no bull trout have been documented at the spring-run downstream anadromous smolt migrant trap, which is located in the lower Clearwater River near easternmost extent of the Action Area (near Upper Goose Landing).

Bull trout use of the mainstem Clearwater River is thought to be seasonal, as summer water temperatures exceed those preferred by bull trout, especially outside the Dworshak Dam influenced reaches. The factors limiting bull trout in the Clearwater River Subbasin include habitat degradation, loss of prey species, passage barriers, hybridization and competition with exotics, and illegal harvest (CBBTTAT 1998a, pp. 15-20). Deep pools in the Middle Fork may support overwintering and provide thermal refugia (USFWS 2002b). During late spring and summer, water is released from lower levels of the Dworshak reservoir to help cool water temperatures in the lower Snake River downstream of the Clearwater and Snake River confluence. These cooler waters improve thermal conditions for bull trout, salmon, and steelhead in the lower Snake and Clearwater Rivers (Cook and Richmond 2004, p. 1).

12.1.3.9 North Fork Clearwater River Core Area

The North Fork Clearwater River Core Area comprises 12 local populations of bull trout and includes the North Fork Clearwater River and all tributaries upstream of Dworshak Dam. Based on redd counts as an indicator of the Core Area population trend for all streams in the North Fork Clearwater River Core Area, the population went through an increasing trend from about 2000-2010's (USFWS 2013; Meyer et al. 2014; Erhardt and Scarnecchia 2014, cited in USFWS 2015b), but then stabilized beginning in 2001 (Hand et al. 2018, p. 80). The most recent redd counts have been declining but further monitoring is needed to determine stability. Bull trout are widely distributed within the North Fork Clearwater River Core Area, with bull trout redds documented in at least 33 streams associated with the 12 stream complexes identified.

Dworshak Reservoir provides foraging, rearing, and overwintering habitat for subadult and adult bull trout that occupy the reservoir (USFWS 2002b; CSS 2001), but Dworshak Dam isolates bull trout populations in the North Fork Clearwater River Core Area from the Middle and lower Clearwater, South Fork Clearwater, Lochsa, and Selway Rivers (USFWS 2002b, p. 17, 2005). The Idaho Department of Fish and Game (IDFG) has radio-tagged bull trout captured in Dworshak Reservoir and documented their spawning migration into headwater tributaries of the North Fork Clearwater River and their return to the reservoir for overwintering. In those studies, IDFG observed adult bull trout migrate out of the reservoir starting late May to mid-June and return mid-October (Cochner et al. 2002, Schriever and Schiff 2003, p. 21; Schiff and Schriever 2004, p. 9). Prior to the construction of Dworshak Dam, bull trout likely migrated into the mainstem Clearwater River to overwinter, and mixed with individuals from the Lochsa, Selway, and South Fork Clearwater River Core Areas (USFS 2001b). The mainstem portion of the North Fork Clearwater River from Dworshak Reservoir slack water upstream to the confluence with Kelly Creek supports subadult and adult rearing and migration, although current bull trout densities in this area are low (less than 0.5 fish/100 m²) (CBBTTAT 1998b, p. 46). The Service did not identify entrainment as a primary risk to recovery of bull trout but did suggest it as a risk factor (USFWS 2015b). Incidental entrainment of bull trout through Dworshak Dam has been documented using direct and indirect methods (CBBTTAT 1998a; Hanson et al. 2006). Although telemetry studies found bull trout captured at the base of Dworshak Dam remained within the lower Clearwater River above the Action Area, connectivity is available and this Opinion assumes bull trout from this Core Area may be present in the Action Area, but is thought to be very limited.

12.1.3.10 South Fork Clearwater Core Area

The mainstem South Fork Clearwater River provides subadult and adult rearing habitat as well as FMO habitat, and the Core Area provides connectivity for local populations within and among other Core Areas. The lower reaches of large tributaries in the Core Area provide thermal refuge in summer months (USFWS 2015b, p. C-323). IDFG (Schriever et al. 2008, pp. 131-138) has conducted juvenile bull trout distribution studies in most tributaries and headwater streams of the Core Area. These studies have confirmed that bull trout are widely distributed throughout the South Fork Clearwater River (USFS 2014, p. 33). Local populations currently use spawning and rearing habitat in five stream complexes (USFS 2014, p. 33; USFWS 2015b, pp. C-322). Populations in the South Fork are considered strong. No primary threats were identified in the

Recovery Plan for this Core Area (USFWS 2015b, p. C-30) but threats from legacy upland and riparian land management, instream impacts, and non-native fish were identified as factors influencing populations (USFWS 2015b, p. C-323). Forest practices, mining, roads, and grazing activities have altered stream segments by reducing large wood recruitment, pool formation, and off-channel areas, and by increasing sedimentation (USFWS 2015b, p. C-30, C-323). Bull trout from the South Fork Clearwater Core Area use the mainstem Clearwater River for FMO. Although bull trout from this Core Area have never been documented in the Action Area, connectivity is available and we assume bull trout from this Core Area may be present in the Action Area in small numbers, seasonally, as temperatures allow.

12.1.3.11 Selway River Core Area

The Selway River Core Area is located in Idaho and Clearwater counties and includes the Selway River and all its tributaries. The Core Area encompasses approximately 520,242 ha (1,285,516 ac), about 85 percent of which occurs in the Selway-Bitterroot and Frank Church-River of No Return Wilderness Areas (USFS 2001b, p. 1-9). The Selway River provides FMO habitat for 10 local populations of bull trout in the Core Area and provides connectivity for populations in other Core Areas of the lower Snake River geographic region (USFWS 2008a, 2015b). The Selway River Core Area supports a metapopulation of fluvial bull trout that are widely distributed in variable densities; resident local populations are present in some upper tributary reaches. No threats to bull trout in the Selway Core Area were identified in the 2015 Bull Trout Recovery Plan (USFWS 2015b). Subadult and adult bull trout have been observed in the Selway River (CBBTTAT 1998a) and use it for FMO. Bull trout occupancy has been verified by USFS stream surveys (USFS 2009) and individuals are likely to use all accessible areas of the Selway River Core Area. High water temperatures may preclude use in some reaches during low flow, hot summer months (USFWS 2008a). Bull trout from the Selway Core Area use the mainstem Clearwater River for FMO and may be present in the Action Area seasonally, as temperatures allow, in small numbers.

12.1.3.12 Lochsa River Core Area

The Lochsa River Core Area is located in Idaho County and encompasses an area of about 303,024 ha (748,773 ac). The Core Area extends from the confluence of the Lochsa and Selway Rivers to the headwaters of Colt Killed and Crooked Fork creeks, which converge to form the Lochsa River. Seventeen local populations of bull trout are currently known to use spawning and rearing habitat throughout the Lochsa River Core Area. In 2008, the Lochsa population was considered stable (USFWS 2008a, p. 34), and no primary threats were identified in the recovery unit implementation plan (USFWS 2015b, p. C-20). Adults and subadults are suspected to use nearly all accessible areas of the Core Area for FMO and rearing (CBBTTAT 1998c, p. 23), and the lower reaches of multiple tributaries provide thermal refuge from high summer in-stream temperatures in the mainstem Lochsa River. The Lochsa River provides important FMO habitat for the local populations within the Core Area and connectivity to populations in other Core Areas of the Clearwater River Basin (USFWS 2015b). The 2015 Recovery Plan identified no threats to populations in this Core Area. As there are no barriers to downstream movement, bull trout may be present in the Action Area from the Lochsa Core Area in small numbers, seasonally, as temperatures allow.

12.1.4 Status of Critical Habitat in the Action Area

Within the MCRU, three critical habitat units (CHUs) fall overlap the Action Area (USFWS 2010b). The mainstem Upper-Columbia River (CHU 22) includes the Columbia River from John Day Dam upstream to Chief Joseph Dam. The mainstem Snake River (CHU 23) includes the Snake River from Hells Canyon Dam downstream to the confluence with the Columbia River. Lastly, the Clearwater River (CHU 21) includes all portions of the Clearwater River Basin to its confluence with the Snake River. Within adjacent tributaries, several other CHUs are designated. These include the Yakima River (CHU 11), Walla Walla River Basin (CHU 14), and the lower Snake River Basins (CHU 15). While connected to the three CHUs present in the Action Area, these adjacent CHUs do not fall within the Action Area and are not addressed further in this Opinion.

Following brief descriptions of each of the CHUs present in the Action Area, the status of all nine Primary Constituent Elements (PCEs) for each CHU is provided.

12.1.4.1 Mainstem Upper Columbia River CHU 22

The Mainstem Upper Columbia River CHU 22 includes the mainstem Columbia River from Chief Joseph Dam downstream to John Day Dam and all inundated/backwater portions of tributaries (USFWS 2010b). This CHU supports FMO habitat for bull trout and provides connectivity between the mainstem Lower Columbia River (CHU 8), Snake River (CHU 23), and several tributary CHUs adjacent to the Action Area (USFWS 2010b; USFWS 2008a; BioAnalysts 2004, 2007, 2008). The Mainstem Upper Columbia River CHU was identified essential for bull trout to conserve migratory corridors for fluvial bull trout in adjacent Core Areas (USFWS 2010b). This CHU overlaps the Corps' Tri-Rivers AOR from McNary Dam upstream to the Hanford Reach (Figure 1).

Land ownership in the CHU is a mixture of local, state, tribal, Federal, and private interests, though the majority of land use consists of agriculture, rangeland, and residences (USFWS 2015b, p. C-344). Major habitats include waterbodies such as the Columbia River reservoirs and associated tributaries, wetlands associated with tributary floodplains and low-lying depressions, riparian areas, and the adjacent upland communities that include managed agriculture/pasture lands, shrub-steppe, and forest habitats (Douglas County PUD 2011). While bull trout spawning and rearing does not occur within CHU 22, bull trout occur year-round using the unit for FMO. CHU 22 provides connectivity between many Core Areas and is likely impaired due to the presence of nine dams and temperature and habitat constraints. Changes to water quality from elevated Total Dissolved Gas (TDG), temperature, and other factors as well as flow conditions upstream influence PCEs within designated critical habitat downstream.

12.1.4.2 Mainstem lower Snake River CHU 23

The Mainstem lower Snake River CHU 23 extends from the mouth at the Columbia River to the upper end of Brownlee Reservoir, is occupied in several reaches and is essential to the long-term conservation of the species because it helps conserve the opportunity for migratory life history expression, facilitates genetic exchange, and ensures connectivity between populations and Core

Areas. Connectivity between populations in the Tucannon, Asotin, Walla Walla, Clearwater, Grande Ronde and Imnaha Core Areas has likely been limited by operation of Lower Granite and Little Goose dams (USFWS 2010a,b). In addition to dam construction and operation, the mainstem lower Snake River has been altered by reduced habitat complexity, little to no natural floodplain connectivity due to levees and bank armoring, and from agricultural practices alongside the river. Bull trout are known to occupy and use the Mainstem Snake River throughout the year for foraging and overwintering. The Tri-Rivers and Lower Granite AORs overlaps the CHU from the mouth of the Snake River up to and including Lower Granite Lake.

12.1.4.3 Clearwater River CHU 21

The Clearwater River CHU 21 consists of 2,702.1 km (1,679.0 mi) of streams and 6,721.9 hectares (16,619.2 ac) surface area of lakes and reservoirs. The CHU extends from the Snake River confluence at Lewiston, Idaho, on the west to headwaters in the Bitterroot Mountains along the Idaho and Montana border. The Clearwater River CHU represents the easternmost extent of the MCRU and includes the Clearwater River and numerous tributaries. In 2010, the Clearwater River CHU was determined essential for bull trout to maintain distribution in a unique area of the Mid-Columbia Recovery Unit (USFWS 2010b). While the Clearwater River CHU includes five critical habitat subunits (CHSUs): Middle-Lower Fork Clearwater River, South Fork Clearwater River, Selway River, Lochsa River (and Fish Lake), and the North Fork Clearwater River (and Fish Lake), the Corps' Lower Granite AOR overlaps very small segment of the Middle-Lower Fork Clearwater River CHSU (consisting of 159.5 km (99.1 mi) of rivers), encompassing the portion of the Clearwater River impounded by the Lower Granite Dam, extending approximately 5 miles east of the city of Lewiston, Idaho.

12.1.4.4 Status of all nine PCEs for each CHU

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

Mainstem Upper Columbia River CHU 22

Reservoirs in the mainstem Columbia River have inundated wetlands and off-channel habitats, which influence subsurface water connectivity and thermal refugia. Shoreline development for transportation corridors has further reduced the interaction between the mainstem river and shoreline springs. High in-stream temperatures are common. The cities of Pasco, Kennewick, and Richland, Washington (at the upper extent of the Action Area) are protected from flooding by 16.8 miles of levees, further isolating natural subsurface connectivity.

Presence of thermal refugia is also a function of thermal stratification within the reservoirs. Tributary inflow may also play a role in providing subsurface connectivity between cold-water refugia in the reservoir and tributary habitat. Some groundwater influence may occur in riverine areas of the mainstem not dominated by bedrock or immediately below dams, although little is known regarding the ecological significance of this exchange (Corps 2013). Areas throughout that provide some coldwater or natural hyporheic connectivity likely provide bull trout in the mainstem with summer refugia, particularly for sub-adults.

This PCE is considered **Not Properly Functioning** within the Action Area due to lost wetlands and floodplain connectivity from dam operations and shoreline development.

Mainstem Snake River CHU 23

As with the Mainstem Columbia River CHU, PCE 1 in the Mainstem Snake River CHU has limited interaction with its historic floodplain. The riparian corridor and shoreline is heavily impacted by railroad and highway levees, bank armoring, and dam operations. Tributary inflow may also play a role in providing subsurface connectivity between cold-water refugia in the reservoir and tributary habitat. Some groundwater influence may occur in riverine areas of the mainstem not dominated by bedrock or immediately below dams, although little is known regarding the ecological significance of this exchange (Corps 2013). Areas throughout that provide some coldwater or natural hyporheic connectivity likely provide bull trout in the mainstem with summer refugia, particularly for sub-adults.

This PCE is considered **Not Properly Functioning** within the Action Area due to lost wetlands and floodplain connectivity from dam operations and shoreline development.

Clearwater CHU 21

PCE 1 is present but provides limited contribution to FMO habitat in the Clearwater River downstream of Dworshak Dam. A well-developed highway and county road system is present in the lower Clearwater as U.S. Highway 12 and the Camas Prairie railroad parallel the Clearwater River. Encroachment has constrained river meanders, eddies, and hydraulic energy (CBBTTAT 1998a, cited in USFWS 2002c). Such encroachment reduces the connectivity of the mainstem to off-channel habitat and backwater areas. Channel straightening has also occurred along the mainstem, precluding lateral movement and connection to off-channel habitats that may support wetlands and other sources of cooling groundwater (USFWS 2002d).

Within the Action Area, this PCE is **Functioning at Risk** at a result of impacts from transportation corridors, channel straightening, and reservoir operations.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Mainstem Upper Columbia River CHU 22

PCE 2 has been significantly altered by construction and operation of dams throughout the CHU. The lack of fish passage facilities at Chief Joseph and Grand Coulee dams block access to historic FMO habitat and limit connectivity with historic populations upstream and in Canada. Passage facilities (i.e., fish ladders) at the non-Federal dams on the Mainstem Columbia River downstream of Chief Joseph Dam were primarily designed and operated for anadromous salmon and steelhead (NMFS 2011) but may also be used by bull trout. Bull trout are documented at McNary Dam annually in the fish passage facilities (Anglin et al. 2010). McNary Dam includes two fish ladders for passage, one on each shore, a juvenile bypass facility, and extended-length submersible bar screens and vertical barrier screens. Spill for juvenile fish passage occurs annually at McNary Dam, and the spillway includes two spillway surface weirs designed to improve juvenile salmonid downstream passage. The National Marine Fisheries Service

(NMFS) considers the fish passage facilities at McNary to be state-of-the-art, and bull trout have been observed using the fish ladders (Corps 2008); however, their use is limited in comparison to salmon and steelhead. Dams with fish passage can still delay upstream and downstream passage of bull trout, which in turn delays access to spawning tributaries and, thus, can limit reproductive success.

Bull trout are observed passing the upstream fishways and downstream through turbines and spillways at the non-federal Priest Rapids, Wanapum, Rock Island, Rocky Reach, and Wells dams at similar or lower rates compared to salmon and steelhead (BioAnalysts, Inc. 2004; USFWS 2008a). These fishways also comply with NMFS fishway design guidelines and are therefore similar in design, dimension, and operations to upstream fishways at the Federal mainstem dams. USFWS (2008b) reports that although juvenile fish passage facilities were not developed for the downstream passage of larger fish such as adult bull trout, verifiable injury or mortality of adult bull trout passing downstream through turbines and spillways has not been reported at the mainstem Columbia River dams, including those in the Action Area.

While passage at mainstem Columbia River Dams exists, the operation is focused on salmon and steelhead. At the juvenile bypass systems, one to three percent mortality rate and up to a 10 percent injury rate has been measured in some years to adult salmonids passing through the juvenile fish bypass system at McNary Dam (Axel et al. 2005). On the lower Snake River, up to 60 percent of kelts using the Lower Granite Dam juvenile bypass system were observed with non-lethal head injuries in 2014, with higher rates among larger sized adults (Hatch et al. 2015). In 2018-2019, extensive modifications to the Lower Granite Dam juvenile bypass system were made with design consideration given to reduction of injuries.

Adult passage through turbines has also been studied on the lower Columbia and Snake River dams (Rayamajhi et al. 2013; Colotelo et al. 2014). Survival of Snake River steelhead kelts through the turbines ranged from 50-100 percent at each dam between Lower Granite and Bonneville dams; the poorest survival was seen at The Dalles Dam (outside of the Action Area). Turbine route proportions were relatively low (less than 9 percent) in both years. It is increasingly recognized that ‘overshoot’ of overwintering steelhead to reservoirs upstream of the natal tributary is a common behavior for many populations and that downstream passage occurs when adult steelhead are returning to natal tributaries (Richins and Skalski 2017, 2018). At McNary Dam, the average survival rate for overwintering steelhead was estimated at 91 percent of fish that passed through turbines, and 98 percent survival rate through the spillway, surface top-spill weir (Normandeau 2014a). Similar direct injury and survival studies has shown comparable results. At Albeni Falls, turbine passage survival rates for subadult and adult steelhead, 99-100 percent and 88-93 percent, respectively (Normandeau 2014b). A study at Bonneville Dam also recorded average direct survival rates of 98 percent through the ice and trash sluiceway (Powerhouse 1) and 98 percent at the corner collector (Powerhouse 2), with most mortality caused by active pinniped predation in the tailrace during the study period (Normandeau 2011). The fallback rate for salmon and steelhead at the mid-Columbia hydroelectric projects has been documented to range between 0 percent and 7 percent (NMFS 2002). “Fallback” rates relate to the potential for fish to “fallback” through the dams, resulting in contact with structural features of the dam (spillways, turbines, or fish ladders). Adult mortality is likely to be higher than for juveniles (USFWS 2000, 2012). Further, incidents of

fallback or downstream passage of adult bull trout through the mid-Columbia hydroelectric projects appeared to be low (4 percent) and show no apparent mortality (BioAnalysts, Inc. 2004; LGL and Douglas PUD 2008). This operation may not represent sufficient passage for bull trout and the function of this PCE is limited.

Given the above information, passage and migration corridors throughout the Mainstem Upper Columbia River CHU 22 are likely insufficient for bull trout. This PCE is considered **Functioning at Risk**.

Mainstem Snake River CHU 23

Similar to the Mainstem Upper Columbia River CHU 22, migration corridors are present, but limited. Fish passage facilities are present at the four lower Snake River dams, but still pose difficulties, likely passage delays, and mortality risks for passage. The incidental collection of bull trout at juvenile bypass facilities, the observation of bull trout within adult fish ladders, and radio telemetry and PIT tag research have shown that bull trout utilize the mainstem Snake River as a migratory corridor as well as deep-water habitat for overwintering and feeding (USFWS 2015b). The loss of migratory corridors through habitat fragmentation associated with dams has been identified as a threat to the diversity, stability, and persistence of bull trout populations (Kuttel 2002; USFWS 2015b).

Bull trout have been observed at all lower Snake River dams, smolt monitoring traps, juvenile fish facilities, and fish ladders, although observations were anecdotal to salmon monitoring prior to 2000. Bull trout counts have been included in the annual adult fish passage reports since 2006. Numbers of bull trout recorded in 2011 were lowest at Ice Harbor and Lower Granite Dams, with only a single adult observed at each, and counts were highest at Little Goose Dam, where 85 were observed (Corps 2011). In the mainstem Snake River, only five bull trout have been observed passing Lower Granite Dam since 1998 (FPC 2018). The extent of bull trout use and efficacy of passage is not fully understood in CHU 23. On the lower Snake River, up to 60 percent of kelts using the Lower Granite Dam juvenile bypass system were observed with non-lethal head injuries in 2014, with higher rates among larger sized adults (Hatch et al. 2015). In 2018-2019, extensive modifications to the Lower Granite Dam juvenile bypass system were made with design consideration given to reduction of injuries. At the juvenile bypass systems on the Columbia River dams, one to three percent mortality rate and up to a 10 percent injury rate has been measured in some years to adult salmonids passing through the juvenile fish bypass system at McNary Dam (Axel et al. 2005). Thermal barriers between tributary habitat and the mainstem Snake River exist seasonally and further impact the function of this PCE in the Action Area. Seasonally high river temperatures potentially delay or impede migration to and from spawning areas and FMO. Based on the above information, the Service considers PCE 2 **Functioning at Risk** in the Mainstem Snake River CHU 23.

Clearwater CHU 21

Dworshak Dam is the most significant influence on connectivity within the Clearwater CHU. Because Dworshak Dam lacks fish passage facilities, bull trout inhabiting the North Fork Clearwater River drainage have been isolated from other Core Areas in the Clearwater and Snake River Basins as well as mainstem habitat since the dam was constructed in 1971. Drawdowns of Dworshak Reservoir can entrain bull trout and carry them into the mainstem Clearwater River;

these fish likely have low survival after entrainment and are unable to return to spawning and FMO habitat upstream (USFWS 2015b).

Downstream of Dworshak Dam, there are no known barriers in the Mainstem Clearwater River and migration between Core Areas is possible. As a whole, the Clearwater River CHU is Functioning at Risk as a result of Dworshak Dam operation, but within the smaller Lower-Middle Clearwater River CHSU, within the Action Area, PCE 2 is **Functioning Appropriately** for migration.

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

Mainstem Upper Columbia River CHU 22

PCE 3 is present in and contributes to FMO habitat in this reach of the Columbia River. The variation in inundation due to the dams has reduced riparian areas and limited terrestrial organism and nutrient inputs (extended inundation followed by drawdown). The conversion of riverine habitat into reservoirs may have improved the productivity and the quantity of available prey, though species assemblages are likely different from before the dams (USFWS 2011). The mainstem Columbia River in this reach, including the reservoirs, provides an abundant food source for migratory bull trout during the fall, winter, and spring (USFWS 2007). Forage fish such as juvenile salmon and steelhead provide a large forage base for bull trout, as well as whitefish, sculpins, suckers, and minnows that inhabit the reservoir (USFWS 2010b). However, habitat changes created by dock and pier pilings can create habitat favorable nonnative predators that compete with bull trout for salmonid forage fish. In the Columbia and Snake Rivers northern pikeminnow prey heavily on juvenile salmonids (see WDFW 2006b). The declines of native salmon and steelhead populations have likely reduced or altered bull trout diets in the Action Area.

Upper Columbia River mainstem habitats and reservoirs provide rearing habitat for ocean-type Chinook, which provide a source of prey for bull trout. Large numbers of hatchery-raised salmonids are released into the Columbia River basin annually and provide an abundant source of prey for bull trout (USFWS 2007), though smolts may also compete with bull trout for smaller prey species. Tributary mouths support populations of non-endemic rainbow trout, bass, crappie, carp, bluegill, catfish and other species that may provide forage for bull trout.

Based on reduced native salmon forage and riparian function through the Action Area, the Service considers this PCE **Functioning at Risk**.

Mainstem Snake River CHU 23

PCE 3 is present and contributes to FMO habitat in this reach of the lower Snake River. The conversion of mainstem habitat from riverine flow to a lacustrine-like condition has altered the prey composition in the mainstem Snake River. Conversion of aquatic habitats due to backwatering effects of dams and degradation of the riparian corridor have negatively affected the productivity of native species; however, these habitat changes have increased non-native fish production to provide a prey base for bull trout (USFWS 2010a,b). Native species of fish,

including salmonid and steelhead, still occupy the reservoirs and also provide a food source for bull trout. Thirty-four species of resident fishes were collected from the lower Snake River reservoirs during fisheries studies conducted from 1979 through 1993 (USFWS 2010b). Forage fish such as juvenile salmon and steelhead, whitefish, sculpins, suckers, and minnows are present throughout the lower Snake River (USFWS 2010a,b). The number of non-salmonid fish predators has increased since the lower Snake River reservoirs were created (USFWS 2002d). In the Columbia and Snake Rivers northern pikeminnow prey on juvenile salmonids (bull trout prey). Over-water structures such as boat docks may create habitat favorable to non-native predators (see WDFW 2006b).

Based on reduced native salmon forage and riparian function through the Action Area, the Service considers this PCE **Functioning at Risk**.

Clearwater CHU 21

PCE 3 is present and contributes to FMO habitat in the Clearwater River. However, armoring along the mainstem Clearwater River downstream of Dworshak Dam has reduced the presence of riparian vegetation and the associated input of allochthonous (i.e., not indigenous) prey items. Based on reduced native salmon forage and riparian function below Dworshak Dam, the Service considers this PCE **Functioning at Risk** in the Action Area.

PCE 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.

Mainstem Upper Columbia River CHU 22

PCE 4 has been functionally reduced by impoundments created by the hydroelectric projects throughout the Upper Columbia River CHU. Mainstem Columbia reservoirs have inundated off-channel habitats and wetlands. The dams have converted previously free-flowing riverine habitats to more lacustrine habitats in reservoir reaches and homogenized habitat conditions in much of the reach. Pools have been inundated and essentially replaced by deep-water habitat in the mainstem (USFWS 2011). Riparian areas along the mainstem Columbia River are generally narrow in this project reach, and their structure and condition are influenced by daily fluctuations in river level due to dam operation (USFWS 2011). Dam operations, flow management, and the related inundation of off-channel and floodplain areas have reduced the size, quality, and function of floodplains along the upper Columbia River (NMFS 2000a, cited in USFWS 2002e). Off-channel diking, levees and bank armoring along the mainstem and within tributaries has resulted in the loss of floodplain and off-channel habitats that could provide important rearing areas for bull trout (USFWS 2002e). Roads and other features have disconnected hydrologic linkages between off-channel areas and the main channel, interrupted overbank-flow processes, and degraded both wetland function and riparian vegetation.

Residential, agricultural, and recreational development along the mainstem has resulted in the loss of riparian vegetation. Streambanks throughout the mainstem Upper Columbia River CHU are typically characterized as sparsely vegetated steep canyons, with steep shorelines, often

armored with riprap, especially along the banks immediately downstream of dams, to prevent erosion during larger spill events. Shoreline areas near point bars and at the mouths of tributaries are more gradual, with a diversity of habitats, including dense riparian vegetation, unstable and eroding areas, areas of minimal vegetation and exposed bedrock, and areas that are relatively unvegetated and have been stabilized by riprap (Douglas County PUD 2011). Residential, agricultural, and recreational development along the mainstem has also resulted in the loss of riparian vegetation. Dam operations and reservoir management have reduced the size, quality, and function of floodplains along the upper Columbia River (NMFS 2000a).

Transportation corridors along the Columbia River further limit the formation of off-channel habitat. Reduced floodplain connectivity has also decreased the recruitment of large wood needed for the formation of complex habitat. Levees along the Columbia River and the lower portions of tributaries have also limited the development of complex habitats. The Tri-Cities (upper extent of the Action Area) are protected by 16.8 miles of levees.

Habitat complexity in the Mainstem Upper Columbia CHU is **Not Properly Functioning** based on the information above.

Mainstem Snake River CHU 23

PCE 4 is impaired in the mainstem lower Snake River. The mainstem habitat is composed of deep reservoirs with little to no habitat complexity. Only a few tributaries enter the reservoirs. A few backwater areas have been inundated by the impoundment. Recrutable large wood is limited in the lower Snake River reservoirs, and off-channel habitats are scarce. Riparian vegetation along the lower Snake River is dominated by Russian olive (*Elaeagnus angustifolia*), with some black cottonwood (*Populus trichocarpa*), black locust (*Robinia pseudo-acacia*), and various alder and willow shrubs. The steep shorelines and arid landscape associated with project reservoirs limit development of riparian communities (Corps 2002). Streambanks along the Snake River are sparsely vegetated and often armored with riprap, especially along the banks immediately downstream of dams, to prevent erosion during larger spill events. Reservoir habitat in this reach is generally uniform and does not form complex pool habitat common in smaller streams. Little Goose and Lower Monumental Reservoirs have a greater number of backwater areas than Ice Harbor. The confluences of two major tributaries (the Palouse and Tucannon Rivers) with the Snake River provide additional backwater habitat in Lower Monumental Reservoir. These reservoirs tend to support species that depend on shallow-water habitats during some part of their life histories (Corps 2002). Emergent wetland habitat increased significantly after construction of the dams and impoundments due to sedimentation and flooding of backwater areas (Corps 2002).

Habitat complexity in the Mainstem Snake River CHU is **Not Properly Functioning** based on the information above.

Clearwater CHU 21

PCE 4 is present and contributes to FMO habitat in the Clearwater River downstream of Dworshak Dam, though the PCE is impaired compared to pre-dam conditions. The presence of Federal, state, and county roads in the lower reaches of the Clearwater River, including U.S.

Highway 12 have reduced shoreline and in-stream habitat complexity through a reduction of recruitable large wood and an associated reduction in pools and habitat complexity. High levels of sediment in the mainstem result in substrate embeddedness in lower velocity areas, which may reduce substrate complexity and the depth of holding pools. The PCE has been affected by intensive logging that has reduced streamside vegetation and large wood (riparian and in-stream) throughout the reach.

Based on lowered habitat complexity downstream of Dworshak Dam as a result of dam operations, the Service considers this PCE to be **Functioning at Risk** in the Action Area.

PCE 5: Water temperatures ranging from 2°C to 15°C (36°F to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Mainstem Upper Columbia River CHU 22

In the designation of critical habitat, PCE 5 was identified as **not present** in the Mainstem Columbia and Snake Rivers due to construction of the dams and elevated temperatures. While not identified as a PCE in the CHU, temperatures in the Columbia River influences distribution, migration, and foraging opportunities for bull trout throughout the Action Area and between Core Areas. Seasonally, elevated temperatures in passage facilities and in the river impede movement of bull trout, specifically non-spawning adults and sub-adults.

Mainstem Snake River CHU 23

In the designation of critical habitat, PCE 5 was identified as **not present** year-round in the Mainstem Columbia and Snake Rivers due to construction of the dams and elevated temperatures. While not identified as a PCE in the CHU, temperatures in the Snake River influence distribution, migration, and foraging opportunities for bull trout throughout the Action Area and between Core Areas. Seasonally, elevated temperatures in passage facilities and in the river impede movement of bull trout, specifically non-spawning adults and sub-adults.

Clearwater CHU 21

PCE 5 is present in the mainstem Clearwater River downstream of Dworshak Dam, though summer impairments are common. At the U.S. Geological Survey's (USGS) Gage 13341050, approximately 5 RM downstream of Dworshak Dam, mean monthly temperatures of 52.5°F (11.4°C), 54.0°F (12.2°C), 51.3°F (10.7°C) and 53.1°F (11.7°C) have been documented (through 2014) for the months of June, July, August, and September, respectively. While these temperatures are suitable for year-round bull trout use, forestry practices have reduced streamside vegetation in some areas, which has contributed to elevated in-stream summer temperatures (USFWS 2015b), particularly along the shallow river margins. Streambank armoring associated with numerous roads, including U.S. Highway 12 along the Clearwater River, has similarly resulted in a minor loss of shade-producing vegetation from the mainstem riparian corridor, though the adjacent mountains provide the bulk of shading in this area. The presence of major roads immediately adjacent to the mainstem has reduced the connectivity to floodplain habitats, resulting in the interception of groundwater that could contribute to in-stream cooling. The presence of numerous stormwater outfalls along U.S. Highway 12 likely contributes to elevated in-stream temperatures in localized shoreline habitats.

Given the above information, water temperatures in the Clearwater River CHU are **Functioning at Risk** within the Action Area.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Mainstem Upper Columbia River CHU 22

Spawning and rearing does not occur within this CHU, therefore this PCE is not present.

Mainstem Snake River CHU 23

Spawning and rearing does not occur within this CHU, therefore this PCE is not present.

Clearwater CHU 21

Spawning and rearing habitat occurs within this CHU; however, is not present within the Action Area.

PCE 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.

Mainstem Upper Columbia River CHU 22

The current hydrograph is significantly altered as a result of construction and operation of the dams. Dams have increased the river cross-section and moderated peak and base flows in the mainstem, with the river level only changing a few feet annually. Surface water withdrawals throughout the mainstem and tributaries have also reduced in-stream flow, particularly in smaller basins. The hydrograph, although varying from the natural hydrograph, currently provides for FMO habitat.

Chief Joseph, McNary and John Day Dams are run-of-river facilities, meaning that daily inflow through the dam generally equals daily outflow. Run-of-river projects cannot store or draft a significant volume of water. As such, flows at the dam and downstream are primarily shaped by the operations at the Canadian and Federal storage projects upstream, particularly Grand Coulee Dam. Overall, storage dams in the Columbia River Basin have dampened the natural hydrograph with decreased high flows during the summer and increased low flows during the winter (National Research Council 2004). Flows can also vary on shorter timescales (i.e., daily) to optimize power generation during peak energy demands. Power peaking at Columbia River dams creates river stage fluctuations that result in a pronounced change in the natural hydrograph compared to pre-dam conditions.

In addition to the dams, but to a much lesser extent, irrigation or other surface water diversions have reduced river flows. Agriculture, grazing, and development have altered the mainstem Columbia River corridor and stream hydrology with increased runoff and decreased floodplain storage connectivity. These flow reductions and subsequent alterations to in-stream habitat are more evident in the contributing tributaries.

Within the Mainstem Upper Columbia River, numerous dams alter the flow regime and hydrograph of critical habitat. Therefore, this PCE is **Not Properly Functioning**.

Mainstem Snake River CHU 23

The natural hydrograph is significantly impaired by the presence and operation of dams throughout the Snake River. The mainstem Snake River upstream of Lower Granite Dam is influenced by operations at the Hells Canyon Complex and Dworshak Dam on the Clearwater River. While the four dams on the lower Snake River are run-of-river facilities, their presence and operations maintain and enhance reservoir habitat resulting in changes to flow regimes, backwatering in tributaries, and changes to sediment and substrate composition. Overall, storage dams throughout the Columbia River Basin have dampened the pre-dam hydrograph, with decreased high flows during the summer and increased low flows during the winter (National Research Council 2004). Flows can also vary on shorter timescales (i.e., daily) to optimize power generation during peak energy demands.

Operations of four dams on the lower Snake River as well as upstream dams in the Snake and Clearwater Basins alter the flow regime and hydrograph throughout the Mainstem Snake River CHU. Therefore, this PCE is **Not Properly Functioning** within the Action Area.

Clearwater CHU 21

The mainstem Clearwater River below the confluence with the North Fork is influenced by Dworshak Dam operations (Ecovista et al. 2003, p. 10). Before the construction and operation of Dworshak Dam in late 1971, the natural hydrograph of the lower Clearwater River downstream of the dam consisted of a spring freshet with high peak flows, followed by a rapid drop in flows into August. Since the construction and operation of the dam, the hydrograph is similar, though peak flows, on average, have decreased during the spring freshet. Flows at USGS Gage 13341050, located on the mainstem Clearwater River about 5 miles downstream of the dam, indicate maximum discharge (107,000 cubic feet per second (cfs)) from 1965 to 1971 occurred in May 1971, prior to regulation in the Dworshak Reservoir. The maximum discharge since regulation began in 1972 is 127,000 cfs, recorded in June 1974. In response to RPA 4 of the 2008 NMFS FCRPS Opinion, flows are released at Dworshak Dam during spring to aid downstream smolt migration.

In addition to dam operations, agricultural practices, such as irrigation withdrawals, have indirectly affected hydrologic conditions in the Clearwater River Basin. Combined with stream channel alterations and increased runoff, these changes have altered the hydrologic function of most tributaries in the lower Clearwater Basin (CBBTTAT 1998b, cited in USFWS 2002d). The timing, peak, and magnitude of flows have changed in these tributaries, resulting in increased flood frequencies and intensities, decreased water remaining in the watersheds for late season baseflows, increased water temperatures, increased incidence of intermittent stream flows due to low water and high bedload conditions, and decreased stream complexity (CBBTTAT 1998b, cited in USFWS 2002c).

As described above, Dworshak Dam operations alter flows and the hydrograph throughout the Action Area. Therefore, the Service considers this PCE to be **Functioning at Risk**.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Mainstem Upper Columbia River CHU 22

The mainstem Columbia River is CWA 303(d) listed for several impairments, including temperature, dissolved oxygen (DO), pH, TDG, metals, polychlorinated biphenyls, dichlorodiphenyltrichloroethane, and its derivatives, dioxin, and pesticides (USFWS 2011b). Primary water quality concerns in this area include the potential for dissolved gas supersaturation (in excess of state standards of 110 percent), which can harm fish. Because little degassing occurs during transport through Rufus Woods Lake, TDG measured at the Chief Joseph forebay is largely a function of TDG released from Grand Coulee.

Operational and structural modifications at dams have been implemented to reduce TDG levels downstream of Chief Joseph Dam. TDG saturations ranging from about 110 percent to 120 percent (Schneider 2012) remain above the state maximum standard of 110 percent saturation, but considered less harmful for bull trout than the higher saturations generated by Grand Coulee Dam, and is within design parameters for the deflectors. If the Chief Joseph Dam powerhouse is operating when Grand Coulee Dam is spilling, then high TDG concentrations can be passed through the powerhouse and entrained into spilled water, propagating high TDG levels downstream. But the existing system spill priority list has been able to prioritize power generation to be favored at Grand Coulee with spill at Chief Joseph during times when spill is necessary. This supports improved water quality not only downstream of Chief Joseph Dam, but also in Rufus Woods Lake.

The five non-Federal dams in this CHU, including Priest Rapids, have been subject to separate regulatory compliance requirements and relicensing agreements addressing TDG generation. A combination of operational and/or structural modifications have been implemented at each of these dams to increase juvenile salmon survival during outmigration while avoiding or minimizing adverse water quality impacts. In addition, the Corps installed additional spillway deflectors at McNary Dam in 2004 (an initial set of deflectors was installed during the 1970s). The spillway deflectors are designed to reduce TDG saturation during spill. The Corps has continuously measured TDG saturation below McNary since 1990. Spill is managed to keep TDG concentrations within prescribed limits (by Ecology and ODEQ) in the tailrace of the lower Snake and Columbia River dams during the juvenile salmon passage seasons, which is generally from April through August. Outside the juvenile salmon passage season, spill is minimized to the extent possible. Whenever spill occurs outside the fish passage season, it is involuntary, which means it is unavoidable.

In addition to water quality concerns in the CHU, water quantity is highly influenced by Federal and non-Federal actions in the mainstem Upper Columbia River. As much as 6 percent to 10 percent of river flows are withdrawn from the Columbia River for federal irrigation projects. This does not include non-Federal irrigation withdrawals which are difficult to quantify. Reduced flows, especially during warmer summer months, can impact overall water temperatures and reduce the functionality of the habitat for bull trout. In the mainstem Columbia River the federal Columbia River Systems storage projects release stored water to augment summer flows. Additionally, Grand Coulee Dam outflow water temperature has a temporal lag behind the warming/cooling inflow to Lake Roosevelt, observed at the U.S.-Canada border. In

general, water temperatures released from Grand Coulee tend to be cooler than reservoir inflows throughout much of the spring and early summer, and warmer in late summer/fall. Because Lake Rufus Woods does not stratify and has a residence time of about 4 days, it passes on the lagged water temperatures created by Lake Roosevelt.

Thus, PCE in the Mainstem Upper Columbia River is **Not Properly Functioning**.

Mainstem Snake River CHU 23

PCE 8 is impaired and provides a limited contribution to FMO habitat in the lower mainstem Snake River. Impoundment of the river has altered flow characteristics and temperature regimes, and one of the primary water quality constituents affecting bull trout use of the mainstem Snake and Columbia Rivers is temperature (see PCE 5). Water quality in the mainstem Snake River is also limited by several pollutants, including sediment, bacteria, DO, nutrients, pH, mercury, pesticides, and TDG. Dissolved gas supersaturation (in excess of state standards of 110 percent) can harm fish. Spill from the lower Snake River dams can cause gas supersaturation conditions. Sampling for DO levels in 2010 identified levels above 100 percent throughout the three reservoirs, and the highest values were recorded at stations in Ice Harbor Reservoir (Seybold and Bennett 2010). High flows and water turbulence from Lower Monumental Dam, combined with the respiration of abundant submerged macrophytes, could have contributed to high dissolved gas concentrations at the stations in Ice Harbor Reservoir.

The Corps has installed spillway deflectors at all Snake River dams in this reach. The spillway deflectors are designed to reduce TDG saturation during spill. The Corps has continuously measured TDG saturation below Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams since 1990. Spill is managed to keep TDG concentrations below prescribed limits in the tailrace of lower Snake and Columbia River dams during the juvenile salmon passage seasons, which is generally from April through August. Any spill occurring outside the juvenile salmon passage season is unavoidable.

Based on the above information on temperatures and TDG, PCE in the Mainstem Snake River is **Not Properly Functioning**.

Clearwater CHU 21

PCE 8 is present and contributes to FMO habitat in the Clearwater River downstream of Dworshak Dam. The mainstem North Fork Clearwater River (below Dworshak Dam) and the mainstem Clearwater River from the confluence with the North Fork to approximately 26 RM downstream are 303(d)-listed for dissolved gas supersaturation (IDEQ 2014). U.S. Highway 12 and the Camas Prairie railroad are located within the riparian corridor and floodplain of the mainstem Clearwater River. The presence of this infrastructure has contributed to decreased water quality in the form of increased suspended sediment levels. Relatively high surface erosion potential and landslide hazards combine to create substantial sediment production concerns throughout this reach.

Based on the above information, this PCE is **Functioning at Risk** in the Action Area.

PCE 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.

Mainstem Upper Columbia River CHU 22

Introduced species are present throughout the Columbia River (Wydoski and Whitney 2003). Conditions in reservoir reaches typically favor non-native species, and these are prevalent in the mainstem Snake and Columbia Rivers. USFWS (2010b) cited a study that identified 36 non-native fish species in the Lower Columbia River. Some of these species, such as brown trout, may compete with bull trout for food resources, thereby affecting bull trout survival. Many were historically stocked to provide additional recreational and sport fishing opportunities. Hybridization between brook trout and bull trout has been documented in some tributaries. Non-native predatory fish including walleye, smallmouth bass, and northern pike have entered or been introduced into the Mainstem Upper Columbia River. In the Columbia and Snake Rivers northern pikeminnow is an important predator of juvenile salmonids (bull trout prey), likely because of their overlap in habitat use. Over-water structures such as boat docks create habitat favorable to non-native predators (see WDFW 2006b).

Based on the numerous species of non-native species found in the Columbia River, the Service considers this PCE as **Not Properly Functioning**.

Mainstem Snake River CHU 23

PCE 9 is impaired in the lower Snake River. Conversion to a more lacustrine habitat has increased predator abundance and productivity of non-native predatory and competing fish species. Conditions in reservoir reaches typically favor non-native species and these are prevalent in the mainstem Snake and Columbia Rivers.

Seventeen non-native fish species currently share resources with 18 native species in the lower Snake River reservoirs (USFWS 2002d). Although numbers differ, species composition of resident fish differs little among the reservoirs. Species found in high abundance in all reservoirs include suckers, northern pikeminnow, bass, chiselmouth, and redbreast shiners (Bennett et al. 1983; Bennett and Shrier 1986; Bennett et al. 1988). Crappie, sunfish, and largemouth bass are highly abundant in backwaters of all reservoirs. Most recently, walleye numbers have increased in the region. The highest densities of smallmouth bass in the Columbia and Snake Rivers occur in the Lower Granite forebay, tailrace, and reservoir (NMFS 2000a,b). In the Columbia and Snake Rivers northern pikeminnow is an important predator of juvenile salmonids (bull trout prey), likely because of their overlap in habitat use. Over-water structures such as boat docks create habitat favorable to non-native predators (see WDFW 2006b).

Based on the numerous species of non-native species found in the Snake River, the Service considers this PCE as **Not Properly Functioning**.

Clearwater CHU 21

There are currently several brook trout populations in the lower Clearwater Basin, including the Potlatch River system (CBBTTAT 1998b, cited in USFWS 2002d). Northern pikeminnow, a

predatory species, are native to the lower North Fork Clearwater subbasin (IDEQ 2002). Predatory smallmouth bass were stocked into the Reservoir in 1979 (Miller 1987). Based on the presence of brook trout populations throughout the lower Clearwater River, the Service considers this PCE to be **Functioning at Risk**.

12.1.4.5 Conservation Role of the Action Area to Mid-Columbia Recovery Unit

The MCRU includes varying statuses of bull trout populations. Some areas within the MCRU are characterized by small, increasingly threatened bull trout populations. Other areas with intact riverine habitat, including wilderness areas and protected forestlands, support more robust bull trout populations. The MCRU, which includes 24 Core Areas, two historically occupied areas, and one RNA (the Northeastern Washington RNA), intersects the Action Area. While bull trout occupying this unit fall primarily outside of the Action Area, bull trout from several Core Areas use the Action Area during the year for foraging, migration, and overwintering purposes. Throughout these areas, bull trout populations are impacted by Federal and non-Federal operations on the mainstem Mid-Columbia River, lower Snake River, and the lower Clearwater River.

The mainstem Mid-Columbia River is characterized by rearing and FMO habitat for sub-adult and adult bull trout. Bull trout populations vary in number, size, and stability in this Basin, ranging from a few, depressed (i.e., having small population size, experiencing substantial threats, and/or has a long-term declining trend in population/redd counts) populations in the Umatilla and Yakima Rivers to multiple strong populations in the Imnaha, Clearwater, and Wenatchee River Basins. Both the mainstem lower Snake River and the Clearwater River Basins provide essential rearing and FMO habitat and connectivity for sub-adult and adult bull trout, which occupy these large rivers and associated tributary systems on a seasonal basis, throughout most of the year. The mainstem lower Snake River Basin is essential in enabling bull trout migration and facilitating genetic exchange between Core Areas.

Without safe, timely and effective (adequate) fish passage facilities, dams and associated infrastructure have limited connectivity among aquatic environments and threatened bull trout and native migratory fish (e.g., salmon and steelhead) from accessing critical upstream habitat. The presence of the dams has also negatively altered flow, water quality, and temperature regimes, limiting bull trout survivability throughout their complex life history stages. Legacy and ongoing human and land management activities (e.g. irrigation diversions and grazing) have led to overall reductions in bull trout habitat complexity, thereby negatively impacting the resiliency of bull trout populations in facing future ecological threats and challenges, like the potential establishment of non-native species (e.g., bass and walleye).

Within the MCRU, three bull trout CHUs overlap the Action Area and, within adjacent tributaries, additional CHUs are designated. In general, these CHUs are essential for maintaining bull trout distribution patterns by providing access to FMO habitat and ensuring connectivity (i.e., conserving critical migratory corridors). In upstream areas, i.e., in tributaries outside of the Action Area, habitat is relatively intact apart from some developed areas with passage barriers (i.e., culverts). Due to a variety of environmental and anthropogenic factors (e.g., elevated TDG levels and water temperature, encroachment, lack of adequate and appropriately-sized fish

passage facilities, and habitat fragmentation) resulting from dam presence within the Action Area, bull trout critical habitat in the MCRU is generally considered either “at risk” or not functional.

12.1.5 Previously Consulted on Effects for Bull Trout and Designated Critical Habitat

Consulted-on effects represent the effects of proposed Federal actions on listed species and designated critical habitat that have been the subject of past Opinions. Consideration of consulted-on effects is an important component of objectively characterizing the environmental baseline for the species or critical habitat at the range-wide and Action Area scales.

The Service queried their on-line database of consultations as of June 19, 2018. There were 928 formal consultations that were concluded, or are ongoing, addressing Federal actions that may affect bull trout. Forty of those were batched consultations covering multiple projects, and 127 were programmatic consultations. Seventy-four of the total number of formal consultations were active on that date, and the rest had been concluded. The consulted-on effects ranged from beneficial or improved conditions, to insignificant or discountable effects, and to adverse effects resulting in injury, mortality or loss of habitat function at the individual, population, and Core Area scales. Only one of the consultations was a jeopardy determination for bull trout: the consultation on Idaho Water Quality Standards for Toxic Pollutants (Reference number: 01EIFW00-2014-F-0233); this was also an adverse modification determination for bull trout critical habitat (USFWS 2015a). Numerous consultations completed across the region included bank stabilizing that in many cases resulted in loss or degraded riparian conditions.

Previously consulted on federal actions have or are anticipated to result in adverse effects to bull trout in the Action Area and/or its designated critical habitat. Projects include: irrigation diversions that affect water resources in the Columbia and Snake River mainstem and tributary systems (annual water depletion varies); hatchery programs occurring on the Snake and Clearwater Rivers and within a number of tributary streams that benefit bull trout through the release of additional food sources; sediment dredging operations within the lower Snake River; aquatic invasive species management (plants) that introduces chemical contaminants to occupied waterways; and tributary habitat and restoration improvement programs that may result in adverse effects to bull trout during habitat improvement activities, but may also provide benefits through monitoring and adaptive management programs that identify and minimize the impacts to migratory bull trout, salmon and steelhead.

Recently, the Service completed formal consultation with the Corps on their operations and maintenance of 14 multiple use dam and reservoir projects within the Columbia River System, which overlap a portion of the Action Area. Many bull trout that interact within the Action Area are affected by dam operations, including bull trout originating in the Entiat, Walla Walla, Umatilla, Asotin, and Tucannon Core Areas. These bull trout experience passage delays, entrainment, degraded water quality, reduced habitat complexity, altered food sources and availability, and direct handling, which is expected to reduce the health and fitness of affected bull trout, delay or result in missed spawning opportunities, and cause injury and mortality of affected bull trout. In addition, altered hydrology, which reduces habitat complexity, limits

riparian vegetation growth, and increases water temperatures, further exposes migratory bull trout to potential predation, reduced native food sources (e.g., salmon and steelhead), and to sublethal or lethal impacts from these stressors.

Most formal consultations for bull trout included an analysis of critical habitat, and types of activities considered would be similar. Critical habitat was designated on the mainstem Columbia, Snake, and Clearwater Rivers in 2010, and critical habitat would have been considered for federal actions in those locations after that date. The duration of effects can be a single event (one day or week), a year or multiple years, and in perpetuity. Life histories affected include adult holding pre-spawning, fertilization to emergence, emergence to juvenile out migration, juvenile out migration, adult migration to spawning areas, subadult FMO, and adult FMO. The effects associated with all but a few of these projects sampled are now fully part of the baseline.

The Assessment (p. 17) identifies previous consultations, including the MSMP that has been integrated into the design features of this consultation. Through consultation with federal agencies, the Service determined that the MSMP, along with two other consultations related to boat launch repairs, were not likely to adversely affect bull trout or its designated critical habitat.

12.1.6 Summary of Baseline Conditions

Bull trout in the mainstem Mid-Columbia, lower Snake and lower Clearwater Rivers, which contribute to bull trout in the Action Area, consists of migratory bull trout originating in spawning and rearing tributaries outside of the Action Area. Thus, connectivity between bull trout local populations, Core Areas, and FMO habitats is important to population persistence. FMO habitats are especially important to migratory bull trout because the migratory form grow larger and are more fecund than resident bull trout, therefore contributing to population stability in Core Areas.

Bull trout throughout the MCRU are impacted by activities occurring within the mainstem and tributary habitats, both federal and non-federal, including primary threats from upland/riparian land management, habitat loss, fish passage barriers, the introduction of non-native species (i.e. brook trout), and water quality and quantity (USFWS 2015b). Core Areas known or believed to contribute to individuals in the Action Area include the Walla Walla, Umatilla, Tucannon, Asotin, Imnaha, and Entiat, as well as the multiple Core Areas associated with the Grande Ronde and Clearwater Rivers. Several Core Areas contain local populations with small population sizes and/or declining trends, but strong or stable populations are present, particularly in the Imnaha, Grande Ronde and Clearwater Rivers.

Within the mainstem Mid-Columbia, lower Snake and lower Clearwater Rivers bull trout are largely affected by dam operations and the resulting impacts to mainstem habitats. Altered flow regimes, sedimentation rates, bank erosion, reduced channel complexity, and poor water quality, including high water temperatures, reduce the quality of bull trout habitat. Declining salmon and steelhead populations could also negatively impact bull trout populations by reducing the number

of juvenile salmon and steelhead that bull trout might prey on, but hatchery operations may provide additional prey base. Barriers between isolated populations continue to be a limiting factor for many bull trout subpopulations in the larger MCRU.

Adult and subadult bull trout migration to and from the mainstems is variable, with general overlaps between October and December, and between April and June. Relative to other salmonids, such as steelhead or Chinook salmon, few bull trout occur within the mainstem Mid-Columbia, lower Snake, or lower Clearwater Rivers, and little is known about specific movements and habitat use patterns while in the mainstems of these rivers, especially during the winter. Adult and subadult bull trout tend to display distinct diel (i.e., 24-hour cycle) habitat use patterns (Goetz 1994; Jakober et al. 2000; Al-Chakhachy and Budy 2007; Muhlfeld et al. 2012). In general, bull trout tend to use relatively deep pools with abundant cover (e.g., large woody debris, river bottom depressions) and higher velocity flows during the day. In contrast, nighttime habitat use by bull trout is characterized by near-shore areas with shallower depths, less cover, and slower water velocities. While overwintering, many bull trout establish small winter ranges and movement decreases relative to other seasons, but bull trout from the Walla Walla basin have been documented moving continuously through the Columbia River corridor (Barrows et al. 2016).

The Action Area overlaps portions of the Mid-Columbia, lower Snake and lower Clearwater River shared FMO habitats. Of the 8 PCEs supporting designated bull trout critical habitat in the Action Area (PCE 6 is not present, as it pertains to spawning and rearing habitat), many are either Not Functioning Properly or Functioning at Risk (Table 7). Within the Mainstem Upper Columbia River and Mainstem Snake River CHUs, PCE 5 (Water Temperature) is absent as a result of dams and elevated temperatures, 2 PCEs (2: Migration Habitat and 3: Food Base) are Functioning at Risk as a result of dam impediments and declining salmon and steelhead populations, while the remaining PCEs are not Functioning Properly. The Clearwater CHU contains Appropriately Functioning Migration Habitat (PCE 2), but the remaining 7 PCEs are Functioning at Risk due to effects associated primarily with mainstem adjacent Highway 12 and the Camas Prairie railroad, but also due to logging, irrigation, legacy logging, and brook trout presence.

Table 7. Status of Primary Constituent Elements (PCEs) of designated bull trout critical habitat.

Primary Constituent Elements (PCEs)	Mainstem Upper Columbia River (CHU 22)	Mainstem Snake River (CHU 23)	Clearwater (CHU 21)
PCE 1- Seeps, springs, and groundwater	Not Properly Functioning	Not Properly Functioning	Functioning at Risk
PCE 2- Migration habitat with minimal barriers	Functioning at Risk	Functioning at Risk	Functioning Appropriately
PCE 3- Forage base	Functioning at Risk	Functioning at Risk	Functioning at Risk
PCE 4- Complex habitats	Not Properly Functioning	Not Properly Functioning	Functioning at Risk
PCE 5- Water temperatures	Not Present	Not Present	Functioning at Risk
PCE 6- Spawning and rearing habitat	Not Present	Not Present	Not Present
PCE 7- Natural hydrograph or minimal departures, if regulated	Not Properly Functioning	Not Properly Functioning	Functioning at Risk
PCE 8- Sufficient water quality	Not Properly Functioning	Not Properly Functioning	Functioning at Risk
PCE 9- Low presence of non-native species	Not Properly Functioning	Not Properly Functioning	Functioning at Risk

12.2 Climate Change

Consistent with Service policy, our analyses under the Act include consideration of ongoing and projected changes in climate. The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2014a, pp. 119-120). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2014a, p. 119). Various types of changes in climate can have direct or indirect effects on species and critical habitats. These effects may be positive, neutral, or negative, and they may change over time. The nature of the effect depends on the species’ life history, the magnitude and speed of climate change, and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2014b, pp. 64, 67-69, 94, 299). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change and its effects on species and their critical habitats. We focus in particular on how climate change affects the capability of species to successfully complete their life cycles, and the capability of critical habitats to support that outcome.

12.2.1 Climate Change and the Columbia River Basin

Climate change research for the larger Northern Rockies area predicts warmer springs, earlier snowmelt, and hotter, drier summers with longer fire seasons (Isaak et al 2015, p. 2540). In the Pacific Northwest, most models project warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation (ISAB 2007, p. iii). 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, p. 16).

Over the last century, average annual temperatures in the US have increased about 2°F (0.2°F per decade) over the last 50 years (USDA 2010, p. 3; Bonneville et al. 2017, p. 92). Winter temperatures have increased more than other seasons, and the daily minimum temperatures, typically occurring at night, have increased more than daily maximums. Models indicate that temperature increases would occur during all seasons, with the greatest increases projected in summer. Precipitation predictions are considered less certain, but most models project decreased summer precipitation and increased winter precipitation.

The variation in precipitation and temperature patterns from one year to the next, combined with the geographic complexity of the Basin, result in highly variable Columbia River flows from year to year (Bonneville et al. 2017, p.19). The Columbia River has an annual average runoff of approximately 200 million acre feet per year, with roughly 25 percent of that volume originating in the Canadian portion of the Basin (Reclamation 2016; Bonneville et al. 2017, p. 92). In its analysis of changing water temperatures in the lower Columbia River, the U. S. Environmental Protection Agency found that, since the 1960s, water temperatures in the mainstem Columbia and Snake Rivers have increased roughly 0.3°C per decade (USEPA 2021, p. 73). Dams on the Columbia and lower Snake Rivers appear to have exacerbated summer water temperature warming associated with climate change (USEPA 2021, p. 72). August mean temperatures are expected to increase from near 22°C currently to 23°C by 2040.

12.2.2 Climate Change and Bull Trout

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 (Isaak et al. 2015, p. 2540; Dunham et al. 2014). For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of many trout species (Rieman et al. 2007, p. 1557). 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 (Rieman et al. 2007, p. 1553). Increases in air temperature are likely to be reflected in increases in both surface water and groundwater temperatures.

Bull trout require very cold (<10 °C) water for spawning and incubation (Dunham et al. 2014). 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 as well as juvenile survival. Low elevation river reaches are unlikely to provide suitably cold temperatures for bull trout spawning, incubation, and juvenile rearing under current temperature; therefore, the general impact of temperature and hydrologic changes may not be as extreme or range constrictions as pronounced as what may occur in higher elevation streams. However, increasing mean summer temperatures are likely to interfere with successful migration or result in altered migratory timing or habitat use patterns for salmonid species (USEPA 2021, p. 74), altering forage availability for bull trout in shared FMO habitat. As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations, as well as the salmonid species that currently provide a prey base.

Projected changes in climate may be expected to result in several impacts to bull trout and habitat including contraction of the range of bull trout; variable or elevated stream temperatures that reduce survival and reproduction; altered ground water exchange that limits egg development; and changed geomorphology that reduces presence or quality of spawning habitat (USFWS 2015a). In addition, increased or variable flows from extreme precipitation events, rain on snow and longer dry periods may increase scouring of spawning areas, reduce juvenile rearing capacity of habitat, and inhibit movements during summer low flow conditions (USFWS 2015a). Increased frequency and extended periods of wildfires may result in loss and fragmentation of habitat (USFWS 2015a).

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). For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (Battin et al. 2007; ISAB 2007; Rieman et al. 2007; Isaak et al. 2015). In streams and rivers with temperatures approaching or at the upper tolerance limits for bull trout, such as occurs in the Walla Walla, Yakima, Umatilla and Snake Rivers, there is little, if any likelihood, that bull trout will be able to adapt to or avoid the effects of climate change/warming without connectivity to cooler waters. As bull trout distribution contracts, patch size (contiguous catchment area of suitable spawning/rearing habitat) decreases and connectivity is truncated. Bull trout populations that may be currently connected will likely face increasing isolation (Rieman et al. 2007, p. 1553; Dunham et al. 2014). Due to variations in landform 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 elevated 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.

13 EFFECTS OF THE ACTION: Bull Trout and Designated Bull Trout Critical Habitat

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for

the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

13.1 Insignificant and Discountable Effects to Bull Trout

Bull trout may be exposed to one or multiple stressors as a result of project-related activities; however, most project-related activities will result in effects to bull trout that are expected to be insignificant or discountable (Tables 8 and 9). These activities are not likely to adversely affect the bull trout because the effects are considered extremely unlikely to occur (discountable), will not be measurable or detectable (insignificant), or the effects will be beneficial. This section provides a rationale for the insignificant or discountable determination for each stressor associated with project activities. Stressors include onshore noise and vibration, chemical contamination, sedimentation and turbidity, fish exclusion activities (i.e., seining/herding), direct impingement or crushing, and underwater noise. For a full description of each activity, refer to section 3.1 of this Opinion, “Description of the Proposed Action.” At the end of this section we also discuss potential effects from boating facilitated by public use of Corps’ maintained docks and ramps.

Shoreline noise and vibration- Sources of shoreline noise and vibration include the use of construction equipment ranging from stationary equipment (i.e., generators) to heavy equipment (i.e., excavator, cement mixer, etc.) or impact equipment (pile drivers), and noise and vibration associated with construction activities such as placing and smoothing fill materials, removing and replacing blocks or precast concrete pads, and other general construction noises. This section also considers noise associated with actions occurring above the surface of the water, such as welding or power washing. Activities originating on dry land and/or above the water’s surface are expected to result in noise ranging from 85 to 112 dB (re: 20 µPa) at 50 feet, decreasing with distance from source (Assessment pp. 58 – 62). In air noise is expected to be largely reflected by the surface of the water (WSDOT 2014) and propagation across the surface is expected to be minimal. Although shoreline noise may also be radiated through the ground and into the water, ground-radiated noise does not propagate efficiently in shallow water (WSDOT 2014). Project-related activities will occur at existing boating facilities where in-water noise as a result of recreation and boating is already occurring, thus, we expect project-related shoreline or over-water noise and vibration will be largely masked by existing ambient noise conditions. We do not expect any onshore or over-water noise that may be transmitted underwater will rise to a degree that would cause behavioral, sublethal, or lethal effects to bull trout. Given the origination location (i.e., on dry land or above the surface of the water) and existing ambient conditions, combined with anticipated sound production below thresholds believed to cause adverse effects to bull trout, we expect the effects to bull trout from shoreline and overwater noise will be insignificant.

Table 8. Determination of effects to individual bull trout resulting from routine dock or ramp repair and maintenance activities. Activities in **BOLD** will occur onshore or above the water (Assessment, p.7). “NLAA” = not likely to adversely affect; “LAA” – likely to adversely affect

	Frequency ¹	Shoreline noise and vibration	Chemical contamination	Sedimentation and Turbidity	Fish exclusion activities	Impingement/ crushing	Underwater noise
Cleaning	Often	NLAA	NLAA				
Board and Plank Replacement	Often	NLAA					
Rail and Kickboard Replacement	Often	NLAA					
Gangway and Rail Welding	Occasion	NLAA	NLAA				
Shoreline Anchor Repair and Replacement	Rare	NLAA	NLAA				
Cleat Replacement	Often	NLAA					
Float Section Connection Ring or Cable Replacement	Occasion	NLAA					
Float Replacement	Rare	NLAA					
Pile Replacement	Rare		NLAA	NLAA	NLAA	NLAA	LAA
Submerged Anchor Replacement	Rare		NLAA	NLAA	NLAA	NLAA	NLAA
Submerged Anchor Cable Replacement	Rare		NLAA	NLAA	NLAA		NLAA
Complete Dock Replacement	Rare	NLAA	NLAA	NLAA	NLAA		LAA

¹ Often = Annual event; Occasion = Less than annual event; Rare = Occurs every few years or less.

Potential chemical contamination- Potential chemical contamination may occur where debris (i.e., algae and/or goose feces) generated during dock cleaning enters the water; contamination from spills or fuels or lubricants; debris from underwater cutting associated with submerged anchor and anchor cable replacement; and introduction of concrete or concrete integrant (i.e., dust, debris, uncured mixes, etc.). Potential chemical contamination may also occur as a result of pothole repair that includes the use of cement grout. The MSMP (Appendix A) requires docks be built with materials that do not contain preservatives and that wood will not be treated; therefore, we do not expect effects to bull trout from preservatives or chemical treatments.

Table 9. Determination of effects to bull trout resulting from routine boat ramp repair and maintenance activities. Activities in **BOLD** will occur onshore or above the water (Assessment, p.7). “NLAA” = not likely to adversely affect.

	Frequency ¹	Shoreline noise and vibration	Chemical contamination	Sedimentation and Turbidity	Fish exclusion activities	Impingement/ crushing	Underwater noise
Onshore Fill and Smooth	Often	NLAA	NLAA	NLAA			
Onshore Block Resetting/Replacement	Occasion /Rare	NLAA	NLAA	NLAA			
Onshore Pothole Repair	Often	NLAA	NLAA	NLAA			
Onshore Concrete Section Replacement	Rare	NLAA	NLAA	NLAA			
In-water Fill and Smooth	Rare			NLAA	NLAA		NLAA
In-water Block Resetting/Replacement	Occasion /Rare			NLAA	NLAA		NLAA
In-water Pothole Repair	Often		NLAA	NLAA	NLAA		NLAA
In-water Concrete Section Replacement	Rare		NLAA	NLAA	NLAA	NLAA	NLAA
Complete concrete or block ramp replacement (assumes in-water work)	Rare	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

¹ Often = Annual event; Occasion = Less than annual event; Rare = Occurs every few years or less

Dock cleaning will wash algae and/or goose feces from the docks into the water, which are expected to be diluted by the volume of the river and/or settle onto the substrate. Algae and goose feces are present in the mainstem rivers, and we do not expect the introduction of additional materials to present toxic exposure to bull trout because of the large volume of the river. This action does not include the use of chemical cleaners or agents, thus, there is no potential for chemical contamination from cleaners or agents.

The proposed project includes minimization measures to reduce transmission of fuels and lubricants to water, including maintaining spill kits on site and operating and refueling equipment away from the water, and other measures described in the Assessment (pp. 68 – 69). The expected volume of any spills would be limited by the small size of the fuel tank and equipment placement (i.e., set back from the water) provides opportunity to contain spills quickly. Any residual amount that may enter the water would be of small enough volume and concentration that we do not expect adverse effects to bull trout. Although the excavator track may be partially submerged during ramp replacement, the entirety of the excavator will be

cleaned prior to contact with water and maintained in a clean and leak-free condition (Assessment, p. 14). Therefore, we expect effects to bull trout associated with fuels or lubricants will be insignificant or discountable.

Cutting helical anchor screws (i.e., one of the two types of submerged anchor) or underwater anchor cables will produce minor amounts of steel debris that is expected to settle quickly to the substrate. Submerged anchor and anchor cable replacement are expected to be rare occurrences (Table 2; Assessment, p. 62) and both activities will require fish exclusion prior to implementation. Given the rare occurrence and exclusion of bull trout from the work area prior to and during implementation, we expect effects to bull trout from cutting underwater screws and cables will be insignificant and/or discountable.

The project contains several measures to prevent concrete or concrete integrant from entering the adjacent water, including no in-water pouring, allowing concrete to “cure” for 7 days prior to contact with water, and requiring concrete debris to be contained and disposed of in an upland location. Given the minimization measures incorporated into the project that will minimize the risk or avoid introducing concrete or concrete integrant to the river, we expect effects to bull trout from the use of concrete will be discountable. The project also includes the use of cement grout to repair potholes at existing boat ramps. Effects to aquatic resources occur when grout interacts with the water to increase pH in the surrounding water; however, grout will contain an anti-washout mixture that minimizes grout contact with the surrounding water column, which has been shown to moderate changes in pH (Fitch 2003, p. 15). Grout quantity will be limited to 0.5 cy and the patch size to 2 ft² or less (Corps 2021), which reduces the area of impact. Bull trout exposure is reduced because, as described in the Assessment (p. 63), in-water pothole repair (when grouting may occur), will only occur during the in-water work window, at low pool, and following fish exclusion. Given the small scale and extent of water quality impacts and measures that minimize or avoid exposure to bull trout, we expect impacts to bull trout from the use of cement or in-water grout application will be insignificant or discountable.

Sediment Transport and Turbidity- Turbidity is likely to result from removing and replacing submerged helical screws and anchor blocks from the substrate, as a result of extracting or driving piles, or in association with placing and retracting barge spuds (i.e., the feet that hold the barge in place). Sedimentation may occur during onshore or in-water ramp repair and maintenance activities. Turbidity generated during repair and replacement of anchor blocks, through removal of existing piles, during pile driving, or associated with securing or removing barge spuds is expected to be of relatively small quantity given the small size of the anchors/piles/spuds and is expected to settle out quickly. Likewise, sedimentation that may be generated during in-water ramp repair and maintenance is expected to settle quickly because these activities will occur during low pool and very near the shoreline where there is little to no flow. Bull trout will be excluded from the work area, reducing the potential for exposure to turbidity and/or sediment. Sediment transport during onshore ramp repair and maintenance activities is expected to be limited because, as described in the Assessment (p. 2), the proposed action will incorporate the design criteria from the MSMP (p. 80), which includes measures to minimize sediment transport to adjacent water, including maintaining sediment control materials on-site and use of temporary erosion control measures that will be in place and appropriately installed downslope of project activities. Given the minor amount of anticipated in-water

turbidity and reduced exposure to bull trout, and minimization measures that reduce sediment transport, we expect effects to bull trout from turbidity and sediment transport will be insignificant or discountable.

Fish exclusion- Fish exclusion will occur prior to pile replacement, submerged anchor replacement and submerged anchor cable replacement, and prior to all in-water ramp repair or replacement activities. Fish exclusion activities are described in the Assessment (p. 13) and in section 3.3 of this Opinion, “Conservation Measures.” Project timing and location minimizes the number of individual bull trout that may be impacted, and the reservoir will be lowered to minimum operating pool to further reduce the number of bull trout that may be present or that would need to be herded out. Any remaining bull trout will be displaced using seine nets, working from the top of the existing footprint and out to the edge of the work area. Nets will be placed to prevent bull trout reentry. Seining works by herding fish from a location and does not involve direct contact. Adult and subadult bull trout are expected to move away of their own volition into nearby suitable habitat. Due to the non-invasive nature and timing of this activity, and availability of nearby suitable habitat, we expect effects to bull trout from fish exclusion will be insignificant.

Impingement or crushing- Bull trout may be affected through impingement or crushing while replacing submerged anchor blocks or during ramp repairs when equipment may enter the water or when precast slabs are placed in-water; however, as described above, fish will be excluded from the work area prior to implementation and nets will prevent movement back into the work area. We expect adult and subadult bull trout to move away from the work area in response to seining. Therefore, we expect the effects to bull trout from impingement or crushing to be discountable.

Underwater noise- Bull trout may be affected by underwater noise associated with cutting helical anchor screws or anchor cables, from noise associated with moving floats or other structures to shore, or from barge operations where barges are used in pile driving. Based on our review of typical noise associated with non-impact construction equipment (WSDOT 2014, pp. 7.11 to 7.13), we assume the greatest SPLs will be associated with operating underwater saws. However, as described in the Assessment (p. 62), the underwater sound pressure level produced when cutting the screws and cables is not expected to exceed 117dB_{RMS}, which is below the threshold criteria that may result in behavioral or adverse (i.e., injury or death) effects to bull trout. Therefore, effects to bull trout from noise associated with cutting submerged helical screws and anchor cables is expected to be insignificant.

Boating- Boat docks and ramps maintained by the Corps facilitate private recreational activities (none of the docks support commercial uses). Continued personal recreation activities at these facilities is expected as a result of Project-related repairs and maintenance of existing structures but, because expansion of existing facilities is not included in the proposed action, is not expected to increase existing use patterns. Of the potential activities that are likely to occur, boating has the greatest propensity to affect bull trout. Boating and boat operations may affect bull trout through injury sustained from contact with propellers or hulls, elevated noise and disturbance associated with boat motors or human recreation (swimming or water play),

sediment resuspension associated with propeller wash, and negative effects to forage fish or submerged vegetation that could indirectly reduce the availability of native forage fish.

We expect direct effects are unlikely (i.e., discountable) because recreational boating occurs primarily during the summer months when warm summer temperatures are expected to preclude proximal bull trout presence, particularly in the nearshore environments where these stressors are most likely to concentrate. During this time, we expect bull trout to occur in deeper pools (outside of the recreation areas) or near other sources of thermal refugia. As water temperatures become more hospitable to bull trout, in cooler months, we expect the number of boaters to diminish, thus reducing bull trout exposure. Any bull trout that may occur in proximity to boats or boating activities will be adults and subadults that are expected to move away at the onset of disturbance. Therefore, we expect any effects to bull trout from boat operations or associated recreation will be insignificant or discountable. Although we expect there may be indirect effects to aquatic vegetation or to bull trout forage items, we expect these will result in insignificant effects to bull trout individuals because indirect effects are expected to be localized to the existing dock facilities, of which there are 37 across the mainstem Columbia, lower Snake, and lower Clearwater Rivers. As described in the Assessment (p. 58), recreational boating noise is expected to induce moderate behavioral effects with little potential for injury or mortality to salmonid species that bull trout might prey on. While we expect local impacts to aquatic vegetation and bull trout prey items, we expect bull trout will be able to locate alternative prey items within close proximity and, given the low density of bull trout in these river systems, we do not expect intra-specific competition to reduce foraging efficiency. Thus, we expect indirect effects of boating will be insignificant to bull trout.

13.2 Adverse Effects to Bull Trout

Bull trout may experience adverse effects as a result of elevated underwater sound associated with pile driving activities. The proposed action includes a number of impact minimization measures (Assessment, pp. 67 – 69) to avoid and/or minimize adverse effects to bull trout as a result of pile driving, and the following analysis assumes those measures will be implemented during these activities. This Opinion analyzes the likelihood and magnitude of potential effects, taking into consideration those minimization measures.

13.2.1 Elevated Underwater Sound Pressure Levels

The following summary of underwater noise was taken largely from Chapter 7.0, Construction Noise Impact Assessment, of the Washington State Department of Transportation (WSDOT) Biological Assessment Preparation Manual (2014).

Underwater noise refers to sound pressure waves that are transmitted through the water. The sound is generally measured in decibels (dB), however dB is a relative measure, not absolute, and is accompanied by a reference scale ($\text{dB} = 20 * \log (P1/P_r)$, where $P1$ is the measured noise pressure and P_r is the reference pressure) to denote the Sound Pressure Level (SPL). Decibels are measured on a logarithmic scale, so each 10 dB increase doubles the sound (USDOT 1995, cited in WSDOT 2014, p. 7.6). Noise attenuation is generally described as a reduction in the dB level per doubling of distance from the source (i.e., noise is quieter further from the source). Depending on the nature of the noise source, noise propagates at different rates. Sound waves

bend upward when propagated into the current and downward when aimed downstream, and sound waves bend towards colder, denser water. Because of these variables, sound is always reported with reference to the distance at which it was measured. Underwater noise is generally measured, and reported, at a 10-meter distance.

Transmission loss (TL) underwater is the accumulated decrease in acoustic intensity as an acoustic pressure wave propagates outwards from a source. The intensity of the sound is reduced with increasing distance due to spreading. Spreading is difficult to calculate because of environmental conditions that cause reflections or refractions of the waves (WSDOT 2014, pp. 7.31 to 7.32), current velocity, topographic features, or in-water structures that break up sound waves, but experts generally agree that true spreading ranges between 3 and 6 dB per doubling distance, or an average of 4.5 dB per doubling of distance. Noise propagation in rivers is limited by the sinuosity of the river, in that noise does not propagate around a river bends. In this, “line-of-sight” is often used to determine the extent of noise propagation in a river system.

Underwater noise is reported using different measures. Instantaneous peak pressure (dB_{PEAK}) refers to the instantaneous maximum overpressure or underpressure observed during each pulse and can be presented in Pascals (Pa) or as SPL in dB with a reference to a pressure of 1 Pa (dB re: 1 Pa). Root Mean Square (dB_{RMS}) is the square root of the energy divided by the impulse duration and, although it cannot be converted directly to dB_{PEAK} , dB_{PEAK} is generally 10 to 20 dB higher than that dB_{RMS} . Sound Exposure Level (SEL) is often used as an indication of the energy dose and is calculated by summing the cumulative pressure squared, integrating over time, and normalizing to 1 second. The units for SEL are $\text{dB re: 1 } \mu\text{Pa}^2 \text{ sec}$.

Pile driving has been shown to produce a range of effects on fish species, including lethal, sublethal (physiological or neurological effects), and behavioral effects. The Service’s Washington Fish and Wildlife Office has produced a guidance document to aid in evaluating potential effects to bull trout from pile driving (Teachout 2010). For the effects analysis of this Opinion, we rely on this document as basis for describing and evaluating the effects of project-related pile driving on bull trout.

Lethal and Sublethal Effects- Pile driving produces sound energy that can result in injury and mortality to aquatic species and is generally related to the effects of rapid pressure changes, especially on gas-filled spaces in the animal’s body, such as swim bladder, lungs, sinus cavities, etc. In fishes, injury occurs primarily through barotrauma when underwater SPLs rapidly expand and compress the swim bladder, leading to injury of the adjacent tissue (Yelverton et al. 1973, p. 37; Gaspin 1975; Yelverton et al. 1975, p. 17; Yelverton and Richmond 1981, p. 6; Turnpenny and Nedwell 1994; Hastings and Popper 2005). Death may be instantaneous, occurring with several minutes, or delayed several hours or days (Abbott et al. 2002). Necropsy of Sacramento blackfish (*Othodon microlepidotus*) exposed to high SPLs showed extensive internal bleeding and ruptured heart chamber despite the fact that they continued to live several hours after exposure. Not all fish killed by barotrauma float to the surface and, because fish kills are generally reported only upon discovery of dead fish floating at the surface, the frequency and magnitude of fish kills is likely underestimated (Teleki and Chamberlain 1978; WSDOT 2003).

Even in the absence of mortality, elevated SPLs can cause sublethal injuries. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a

temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996, p. 1759). Popper et al. (2005, p. 3959) found temporary threshold shifts in hearing sensitivity after exposure to cumulative sound exposure levels (SEL) as low as 184 dB. Temporary threshold shifts reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success. Hastings (2007, p. 5) determined that a SEL as low as 183 dB (re: 1 μPa^2 per second) was sufficient to injure the non-auditory tissues of juvenile spot (*Leiostomus xanthurus*) and pinfish (*Lagodon rhomboides*) with an estimated mass of 0.5 grams. Sublethal injuries have been shown to reduce osmoregulatory efficiency and increase energy expenditure (Gaspin et al. 1976, p. 32; Govoni et al. 2008, p. 1) and can effect equilibrium and interfere with the ability to carry out essential life functions such as feeding and predator avoidance (Gaspin 1975; Turnpenny et al. 1994; Hastings et al. 1996; Popper 2003).

Injury studies demonstrate size-specific differences in injury, where fish with greater mass sustain less injury than a fish of smaller mass when exposed to the same pulse of energy (Yelverton et al. 1973, pp. 29, 37, 49; Yelverton et al. 1975, p. 17; Yelverton and Richmond 1981, p. 8; Stadler 2002). Additionally, species-specific differences in injury have been documented (Song et al. 2008, pp. 1362-1365; Popper et al. 2005, p. 3964), making comparisons of the effects of elevated SPL across species difficult.

The potential for injury and/or mortality from pile driving also depends on the type and intensity of the sound, which can be influenced by the type of hammer, type of substrate, and water depth. Although physical damage to non-auditory tissue may be best described using *cumulative* SEL, most relevant data are not reported in cumulative SEL (Yelverton et al. 1975; Wiley et al. 1981; Stuhmiller et al. 1996) and the raw data needed to calculate cumulative SEL is not contained in the reports.

In an attempt to better define the threshold of underwater noise effects to listed species, the California Department of Transportation (Caltrans) and Federal Highway Administration (FHWA) established the inter-agency Fisheries Hydroacoustic Working Group (FHWG), comprised of transportation and resource agencies, underwater acoustics experts, and fish biologists. Through their efforts, the FHWG developed an agreed upon “interim criteria” for evaluating the potential for physical effects (i.e., “injury”) to listed species from underwater SPLs associated with pile driving (FHWG 2008), using cumulative SEL to account for the repeated strikes associated with pile driving. Injury is therefore expected if either: 1) the peak pressure of any strike exceeds 206 dB; or 2) the SEL, accumulated over all pile strikes, exceeds 187 dB (re: 1 μPa^2 per second) for fishes 2 grams or larger and 183 dB (re: 1 μPa^2 per second) for fishes smaller than 2 grams. The number of pile strikes is used to determine the cumulative SEL by applying the following equation:

$$\text{Cumulative SEL} = \text{Single-strike SEL} + 10 \cdot \log(\text{number of pile strikes})$$

The number of pile strikes is estimated per continuous work period. The Service assumes that there will be a break of at least 12 hours between work periods. A break of this duration is typical for most pile driving operations and is thought to allow for fish to recover from exposure to high SPLs.

Behavioral Effects- Sounds generated by pile driving are impulsive sounds made up of a series of frequencies/tones, generally between 100 and 800 Hertz (Hz). While salmonids can detect sounds at frequencies between 10 and 600 Hz (Mueller et al. 1998), optimal salmonid hearing is thought to be at frequencies around 150 Hz (Hawkins and Johnstone 1978), thus, impact pile driving produces sounds within the range of salmonid hearing. Documented behavioral modification includes swimming away from the sound source, which decreases the exposure to the sound, or remaining in place, which increases the risk of possible injury (Popper 2003). Feist et al. (1992) found that pile driving concrete piles affected juvenile salmonid distribution, school size, and schooling behavior, where schools exhibiting increased milling behavior (i.e., moving in an eddying mass) and moving towards acoustically isolated areas on days when pile driving occurred. Such behavioral response could be adverse or not, depending on the location and duration of pile driving activity. For example, displacement could result in loss of foraging efficiency if an individual were forced from optimal feeding habitat (Engas et al. 1996), or reproductive effects, if forced from spawning habitat. Displacement from optimal overwintering habitat may be adverse if such disruptions result in significantly increased energetic expense, predation risk, or other responses that may increase the likelihood of injury. Pile driving may also interfere with normal migration.

In determining the threshold at which pile driving may result in behavioral effects, Turnpenny et al. (1994) studied the behavioral response in brown trout, bass, sole, and whiting, and found that brown trout showed avoidance reaction at sounds above 150 dB_{RMS} and other reactions (i.e., startle response) at 170 – 175 dB_{RMS}. Observations by Feist et al. (1992) suggest that sound levels in this range may disrupt normal migratory behavior. In other studies, Fewtrell (2003) found that seismic air gun impulses resulted in significant increases in behavioral response the SPLs exceeded 158 – 163 dB_{RMS}, but found no significant physiological response (i.e., cortisol or glucose changes). Conversely, Santulli et al. (1999) documented significant physiological response in European bass from seismic survey noise. Although there exists a level of uncertainty extrapolating experimental data to field data and in comparing pile driving effects to seismic noise, there appears to be some species-specific differences in behavioral response.

The Service has adopted the conservative threshold 150 dB_{RMS} for assuming behavioral effects to bull trout. This “safe limit” was first recommended by Hastings (M. Hastings, pers. comm. 1997, cited in Teachout 2010, pp. 5-6), and represents a reasonable margin below the lowest level where fish injury was observed. Therefore, we assume that SPLs in exceedance of 150 dB_{RMS} are likely to cause temporary behavioral changes in bull trout but are not expected to result in direct injury or mortality. Behavioral response may include area avoidance or altered migratory timing and may represent a significant disruption in foraging efficiency or overwintering behavior depending on the duration and timing of exposure, life history, normal use of the area, and the importance of the area in meeting individual overwintering needs.

13.2.2 Effects of Pile Driving to Bull Trout

Under this program, the Corps proposes to replace dock piles as needed at existing boat docks within their Tri-State and Little Granite AORs, which includes 42 docks (Trumbo, B., *in litt.* 2021a). Up to 74 piles may be replaced as part of the proposed action. Most piles are located within the lower Snake River, but 1 dock with 2 piles, at the Lewis and Clark Interpretive Center in Lewiston, Idaho, sits at the confluence of the lower Clearwater and Snake Rivers. Therefore, we expect effects to individual bull trout will primarily be limited to those bull trout occurring in the lower Snake River, but could affect a very small number of bull trout within the lower Clearwater River and are expected to have no effect on bull trout occurring in the Mid-Columbia River because the Corps does not anticipate replacing piles at docks located on the Mid-Columbia River (Trumbo, B., *in litt.* 2021c). The Corps will prioritize replacing piles with anchor and cable systems which, as described above, would be expected to result in insignificant effects to bull trout, but replacing existing piles with piles is likely to occur and, therefore, is assumed for the purposes of this analysis. We conservatively assume all 74 piles may be replaced with piles during the 20-year term of the action while recognizing this may be an over-estimation.

Piles will be placed within the nearshore environment, as dock floats are placed at least 40 horizontal feet from OHWM but no more than 100 feet from OHWM (Assessment, Appendix A). Replacement piles may be 8-inch or 12-inch in diameter (existing piles are 8-inch diameter), but this Opinion conservatively assumes 12-inch steel piles will be used. Pile driving will occur between November 1 and February 28 (Trumbo, B., *in litt.* 2021c), which overlaps bull trout over-winter period, and we assume pile driving will occur during the daytime. The number of piles replaced at each location will vary. Piles will be replaced as needed, but the Corps anticipates replacing 1 or 2 per year (Assessment, pp. 2-3). Given the Corps assumes 240 strikes per pile, the Service's pile driving calculator assumes 2 piles will result in approximately 12 minutes of elevated underwater SPLs. Although the Corps has clarified some docks in the Action Area have as many as 8 piles, most have 4 or fewer piles. The Corps expects complete pile replacement "an extreme rarity" (Assessment, p. 3); therefore, this Opinion assumes up to 2 piles will be installed at any one location during a given maintenance event.

Piles may be placed using either vibratory or impact pile driving methods, but the Corps has indicated they will prioritize using vibratory driving methods (Assessment, p. 68). Impact pile driving produces repeated peak sound pressure levels; therefore, the effects to bull trout from elevated underwater SPL considers the number of strikes per pile and the number of piles driven each day. The Corps estimates each pile will require 240 strikes and, as previously identified, we assume they will drive up to 2 piles each day at a given location. To calculate the SPL from pile replacement, the Services have agreed to use pile driving monitoring data from the nearby Yakima River (Laughlin 2004) as a reasonable surrogate to estimate project-related SPLs. Laughlin et al. monitored SPLs from impact pile driving 16-inch steel piles at 30 meters. Using their results, without adjusting for the smaller piles size, we conservatively assume impact pile driving 12-inch steel piles is expected to produce an SPL of 200 dB_{PEAK}, 187 dB_{RMS}, and 173 dB_{SEL} at 30 meters. The Corps will also incorporate the use of wood block cushion and bubble curtain, which have been shown to reduce SPLs (WSDOT 2014, p. 7.42), but the documented

effectiveness of bubble curtains has been highly variable, ranging anywhere from 0 to 30 dB. For this Opinion, we conservatively assume the combined use of a wood block and bubble curtain may attenuate SPL by up to 5 dB.

Vibratory pile driving consists of a set of jaws that clamp onto the top of a pile, holding the pile steady while the pile is vibrated to depth (WSDOT 2014, p. 7.14). Because vibratory pile drivers are not impact tools, they typically produce noise levels 10 to 20 dB_{PEAK} below that of impact drivers (WSDOT 2014, p. 7.37). Impacts to fishes or other aquatic organisms have not been documented as a result of vibratory pile driving. However, vibratory pile driving requires more time to install piles, extending the duration of elevated SPLs, and often requires “proofing,” or striking the pile with an impact hammer to determine its load bearing capacity. The Corps estimates up to 5 strikes may be needed for each pile (Corps 2021b) installed using the vibratory method. The Corps will not use attenuation devices during impact proofing.

As described in section 7.1.1 of this Opinion, “Status of the Species in the Action Area,” adult and subadult bull trout may be present in the Action Area; therefore, the Service assumes all bull trout that may experience the effects of pile driving will be adults and subadults greater than 2 grams.

13.2.2.1 Lethal and Sublethal Effects to Bull Trout from Pile Driving

The Service has determined that within a radius of 100 meters from impact pile driving 12-inch steel piles (0.3 km²), elevated SPLs are likely to exceed the threshold levels believed to result in injury or death to bull trout (Appendix D). This area is a conservative estimate, as it does not consider bottom topography, underwater landforms (i.e., river bends or basins), or other conditions that may reduce the actual transmission rate. Although the Corps will coordinate with their Reservoir Control Center to lower the water level in the reservoir and will exclude bull trout from the immediate work area prior to implementation, bull trout may occur within the larger area of injury extent.

Project location, timing, frequency, and duration are expected to reduce the number of bull trout that may be affected. Pile driving will occur in the nearshore environment (i.e., no more than 100 feet from shore (Appendix A)) and is anticipated to occur during the day. Shoreline and much of the nearshore environments generally do not provide quality habitat to bull trout, and bull trout are typically found in deeper waters during the day when pile driving is most likely to occur, moving into shallower waters at night to forage. Impact pile driving is expected to be an infrequent occurrence. Assuming all 74 piles are replaced during the 20-year program, an average of 3 to 4 piles will be replaced each year, of which an average of 2 per year will be installed via impact driving. Exposure time is further limited by the number of piles: The Corps predicts they will install up to 2 piles in a single day which, assuming 40 strikes per minute for impact pile driving, we expect will result in 12 minutes of elevated SPLs exceeding lethal/sublethal thresholds.

Due to the fact that bull trout occur at low density in the lower Snake and lower Clearwater Rivers and because the entire Action Area (i.e., noise extent at 37 locations; Table 1) represents a very small portion of the lower Snake River and a much smaller portion of the lower Clearwater River, we expect few bull trout will experience elevated SPLs associated with impact pile

driving. However, despite the many factors that combine to reduce the potential exposure of bull trout to adverse effects associated with impact pile driving, based on the number of docks, number of facilities, and length of the program, there is the potential that a few individual bull trout may experience adverse effects as a result of impact pile driving, leading to injury or death.

As previously described, vibratory pile driving produces SPLs 10 to 20 dB_{PEAK} below that of impact driving. Conservatively adjusting for the reduced SPLs of vibratory pile driving, we assume vibratory pile driving would produce SPLs of 190 dB_{PEAK} or 173 dB_{SEL}, which falls below the threshold SPL believed to result in lethal or sublethal effects to bull trout over 2 grams (Appendix D). Therefore, we do not expect vibratory pile driving will result in lethal or sublethal effects to bull trout.

Impact proofing is expected to produce SPLs of 200 dB_{PEAK}, exceeding the lethal and sublethal threshold to a distance of 12 meters, or 39 feet, from the source (Appendix D). Vibratory pile driving precedes impact proofing, thus bull trout response to vibratory pile driving is likely to influence bull trout exposure to impact proofing. Briefly, vibratory pile driving may result in behavioral effects to bull trout (see below for a more in-depth discussion of behavioral effects of vibratory pile driving). Behavioral response studies suggest bull trout may move away from vibratory pile driving or may remain in place (Popper 2003). We expect the behavioral response will be mixed. Any bull trout that remain in place for the duration and immediately following vibratory pile driving may occur within the area of injury extent associated with impact proofing and may experience adverse effects leading to injury or death. Since the Corps estimates they will perform 5 strikes per pile, the duration of effects is expected to be very short. Based on the very small impact area relative to the size of the lower Snake and lower Clearwater Rivers, low density of bull trout that are expected to occur in each, reduced likelihood that bull trout would occur in the nearshore/shoreline environment during the day (see above), and because bull trout will be excluded from the immediate work area prior to vibratory pile driving, we expect the number of bull trout within 39 feet of impact proofing will be very few, but their presence cannot be ruled out. Given the low frequency of pile driving events (i.e., no more than 74 total piles across 20 years, less the number of piles installed via impact driving), we expect very few bull trout might be adversely affected, leading to injury or death, as a result of impact proofing over the course of the program.

13.2.2.2 Behavioral Effects to Bull Trout from Pile Driving

The Service expects pile driving will produce SPLs exceeding the behavioral effects threshold of 150 dB_{RMS} (re: 1 µPa) but, given the different sources of noise (impact driving, vibratory driving, and impact proofing) and number of pile strikes associated with each method, the area of extent in which behavioral effects are anticipated varies (Appendix D): Impact pile driving is expected to produce elevated SPLs likely to exceed the behavioral effects threshold within a radius of 4,078 meters (52.25 km²); Vibratory pile driving is expected to produce elevated SPLs likely to exceed the behavioral effects threshold within a radius of 1,893 meters (11.26 km²); and, impact proofing (5 strikes per pile) is expected to produce elevated SPLs likely to exceed the behavioral effects threshold within a radius of 8,786 meters (242.51 km²). These are extreme estimates that do not consider bottom topography or underwater landforms (i.e., river bends or basins) that are expected to reduce the extent of noise propagation. Taking these factors into consideration, we expect the behavioral effects extent will be confined largely to boat basins where docks and their

associated pile driving are encompassed by basins, and by the nearest bends in the river, providing the sinuosity of the bends is great enough to intercept and, thus, restrict noise propagation. Where docks are exposed (i.e., not confined to a boat basin), we expect elevated underwater SPLs that exceed behavioral response thresholds could span the width of the adjacent river. Although the Corps will coordinate with their Reservoir Control Center to lower the water level in the reservoir and will exclude bull trout from the immediate work area prior to implementation, bull trout may occur within these larger behavioral impact areas.

Behavioral effects are likely to be realized through area avoidance or local (i.e., the individual remains in place) changes in behavior, which could be adverse or not, depending on the importance of each location for bull trout. Pile driving will occur between November 1 and February 28, which overlaps late-season outmigration and overwintering periods and will not occur during peak migration; hence any interference with outmigration will be limited. While we expect pile driving of any type will cease relatively quickly, the Service assumes up to 12 hours may be needed for bull trout to recovery from elevated SPLs once pile driving operations cease (Teachout 2010, p. 7) and behavioral effects may continue to impact individuals once pile driving has ceased. Bull trout typically maintain relatively small winter ranges, moving infrequently and within a short distance, generally to forage. Disturbances that cause displacement from optimal overwintering habitat or disruptions in foraging behavior may result in adverse behavioral modification by reducing foraging efficiency or displacing individuals to poorer quality habitat. Considering the degraded baseline condition of the Mainstem Snake River and Clearwater River CHUs, individual bull trout fitness may be depressed prior to pile driving, in which case any behavioral response to pile driving may exacerbate their response to existing conditions. The degree to which project-related effects alter foraging efficiency or result in displacement from optimal overwinter habitat will determine the magnitude of impacts, but the actual importance of habitat within each behavioral area of extent and the availability of nearby comparable habitat is unknown. While it is possible that the behavioral response elicited by bull trout may not result in adverse effects, the possibility cannot be ruled out and the number of bull trout that might experience adverse effects cannot be determined. In light of these uncertainties, we conservatively assume that elevated underwater SPLs that exceed the behavioral effects threshold will create a likelihood of injury by significantly disrupting normal behaviors to all bull trout within the area where the behavioral effects threshold is exceeded.

13.2.2.3 Summary of Adverse Effects to Bull Trout

In summary, we expect adverse effects to all (adult and subadult) bull trout within the area where elevated underwater SPLs exceed the thresholds for sublethal, lethal, and behavioral effects. The actual number of bull trout expected to occur within these area is unknown but is believed to be relatively small given the overall low density of bull trout in the lower Snake and lower Clearwater Rivers and size of the Action Area relative to the size of the rivers. Elevated SPLs are expected to be relatively short duration (generally lasting less than a day) and infrequent (i.e., a maximum of 74 piles over the course of the 20-year programmatic, or 3 to 4 piles per year on average), which further reduces the number of bull trout that might be exposed. Since bull trout do not use the Action Area for spawning or juvenile rearing, we do not expect any effects to juvenile bull trout, eggs, fry, and alevins. Given the low density of bull trout in the lower Snake and lower Clearwater Rivers is comprised of bull trout from numerous local populations, and the fact that the number of bull trout that overwinter in the mainstems lower Snake and lower

clearwater Rivers (versus overwintering in the lower reach of their natal tributaries) represents only a subset of the total local population, we do not expect the level of take associated with pile driving will result in significant effects at the local population level. If bull trout populations increase in Core Areas over the term of the action, more bull trout may be exposed to project-related stressors. However, the Proposed Action is not expected to influence positively or negatively the survival and recovery of these Core Areas because only a small proportion of bull trout from these Core Areas is associated with the Action Area and few bull trout are likely to be adversely affected.

Effects to Designated Bull Trout Critical Habitat

The proposed action may affect designated bull trout critical habitat through impacts to one or more of the primary constituent elements (PCEs; also referred to as PBFs, or “physical and biological factors”). Both negative and beneficial effects to PCEs are discussed. Project-related effects are considered against the baseline conditions described in the section 7.1.4 of this Opinion, “Status of Critical Habitat in the Action Area.” The Service expects that both negative and beneficial effects on PCEs will be too limited in scope and duration to change the current baseline condition of indicators at a watershed scale; however, we do expect some significant effects at the local scale.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia. The proposed action will occur at existing recreational facilities and project-related activities, including full dock and ramp replacements, will remain within the existing footprint of existing docks and ramps with some minor adjustments that will not increase the overall size of the footprint or demonstrably alter the location of the existing structures. Groundwater influences may occur in some riverine areas along the mainstem, but any occurrence at Corps’-maintained facilities or the impact that existing structures may have on groundwater inputs is unknown. While we expect the proposed project will not contribute to worsening of PCE 1, to whatever extent the existing facilities have impacted PCE 1, the proposed Project will maintain those conditions. Considering the small footprint of the existing structures, i.e., ramps covering 18,543 sq ft of habitat below OHWM, in relation to the large river systems, we expect any effect to this PCE is insignificant.

PCE 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. The proposed action may affect PCE 2 through localized, temporary water quality impairments (i.e., sediment, turbidity, and chemical contaminants), long-term preservation of the existing 42 boat docks and 31 boat ramps along the Mid-Columbia, lower Snake, and lower Clearwater Rivers, and disturbances related to pile driving. We do not expect temporary water quality impairments or the long-term maintenance of existing boat docks and ramps to result in adverse effects to PCE 2 because the boat docks/ramps and disturbances associated with turbidity and chemical contamination from their repair and maintenance will be restricted to the nearshore and shoreline environments, which do not provide optimal bull trout migration habitat.

Disturbances from pile driving activities may result temporary impediments to migration, depending on the location of pile driving disturbances in relation to migratory routes and the behavioral response of bull trout. While most bull trout migrations are nocturnal, there may be isolated instances of bull trout attempting to migrate during daylight transition times (early morning or early evening hours) when pile driving may occur. Elevated underwater SPLs may exceed behavioral thresholds across the span of the mainstem lower Snake or Clearwater Rivers where piles are replaced at docks exposed to the river (i.e., docks not enclosed within a boat basin). However, none of the facilities are directly adjacent spawning or rearing tributaries, pile driving will occur outside of peak migration periods, and disturbances will be short-term (i.e., piles will be installed in less than 1 day, plus a 12-hour recovery period). Therefore, while we expect short-term, local disturbances that may temporarily interfere with bull trout migration, we do not expect the Project to preclude migration or significantly reduce the function of PCE 2.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish. PCE 3 is currently functioning at risk across the Action Area as a result of reduced native salmon forage and riparian function that is largely influenced by dam operations. Project-related effects are expected to be both negative and beneficial to this PCE. Existing boat dock and ramp structures occur within the riparian and nearshore environment and will be maintained for the next 20 years, which will continue to contribute negatively to riparian habitat and function, primary productivity, and predation risk, which in turn negatively affects forage production. Existing docks will continue to provide habitat favorable to non-native predators (ambush habitat and lack of complex cover resources), both a negative and beneficial effect in that salmonid forage base is reduced, but bull trout may also prey on non-native species. Shading and loss of aquatic vegetation may reduce foraging efficiency of native prey species. Pile driving, which is expected to adversely affect bull trout, is also expected to adversely affect other fish species, including salmonids and non-native species, reducing forage availability for bull trout. The proposed action is also likely to result in additional localized effects to the benthic community, through increased sediment and turbidity (see Carrasquero 2001), and potential lethal or sublethal effects to forage base near occurring in close proximity to grout repairs (Alabaster and Lloyd 2013). We expect impacts associated with sediment/turbidity and grouting to be extremely localized and short-term. Boat operations facilitated by Corps'-maintained docks may also result in increased turbidity, reduced aquatic vegetation, and noise that may contribute negatively to forage base for bull trout (see Anchor Environmental 2006).

The proposed action includes a number of conservation measures designed to reduce or minimize impacts to PCE 3, including measures defined in the MSMP that impose design criteria favorable to Act-listed species on all docks repaired or maintained under the program. These include requiring docks to be covered with 100 percent surface grating permitting a minimum 50 percent light penetration to reduce shading, restrictions on dock size (to reduce predation and minimize salmonid behavioral response) and placement (that favor salmonid migration), restricting submerged anchor sizes to no greater than 1-foot height (to avoid creating predator habitat), and restrictions on removing any existing natural habitat features, which would include any remaining or existing complex habitat features or aquatic vegetation. We expect these measures will minimize effects to forage base that will, in turn, minimize any effects to

individual bull trout. However, based on the number of locations covered by the program, length of the program, and uncertainties in the exact value of each location to bull trout foraging and overwintering, we expect some localized adverse effects to PCE 3.

While quantifying the precise effects to PCE 3 is difficult because of uncertainty in determining the exact amount of forage base negatively and/or positively affected as a result of the proposed action, we can estimate impacts using the area affected by the proposed action. Existing boat ramps cover an area approximately 74,170 ft², of which approximately 18,543 ft² (25 percent) occurs below OHWM. The coverage area of the 42 existing docks is unavailable, but the Corps has committed to maintaining the existing surface coverage area of the existing structures. For this analysis, we assume any modification to the surface area coverage will be very small, i.e., less than one ft²; therefore, we estimate the impacts to PCE 3 will be limited to the extent of the existing surface area of docks and to the coverage area of the boat ramps. While we consider the combined effects to forage base a localized adverse effect to PCE 3, we do not expect adverse effects to individual bull trout because the footprint of the structures is very small compared to the size of the adjacent rivers, and because the low density of bull trout in the project area reduces the likelihood of competition for alternative forage resources. Also, considering the small area of impact and small footprint of the docks and ramps compared to the entirety of the Mainstem Columbia River, Mainstem Snake River and Clearwater River CHUs, we do not expect the localized effects to significantly reduce PCE 3 function at the CHU level.

PCE 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. PCE 4 does not function properly (i.e., adverse baseline) in the Mainstem Columbia River and Mainstem lower Snake River CHUs, largely to result of dam operations and anthropogenic activities that have reduced riparian habitat and function. PCE 4 functions at risk in the Clearwater River CHU. Existing docks and ramps contribute negatively to this PCE by reducing habitat complexity and precluding natural vegetation development. By their very construction and operation, riparian vegetation is locally absent at existing boat docks and ramps. Repair activities will preclude re-establishment. The program will repair and maintain for the long-term (i.e., 20 years) the existing docks and ramps, which will continue to contribute to local areas of hardened substrate, lower velocity, and homogenous nearshore and shoreline habitat.

The proposed action includes a number of conservation measures to minimize impacts to PCE 4, primarily by retaining the existing size and coverage area of docks and ramps and restricting removal of any existing in-water habitat that occurs outside of the repair areas. Maintenance or removal of riparian vegetation, outside of any vegetation that may be attempting to re-establish within the footprint of existing ramps, is not included in the proposed action. Despite the small footprint of the existing facilities relative to the CHUs in which they occur and dispersed placement of each across the three CHUs, the baseline of the Mainstem Columbia River and Mainstem Snake River is currently functioning in an adverse condition (i.e., not functioning properly); therefore, and additional negative influences are considered an adverse effect to some degree. The precise contribution to the adverse function of the CHUs is difficult to quantify but can be expressed in terms of area affected. Existing boat ramps cover an area approximately 74,170 ft², of which approximately 18,543 ft² (25 percent) occur below OHWM. The coverage

area of the 42 existing docks is unavailable but the surface coverage area of the existing structures will be maintained within a small margin. For the purposes of this analysis, we expect and modification to the surface area of the structures to be less than one ft²; therefore, we can approximate impacts by the extent of the existing surface area of docks. Although we expect Project-related activities will continue to contribute negatively to PCE 4 at the local level, we do not expect adverse effects at the species level or significant reduction in PCE function at the CHU level because of the low density of bull trout in the Action Area and small footprint of the boat docks/ramps relative to the size of the CHUs.

PCE 5: Water temperatures ranging from 2°C to 15°C (36°F to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading (provided by riparian habitat); streamflow; and local groundwater influence. Water temperatures along the mainstem Snake and Mid-Columbia Rivers are elevated as a result of existing dams, and the Service has determined that PCE 5 is not present in the Mid-Columbia and lower Snake Rivers. Riparian influences at existing recreational dock and ramps contribute marginally to water temperature; thus, project-related activities that maintain existing shoreline conditions (i.e., preclude any future development of riparian vegetation) are expected to have insignificant or discountable effects to PCE 5.

PCE 6: Substrate Characteristic in spawning and rearing areas. The proposed action does not occur within spawning and rearing habitat; thus, the project will have no effect on PCE 6.

PCE 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. The proposed action will have no effect on the current hydrograph, which is artificially controlled by dam operations. Any affect that docks may have on local nearshore or shoreline velocity will likely be masked by the larger, dam-influenced flow patterns; thus, the Project is expected to have an insignificant effect on PCE 7.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited. The proposed action is expected to result temporarily, localized effects to water quality in the nearshore environment as a result of sediment, elevated turbidity and chemical contamination. Project minimization measures (Assessment, pp. 67- 69; Corps 2021) will minimize sediment transport, turbidity, and the area of chemical contamination and will thus have insignificant effect on PCE 8. Pile removal and placing/removing barge spuds may remobilize sediments at the site of the pile/spud, but we expect sediments will settle out quickly and within a short distance, also an insignificant effect. While upstream activities (outside of the Action Area) have contributed contaminated sediments that have settled out in the Mid-Columbia River, project-related pile driving or removal will not occur on the Columbia River. Therefore, we do not expect these project-related impacts to water quality to have significant effects to normal bull trout reproduction, growth, or survival.

PCE 9: Sufficiently low levels of occurrence of nonnative 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. Boat docks are often used as ambush habitat by nonnative predators that prey on bull trout and

their salmonid prey. Maintenance of these structures will continue to provide ambush habitat for the duration of the 20-year programmatic; however, the program contains a number of measures that minimize the effectiveness of docks to serve as ambush habitat (Assessment, Appendix A), including design and placement criteria that reduces shading for in-water predators and anti-perch mechanisms that prevent use by avian and overhead predators, as well as other measures identified in the MSMP. Boat operations at existing facilities may also contribute temporarily to predatory success where air bubbles from propeller wash or stirred up sediment reduce lighting; however, as stated above, we do not expect bull trout to occur in close proximity to boat operations, thus boat operations are not expected to provide favorable predatory conditions in proximity to bull trout. Due to the small footprint of the existing structures and design measures included in the proposed action, we expect project-related effects to PCE 9 will be insignificant.

13.3 Summary of Effects

In summary, the Corps will repair or maintain existing boat docks and ramps within their Tri-Rivers and Lower Granite AORs. This includes 31 boat ramps with a total of 47 lanes and 42 docks, some that use piles and some that use submerged anchor systems to hold them in place. There is a total of 74 piles associated with the existing docks. Most of the Corps' proposed repair and maintenance activities will result in effects to bull trout and their designated critical habitat that are either insignificant or discountable. Adverse effects to bull trout are expected as a result of pile driving, where bull trout occurrence overlaps areas of elevated underwater SPLs that exceed thresholds likely to cause lethal, sublethal, or significant behavioral effects to bull trout. Pile driving will occur between November 1 and February 28. During this time, bull trout occurrence is expected to be greatest in or near optimal overwintering or foraging habitat; however, the overlap between high quality foraging and overwintering habitat and docks with piles is unknown. Given the length of the program and number of docks with piles, we assume some bull trout are likely to be present within the pile driving area of impact and will experience adverse effects leading to injury or death or increasing the likelihood of injury or death by significantly disrupting normal behaviors. As piles occur primarily within the lower Snake River (there is one dock with 2 piles at the mouth of the lower Clearwater River), adverse effects to individual bull trout will be largely limited to those bull trout occurring in the lower Snake River, will affect very few bull trout occurring in the lower Clearwater River, and will be expected to have no effect on bull trout occurring in the Mid-Columbia River.

Piles may be replaced using vibratory or impact hammer pile driving methods, but only impact pile driving and impact proofing are expected to produce SPLs that exceed thresholds for injury or mortality to bull trout. We expect adverse effects to bull trout resulting in injury or mortality within 100-meter radius of impact pile driving and within a 12-meter radius of impact proofing, or to the extent where river bends or other landforms (i.e., barrier walls of boat basins) restrict noise propagation, whichever is nearest to the activity. We expect adverse behavioral effects to bull trout as a result of reduced foraging efficiency or displacement from optimal overwintering habitat that results in an increased potential for injury within 4,078 meters (52.25 km²) of impact pile driving, within 1,893 meters (11.26 km²) of vibratory pile driving and within 8,786 meters (242.51 km²) of impact proofing, or to the distance where existing river bends or other landforms eliminate noise propagation, whichever is nearest. That is, we expect behavioral effects will be confined largely to boat basins where docks are encompassed by basins, and by the nearest bends in the river wherever river sinuosity is great enough to intercept and, thus, attenuate noise

propagation (i.e., noise propagation is limited to “line-of-sight”). Although elevated SPLs will be temporary and infrequent (see below), habitat conditions in the lower Snake River are currently degraded, as evidenced by the poor function of most PCEs, which may contribute to reduced fitness of individual bull trout at the time of pile driving.

Of the 37 boat dock and ramp locations, 20 locations across the lower Snake River and at confluence of the lower Clearwater River include piles. Pile driving events will be short-term, i.e., completed in less than one day, and infrequent because pile driving is limited to a maximum of 74 piles over the course of the 20-year programmatic, or 3 to 4 piles per year on average. The Corps has determined that the number of piles installed using impact pile driving will not exceed 40 piles, approximately 2 per year. Thus, activities likely to result in adverse effects to bull trout will be disparate both spatially and temporally. These factors will reduce the overall number of bull trout likely to be exposed to adverse elevated SPLs. The exact number of bull trout that may experience adverse effects is unknown but, given the low density of bull trout in the Action Area and the fact that the number of bull trout that leave their natal tributaries comprised a smaller subset of the local populations, we do not expect the level of take associated with pile driving to result in significant effects at the local population level.

We expect the proposed action will result in short-term, local adverse effects to PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish, and PCE 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. PCE 3 is currently functioning at risk across all three CHUs and PCE 4 is not functioning properly in the Mainstem Upper Columbia River and Mainstem Snake River CHUs and is functioning at risk in the Clearwater River CHU. Project-related effects are evaluated against this baseline.

Effects to bull trout designated critical habitat include those in the riparian and nearshore areas associated with the existing structures, including ramps covering 74,170 ft², of which approximately 18,543 ft² (approximately 25 percent) extends below OHWM, and the immediate area of the 42 docks, for which the total surface area is unavailable. The proposed action will maintain the current coverage area of existing boat docks and ramps (we expect any minor modifications will not result in surface coverage area change greater than 1 ft²), thus, repair and maintenance is not expected to introduce further degradation of PCEs 3 or 4, and may even be beneficial where older docks are replaced with structures that benefit bull trout and their prey species by increasing light penetration, installing anti-perch devices, and other measures identified in the MSMP. However, repair and maintenance of Corps-maintained docks and ramps will perpetuate any negative impacts associated with these structures. While we expect continued effects to PCEs 3 and 4, contributing to adverse effects at the local level, we expect the effects are insignificant at the watershed level due to the limited number docks and size of the associated footprint of the Action Area relative to the entire shoreline area of the Corps’ Tri-Rivers and Lower Granite AORs and the size of the Mainstem Upper Columbia River, Mainstem Snake River, and Clearwater CHUs. The proposed project will either have no effect or insignificant effect on the remaining PCEs.

14 CUMULATIVE EFFECTS: Bull Trout and Designated Bull Trout Critical Habitat

Cumulative effects include the effects of future state or private activities, not involving federal activities, that are reasonably certain to occur in the Action Area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Cumulative effects from a variety of activities are likely to adversely or beneficially affect bull trout and their habitat within the Action Area. These actions include, but are not limited to, industrial and residential development, road construction and maintenance, mining, forest activities, fish management activities, irrigation, agriculture, grazing, and fire management. Potential impacts that may contribute to cumulative effects include water flow fluctuations, degraded water quality, migration barriers, habitat degradation, resource competition, and introduction of non-native invasive species. Effects to bull trout in and near the Action Area are primarily the result of urban development, agriculture, and associated water diversion and water control activities that occur outside of the Action Area. Urban and rural land uses for residential, commercial, industrial, and recreational activities, such as boating and golf courses, often require water withdrawals and can further contribute pollutants and sediments to surface waters. Irrigation is ongoing throughout the Columbia River basin. There may be potential new water development such as storage projects, ongoing private water withdrawals, and ground-water wells. State water resource agencies regulate the quantity of water withdrawals.

Many impacts from non-Federal activities in the Action Area that have degraded or hindered the conservation of bull trout and its designated critical habitat and will continue in the foreseeable future at similar intensities as in the recent past. Information on specific planned or foreseeable non-Federal activities is uncertain. The types of ongoing non-Federal activities and land uses expected to continue to affect listed species and critical habitat within the Action Area include development, agriculture, recreation, and climate change as a result of human activities. We are not aware of any specific, significant new or changes to existing state, tribal, local, or private activities within the Action Area.

15 INTEGRATION AND SYNTHESIS OF EFFECTS: Bull Trout and Designated Bull Trout Critical Habitat

The Integration and Synthesis section is the final step in assessing the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action and cumulative effects to the environmental baseline and, in light of the status of the species and critical habitat, formulate the Service's opinion as to whether the action is likely to jeopardize the continued existence of listed species.

The Action Area overlaps the Mid-Columbia River, Lower Snake River, and Clearwater River shared FMO habitats, part of the larger Mid-Columbia Recovery Unit. Bull trout within these shared areas consists of migratory bull trout originating in spawning and rearing tributaries outside of the Action Area. Although a number of Core Areas are known or believed to contribute to individuals in the Action Area, project-related activities that may adversely affect bull trout (i.e., pile driving) are restricted to the lower Snake River and one location at the mouth

of the Clearwater River; hence, only those bull trout that occur within the lower Snake River and confluence with the lower Clearwater River are at risk from project-related adverse effects. We expect bull trout from the Tucannon, Asotin, and Imnaha Core Areas, as well as the multiple Core Areas associated with the Grande Ronde and Clearwater Rivers may occur within this smaller area. Bull trout from these Core Areas are impacted by activities occurring within the mainstem and tributary habitats, both federal and non-federal, including primary threats from upland/riparian land management, habitat loss, fish passage barriers, the introduction of non-native species (i.e. brook trout), and water quality and quantity. Within the mainstem Mid-Columbia, lower Snake and lower Clearwater Rivers bull trout are affected by dam operations that result in altered flow regimes, increased sedimentation rates, bank erosion, reduced channel complexity, poor water quality, reduced forage base (i.e., declines in salmonid and steelhead numbers), and connectivity barriers.

Bull trout are likely to experience adverse effects associated with elevated underwater SPLs that arise from pile driving activities, which will occur between November 1 and February 28, overlapping the occurrence of overwintering bull trout. Elevated SPLs are likely to exceed the threshold for injury or mortality within a 100-meter radius of impact pile driving 12-inch steel piles and a within a 12-meter radius of impact proofing 12-inch steel piles. Elevated SPLs are likely to exceed the threshold levels that result in behavioral modification that increase the likelihood of injury within 4,078 meters of impact pile driving, within 1,893 meters of vibratory pile driving, and within 8,786 meters of impact proofing. We conservatively assume all behavioral effects will result in injury to bull trout because of the poor baseline condition of the critical habitat PCEs that are expected to negatively affect the fitness of individual bull trout during the period in which project-related stressors may occur. The actual number of bull trout that may occur within the area where underwater SPL thresholds are exceeded is unknown because of uncertainties regarding Core Area contributions to bull trout in the Action Area and uncertainties regarding site-specific habitat quality that may influence use patterns. As previously described in section 7.1.1 of this Opinion, “Status of the Species in the Action Area,” rates of bull trout documented at fish passage facilities at dams is likely low in relation to total numbers of bull trout present in the mid-Columbia and Snake Rivers, and occurrence from some Core Areas is assumed rather than documented (i.e., Clearwater Core Areas and Grande Ronde).

Although the number of bull trout that may experience adverse effects is unknown, we expect few bull trout will be affected, for a number of reasons. The Corps will prioritize installation of anchor and cable systems over piles and will prioritize vibratory pile driving over impact pile driving (no more than 40 piles will be replaced via impact driving), plus, the number of piles that will be installed will not exceed 74 piles across a 20-year program, or 3 to 4 piles per year across 20 facilities that contain piles. Pile driving will occur during the day when bull trout are less likely to occur in nearshore environments. Given the low density of bull trout expected to occur in the lower Snake River (see Tables 5 and 6) and lower Clearwater River is comprised of bull trout from multiple local populations (i.e., adverse effects will be distributed across multiple local populations), and the fact that the number of bull trout that leave their natal tributaries represents a small portion of the total population size, we do not expect the level of take associated with pile driving in the lower Snake River and at the mouth of the lower Clearwater River to result in significant effects at the local population level. Thus, we do not expect significant effects to bull trout numbers at the Core Area level or at the Recovery Unit level.

Given the timing occurs outside of peak migration and during the day (bull trout typically migrate at night), and no docks are located near the mouths of spawning tributaries, we do not expect project-related impacts to create barriers to migration or to significantly interfere with migration. Thus, while we expect some adverse effects to bull trout distribution at the local scale, associated with behavioral response to pile driving and interactions near existing docks and ramps, we do not expect the project to significantly affect bull trout distribution within shared FMO habitat overlapping the Corps Tri-Rivers or Lower Granite AORs. Additionally, we do not expect the project to result in significant effects to reproduction. The project does not occur in spawning and rearing habitat, nor will activities occur during pre-spawning migration; hence, the proposed action will have no effect on eggs, alevins, or fry or early rearing individuals. Behavioral response to pile driving may reduce foraging efficiency or displacement from optimal overwintering habitat for a few bull trout which, combined with any pre-existing stressors associated with the poor habitat quality (see section 7.1.4 “Status of Critical Habitat in the Action Area”), may result in reduced fitness. However, we do not expect this to translate to significant reproductive impacts because project-related impacts will be of short duration and infrequent. As we expect few bull trout may be injured or harmed, we do not expect a significant reduction in the total number of spawning individuals for any local population contributing bull trout to the Action Area.

The Action Area overlaps the critical habitat units of the MCRU: Mainstem Upper Columbia, Mainstem Snake River, and Clearwater River. Designated bull trout critical habitat is either not present in the Action Area, is functioning at risk, or is not properly functioning. The proposed action will not affect or will result in insignificant effects to 7 of the 9 PCEs that comprise bull trout critical habitat. The proposed project will contribute to the suboptimal function of PCE 3 (complex habitat) and the adverse conditions of PCE 4 (abundant forage base) by maintaining the structures for the next 20 years, precluding any natural processes or habitat development where such processes would interfere with the maintenance and use of the facilities. Boat ramps cover approximately 74,170 ft² of riparian and nearshore habitat with approximately 18,543 ft² below OHWM. The surface area of docks is not available, but the proposed project will maintain the current coverage area of existing docks (within a small margin). Within these areas, we expect some localized adverse effects to PCEs 3 and 4, but do not expect adverse effects to individual bull trout. Considering the small footprint of the Action Area relative to the size of the CHUs, we do not expect these localized effects to result in significant effects to PCEs 3 and 4 at the CHU level.

16 CONCLUSION: Bull Trout and Designated Bull Trout Critical Habitat

After reviewing the current status of bull trout, the environmental baseline for the Action Area, the effects of the proposed Natural Resource Management Routine Boat Dock and Ramp Maintenance and the cumulative effects, it is the Service's biological opinion that the Natural Resource Management Routine Boat Dock and Ramp Maintenance, as proposed, is not likely to jeopardize the continued existence of the bull trout and is not likely to destroy or adversely modify designated critical habitat.

17 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 to attempt to engage in any such conduct. *Harm* is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any activity authorized or funded by the Corps, as appropriate, 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 their contractor to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [50 CFR 402.14(i)(3)].

18 AMOUNT OR EXTENT OF TAKE

The Service anticipates incidental take of bull trout will be difficult to detect in most cases for the following reasons:

- The Action Area is comprised of 37 locations across the Mid-Columbia, lower Snake, and lower Clearwater River shared FMO habitat. The bull trout is wide-ranging within suitable habitat throughout the shared FMO habitats but are difficult to detect due to its preference for residing in fast-moving water near the bottom of the water column and tendency to remain under cover during the day. Bull trout from multiple Core Areas interact with the shared FMO area, but the exact number of bull trout that use the shared area is unknown and, for a number of local populations, use is assumed but undocumented. The fate of a large number of tagged bull trout that have entered the shared FMO habitats is unknown but, based on the available information, bull trout density in these shared FMO habitats is assumed to be low. Bull trout do not typically occur in shoreline or nearshore environments at the time when project activities will

occur (i.e., during the day); hence, the number of bull trout that may occur near project-related disturbances is expected to comprise a subset of those occurring within the shared FMO habitats.

- Changes in bull trout numbers in the Action Area caused by take incidental from project-related activities are likely to be masked by natural, seasonal fluctuations in bull trout numbers or by other causes, such as bull trout behavioral changes in response to changes in water quality or flow velocities. Changes in bull trout numbers in the Action Area caused by take incidental from project-related activities are also likely to be masked by effects associated with dam operations or other anthropogenic stressors, or by natural predation. Mortality of individual bull trout may be delayed, as described in section 8.2.1 of this Opinion, “Elevated Underwater Sound Pressure Levels,” and finding bull trout that have been injured or died is unlikely because they are likely to be swept downstream or preyed upon.
- The relationship between habitat conditions and the distribution and abundance of individual bull trout is imprecise such that a specific number of affected individuals cannot be practically obtained.

Pursuant to 50 CFR 402.14(i)(1)(i), a surrogate can be used to express the anticipated level of take in an Incidental Take Statement, provided three criteria are met: 1) measuring take impacts to a listed species is not practical; 2) a link is established between the effects of the action on the surrogate and take of the listed species; and 3) a clear standard is set for determining when the level of anticipated take based on the surrogate has been exceeded. In this case, the extent of impacts to bull trout habitat caused by Project-related activities likely to actually kill or injure bull trout is a reasonable surrogate to express the amount of anticipated take.

The discussion above explains why it is not practical to express the amount or extent of take in terms of individual bull trout. It is the Service’s customary practice to rely on habitat impacts to inform the determination of bull trout take impacts. For this reason, quantifying and monitoring impacts to bull trout habitat caused by routine boat dock and ramp repair and maintenance is a scientifically credible and practical approach for expressing and monitoring the anticipated level of bull trout take in situations where monitoring of take impacts in terms of individual bull trout is not feasible or practicable. Based on the best available information and research, we anticipate that some level of incidental take of bull trout will occur wherever elevated underwater sound pressure levels exceed threshold known to result in lethal, sublethal, and/or behavioral effects, that create a likelihood of injury by significantly disrupting normal behaviors, to salmonids or other fishes.

The Service is using two habitat-based surrogate measures to express incidental take to bull trout. The **first** surrogate measure uses the area within which elevated underwater SPLs are likely to exceed threshold levels expected to result in lethal and sublethal effects to bull trout. The **second** surrogate measure uses the area within which elevated underwater SPLs are likely to exceed threshold levels that are likely to result in adverse behavioral effects to bull trout. The causal link between elevated underwater SPLs and bull trout is described above in this Opinion (e.g., see section 8.2.1, “Elevated Underwater Sound Pressure Levels”).

Using the **first** habitat surrogate measure, we expect incidental take of bull trout in the form of harm wherever elevated underwater SPLs associated with pile driving exceeds lethal or sublethal thresholds. We expect threshold will be exceeded with 100 meters (0.3 km²) of impact pile driving up to 40, 12-inch steel piles. In addition, we expect thresholds will be exceeded within 12 meters of impact proofing the remaining 12-inch steel piles, up to a total of 74 piles. If, at any time during the 20-year program, the total number of piles installed exceeds 74 or the number of piles driven using the impact pile driving method exceeds 40 piles, or if the size of pile exceeds 12-inch, the amount of incidental take exempted here will be exceeded (Table 10).

Using the **second** habitat surrogate, we expect incidental take of bull trout in the form of harassment wherever elevated underwater SPLs associated with pile driving exceeds behavioral thresholds. We expect threshold will be exceeded with 4,078 meters of impact pile driving up to 40, 12-inch steel piles. In addition, we expect behavioral thresholds will be exceeded within 1,893 meters of vibratory pile driving and within 8,786 meters of impact proofing associated with vibratory pile driving, for the remaining piles up to a total of 74, 12-inch steel piles. If, at any time during the 20-year program, the number of piles installed exceeds 74 or the number of piles installed using the impact pile driving method exceeds 40 piles, or if the size of piles exceeds 12-inch, the amount of incidental take exempted here will be exceeded (Table 10).

Table 10. Incidental take of bull trout expected from elevated sound pressure levels in the Action Area during the 20-year period of project implementation.

Action	Form of Take	Stressor	Duration and period	Distance (Area)¹
Impact pile driving up to 40, 12-inch steel piles	Harm (injury or death)	Exposure to elevated underwater sound pressure levels that result in lethal and sublethal effects	Less than one day at each dock, assuming 1-2 piles per dock, per repair event, and 40 strikes per minute	100 meters (0.3 km ²)
Impact <i>proofing</i> 12-inch steel piles installed using vibratory driving up to a total of 74 piles (when combined with the number of piles installed via impact driving)	Harm (injury or death)	Elevated underwater sound pressure levels that result in lethal and sublethal effects	Less than one day at each dock, assuming 1-2 piles per dock, per repair event	12 meters (450 m ²)
Impact pile driving up to 40, 12-inch steel piles	Harassment (behavioral impacts)	Elevated underwater sound pressure levels that result in behavioral effects	Less than one day at each dock, assuming 1-2 piles per dock, per repair event, and 40 strikes per minute	4,078 meters (52.25 km ²)
Vibratory pile driving 12-inch steel piles, up to a total of 74 piles (when combined with the number of piles installed via impact driving)	Harassment (behavioral impacts)	Elevated underwater sound pressure levels that result in behavioral effects	Less than one day at each dock, assuming 1-2 piles per dock, per repair event	1,893 meters (11.26 km ²)
Impact <i>proofing</i> 12-inch steel piles installed using vibratory driving	Harassment (behavioral impacts)	Elevated underwater sound pressure levels that result in behavioral effects	Less than one day at each dock, assuming 1-2 piles per dock, per repair event	8,786 meters (242.51 km ²)

¹ Distance given assumes open line-of-sight across the given distance, which is unlikely due to river meanders and other landforms present. Actual distance will be confined to the extent of noise propagation (i.e., boat basin barriers, river bends, etc.).

19 EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that the above levels of anticipated take are not likely to result in jeopardy to the species or the destruction or adverse modification of its critical habitat.

20 REASONABLE AND PRUDENT MEASURES

The Service finds the following reasonable and prudent measure is necessary and appropriate to minimize the impacts (i.e., the amount or extent) of incidental take of bull trout:

- Minimize and monitor incidental take of bull trout caused by elevated underwater sound pressure levels.

21 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To demonstrate that potential project-related effects to bull trout have been adequately reduced and that the validity of the ITS remains intact, the Corps shall, for the 20-year term of the proposed action, submit an annual report for the preceding calendar year. The Corps shall submit annual reports to the Service's Washington Fish and Wildlife Office on or before May 1 of each year, or by a date agreed upon by the Services and Corps. Each report shall include the following information:
 - a. The total number of boat docks maintained or replaced;
 - b. The pre-existing and post repair-replacement surface coverage area of docks where docks are replaced in portion or in their entirety;
 - c. The number of piles installed and the method of installation (i.e., vibratory or impact hammer pile driving) for each project location;
 - d. The total number of strikes used for impact proofing, per pile; and
 - e. The total number of boat ramps maintained or replaced.
 - f. A running total of all boat docks, ramps, lanes, and piles replaced since project implementation.
2. The Service is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological

materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

22 CONSERVATION RECOMMENDATIONS

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

1. Monitor and record the species, age class, and health of any species observed within the work area during fish exclusion activities.
2. Use the above information to evaluate shoreline use by priority species such as Act-listed species.
3. Use the above information to evaluate the use of docks and associated structures by predatory fish species.
4. Install boat wash stations at Corps' maintained docks to protect against spread of non-native species.

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

23 REINITIATION NOTICE

This concludes consultation on the action outlined in the request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required and shall be requested by the federal agency or by the Service, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (a) if the amount or extent of taking specified in the incidental take statement is exceeded; (b) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat designated that may be affected by the identified action.

24 LITERATURE CITED

24.1 Published Literature

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APPENDIX A
MCNARY SHORELINE MANAGEMENT PLAN

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Appendix A
McNary Shoreline Management Plan
Lake Wallula/McNary Pool Residential Overwater Structure Design Criteria
Source: Excerpted directly from the Assessment (Corps 2021, Appendix A)

Approved by:
National Marine Fisheries Service
Washington State Department of Fish and Wildlife
U. S. Army Corps of Engineers - Walla Walla
June 2010

1. Objectives

- a) Overwater structure design, construction, and use shall minimize degradation of aquatic, near-shore, and shoreline habitats.
- b) Overwater structures shall not impede any juvenile or adult salmonid life stage, including migration, rearing, and spawning.
- c) Overwater structures shall not enhance habitats used by potential salmonid predators (especially fishes and birds).

2. Overwater structure definitions

- a) A residential overwater structure typically consists of a shoreline anchor, ramp, and float. The structure may also include pile(s) and/or float anchor(s).
- b) Functional grating is the area not covered or blocked by any objects (i.e., framing wood, flotation tubs, etc.). The percent of functional grating is in relation to the surface area of the float.

3. Piers and ramps

- a) To prevent damage to shallow-water habitat, piers and/or ramps shall extend at least 40 feet perpendicular from the ordinary high-water mark (OHWM).
- b) Piers and ramps shall be no more than 4 feet in width.
- c) The bottom of either the pier or landward edge of the ramp shall be elevated at least 2 feet above the plane of OHWM.
- d) Grating shall cover the entire surface area (100%) of the pier and/or ramp. The open area of grating shall be at least 50%, as rated by the manufacturer.
- e) Skirting shall not be placed on piers, ramps, or floats. Protective bumper material will be allowed along the outside edge of the float as long as the material does not extend below the bottom edge of the float frame or impede light penetration.

- f) Shoreline concrete anchors must be placed at least 10 feet landward from the OHWM, and shall be sized no larger than 4-feet wide by 4-feet long, unless otherwise approved by National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries), the US Army Corps of Engineers (Corps), and Washington Department of Fish and Wildlife (WDFW). The maximum anchor height shall be only what is necessary to elevate the bottom of either the pier or landward edge of the ramp at least 2 feet above the plane of OHWM.

4. Preservatives

- a) The dock shall be built with materials that do not leach preservatives or other materials.
- b) No treated wood of any kind shall be used on any overwater structure (float, pier, or ramp).
- c) No paint, stain, or preservative shall be applied to the overwater structure.

5. Preconstruction and construction activities

- a) If native vegetation is moved, damaged, or destroyed, it shall be replaced with a functional native species equivalent during site restoration.
- b) Any large wood, native vegetation, topsoil, and/or native channel material displaced by construction shall be stockpiled for use during site restoration.
- c) No existing habitat features (i.e., woody debris, substrate materials) shall be removed from the shore or aquatic environment.
- d) Construction impacts shall be confined to the minimum area needed to complete the project.
- e) The boundaries of clearing limits associated with site access and construction shall be flagged to prevent ground disturbance of riparian vegetation, wetlands, and other sensitive sites beyond the flagged boundary. This action shall be completed before any significant alteration of the project area.
- f) A supply of sediment control materials [i.e., silt fence, straw bales, coconut fiber (coir) bales] shall be available onsite. This action shall be completed prior to significant alteration of the project area.
- g) All temporary erosion controls shall be in place and appropriately installed downslope of project activities within the riparian area until site restoration is complete.

6. General

- a) No electricity shall be provided to, or on, the overwater structure.
- b) No boat lifts or watercraft lifts (e.g., jet ski lifts) of any type will be placed on, or in addition to, the overwater structure.

- c) Shoreline armoring (i.e., bulkheads, rip-rap, and retaining walls) shall not occur in association with installation of the overwater structure.
- d) Construction of the overwater structure shall be completed during the in-water work window (November 1 to February 28).

7. Piling and float anchors

- a) Piling shall not exceed 8 inches in diameter.
- b) Pilings shall be spaced at least 18 feet apart on the same side of any component of the overwater structure. The pier/ramp and float are separate components.
- c) Each overwater structure shall utilize no more than 4 piles total for the entire project. A combination of two piles and four helical anchors may be used in place of four piles.
- d) All pilings shall be fitted with devices to prevent perching by piscivorous (fish-eating) birds.
- e) Submerged float anchors will be constructed from concrete; and shall be horizontally compressed in form, by a factor of 5 or more, for a minimum profile above the stream bed (the horizontal length and width will be at least 5 times the vertical height).
- f) No in-water fill material will be allowed, with the exception of pilings and float anchors. (Note: uncured concrete or its by-products shall not be allowed.)

8. Floats

- a) Float components shall not exceed the dimensions of 8- by 20-feet, or an aggregate total of 160 square feet, for all float components.
- b) Float materials in contact with the water shall be white in color.
- c) Flotation materials shall be permanently encapsulated to prevent breakup into small pieces and dispersal in water (e.g., rectangular float tubs).
- d) Grating shall cover 100% of the surface area of the float(s). The open area of the grating shall be no less than 50%, as rated by the manufacturer.
- e) Functional grating will cover no less than 50% of the float.
- f) Floats shall not be located in shallow-water habitat where they could ground or impede the passage or rearing of any salmonid life stage.
- g) Nothing shall be placed on the overwater structure that will reduce natural light penetration through the structure.

- h) Floats shall be positioned at least 40 feet horizontally from the OHWM and no more than 100 feet from the OHWM, as measured from the landward-most edge of the float.
- i) Project construction shall cease under high flow conditions that could result in inundation of the project area except for efforts to avoid or minimize resource damage.

APPENDIX B
STATUS OF THE SPECIES: BULL TROUT

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Appendix: B

Status of the Species: Bull Trout

Taxonomy

The bull trout (*Salvelinus confluentus*) 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.

Species Description

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 (USFWS 1998, p. 31648).

Legal Status

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (USFWS 1999, 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 (USFWS 1999, 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.

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.

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:

- i. “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.
- ii. “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.
- iii. “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 U.S. Fish and Wildlife Service (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 (USFWS 2008a, p. 45), the Service reanalyzed the 27 recovery units identified in the draft bull trout recovery plan (USFWS 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 National Marine Fisheries Service Distinct Population Segment (DPS) policy (USFWS 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 (USFWS 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 (USFWS 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 pallasii*), 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).

Status and Distribution

Distribution and Demography

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 anadromous¹ 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) (USFWS 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 (USFWS 2015a, p. A-6).

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

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 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) (USFWS 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) (USFWS 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, resident 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 (USFWS 2015a, p. A-8). Natural reproducing populations of bull trout are present in the McKenzie River basin (USFWS 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 (USFWS 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; USFWS 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 1897; Dambacher et al. 1992; Ziller 1992; USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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) (USFWS 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 (USFWS 2008b). This Core Area also is essential for recovery because bull trout in this Core Area exhibit both resident² 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 miles) of spawning/rearing habitat, including a portion of an unnamed tributary to upper Long Creek, and seasonally use 25.9 km (16.1 miles) of FMO habitat. Brook trout also inhabit Long Creek and have been the focus of

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

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 (USFWS 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 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 (USFWS 2015b, p. B-6).

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 (USFWS 2008b). Migratory bull trout have occasionally been observed in the North Fork Sprague River (USFWS 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. Although brown trout (*Salmo trutta*) co-occur with bull trout and exist in adjacent habitats, brook trout do not overlap with existing bull trout populations. 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 (USFWS 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 (USFWS 2015b, p. B-7).

Mid-Columbia Recovery Unit

The Mid-Columbia Recovery Unit (RU) comprises 24 bull trout Core Areas, as well as 2 historically occupied Core Areas and 1 research needs area. The Mid-Columbia 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 (USFWS 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 1) 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-Columbia 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 USFWS 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 (USFWS 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 (USFWS 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 (USFWS 2015c, p. C-6).

The demographic status is variable in the Upper-Mid Columbia region and ranges from good to very poor. The Service's 2008 5-year Review and Conservation Status Assessment described the Methow and Yakima Rivers at risk, with a rapidly declining trend. The Entiat River was listed at risk with a stable trend, and the Wenatchee River as having a potential risk, and with a stable trend. Currently, the Entiat River is considered to be declining rapidly due to much reduced redd counts. The Wenatchee River 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 (USFWS 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 (USFWS 2015c, p. C-7). Wenaha, Little Minam, and Imnaha Rivers 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 (USFWS 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 (USFWS 2015c, p. C-7). The East Pine Creek population in the Pine-Indian-Wildhorse Creeks 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-Indian-Wildhorse Creeks 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 (USFWS 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 (USFWS 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 (USFWS 2015d, pp. D-1-2).

In order to effectively manage the recovery unit implementation plan (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) (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 2015e, p. E-1).

Three major bull trout life history expressions are present in the Upper Snake Recovery Unit, adfluvial³, fluvial⁴, 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 (USFWS 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

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.

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 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 2005, 2008). Trends were stable or decreasing in the Little-Lower Salmon River, Middle Fork Salmon River, and the Middle Salmon River-Panther (IDFG 2005, 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 U.S. 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 (USFWS 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 U.S. 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 (USFWS 2015e, p. E-8).

Jarbridge River

The Jarbridge 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 Jarbridge River; this watershed does not contain any barriers. Approximately 89 percent of the Jarbridge 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-Jarbridge Wilderness area. A tracking study has documented bull trout population connectivity among many of the local populations, in particular between West Fork Jarbridge River and Pine Creek. Movement between the East and West Fork Jarbridge 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 (USFWS 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 U.S. 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 River. 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 River. 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 (USFWS 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 (USFWS 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 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 2002) but are no longer considered Core Areas in the final recovery plan (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 2015f, p. F-3).

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 (USFWS 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).

Emerging Threats

Climate Change

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 (USFWS 2015, p. vii, and pp. 17-20, USFWS 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.

Conservation

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 (USFWS 2015, p. v.).

Information presented in prior draft recovery plans published in 2002 and 2004 (USFWS 2002a, 2004) 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 (USFWS 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 Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (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 (USFWS 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 (USFWS 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 recovery 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 (USFWS 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) (USFWS 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 (USFWS 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 (USFWS 2015, p. 3). Core areas can be further described as complex or simple (USFWS 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 FMO habitats. 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 (USFWS 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.

Recovery Units and Local Populations

The final recovery plan (USFWS 2015) designates six bull trout recovery units as described above. These units replace the 5 interim recovery units previously identified (USFWS 1999). 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 (USFWS 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)(USFWS 2015a-f), which identify conservation actions and recommendations needed for each Core Area, forage/ migration/ overwinter areas, historical Core Areas, and

research needs areas. 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.

Coastal Recovery Unit

The coastal recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015a). The Coastal Recovery Unit is located within western Oregon and Washington. The Coastal Recovery Unit is divided into three regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River Regions. This recovery unit contains 20 Core Areas comprising 84 local populations and a single potential local population in the historic Clackamas River Core Area where bull trout had been extirpated and were reintroduced in 2011, and identified four historically occupied Core Areas that could be re-established (USFWS 2015, pg. 47; USFWS 2015a, p. A-2). Core areas within Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This recovery unit also contains ten shared FMO habitats which are outside Core Areas and allows for the continued natural population dynamics in which the Core Areas have evolved (USFWS 2015a, p. A-5). There are four Core Areas within the Coastal Recovery Unit that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River (USFWS 2015, p.79). These are the most stable and abundant bull trout populations in the recovery unit. The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, loss of functioning estuarine and nearshore marine habitats, development and related impacts (e.g., flood control, floodplain disconnection, bank armoring, channel straightening, loss of instream habitat complexity), agriculture (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation, livestock grazing), fish passage (e.g., dams, culverts, instream flows) residential development, urbanization, forest management practices (e.g., timber harvest and associated road building activities), connectivity impairment, mining, and the introduction of non-native species. Conservation measures or recovery actions implemented include relicensing of major hydropower facilities that have provided upstream and downstream fish passage or complete removal of dams, land acquisition to conserve bull trout habitat, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, road removal, and projects to protect and restore important nearshore marine habitats.

Klamath Recovery Unit

The Klamath recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015b). The Klamath Recovery Unit is located in southern Oregon and northwestern California. The Klamath Recovery Unit is the most significantly imperiled recovery unit, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout (USFWS 2015, p. 39). This recovery unit currently contains three Core Areas and eight local populations (USFWS 2015, p. 47; USFWS 2015b, p. B-1). Nine historic local populations of bull trout have become extirpated (USFWS 2015b, p.

B-1). All three Core Areas have been isolated from other bull trout populations for the past 10,000 years (USFWS 2015b, p. B-3). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, nonnative species, and past fisheries management practices. Conservation measures or recovery actions implemented include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for instream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culvert replacement, and habitat restoration.

Mid-Columbia Recovery Unit

The Mid-Columbia recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015c). The Mid-Columbia Recovery Unit is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia Recovery Unit is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, lower Snake, and Mid-Snake Geographic Regions. This recovery unit contains 24 occupied Core Areas comprising 142 local populations, two historically occupied Core Areas, one research needs area, and seven FMO habitats (USFWS 2015, pg. 47; USFWS 2015c, p. C-1–4). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, agricultural practices (e.g. irrigation, water withdrawals, livestock grazing), fish passage (e.g. dams, culverts), nonnative species, forest management practices, and mining. Conservation measures or recovery actions implemented include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and instream flow requirements.

Columbia Headwaters Recovery Unit

The Columbia headwaters recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015d, entire). The Columbia Headwaters Recovery Unit is located in western Montana, northern Idaho, and the northeastern corner of Washington. The Columbia Headwaters Recovery Unit is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene Geographic Regions (USFWS 2015d, pp.

D-2 – D-4). This recovery unit contains 35 bull trout Core Areas; 15 of which are complex Core Areas as they represent larger interconnected habitats and 20 simple Core Areas as they are isolated headwater lakes with single local populations. The 20 simple Core Areas are each represented by a single local population, many of which may have persisted for thousands of years despite small populations and isolated existence (USFWS 2015d, p. D-1). Fish passage improvements within the recovery unit have reconnected some previously fragmented habitats (USFWS 2015d, p. D-1), while others remain fragmented. Unlike the other recovery units in Washington, Idaho and Oregon, the Columbia Headwaters Recovery Unit does not have any anadromous fish overlap. Therefore, bull trout within the Columbia Headwaters Recovery Unit do not benefit from the recovery actions for salmon (USFWS 2015d, p. D-41). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate

change, mostly historical mining and contamination by heavy metals, expanding populations of nonnative fish predators and competitors, modified instream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e.g., logging, roads), agriculture practices (e.g.

irrigation, livestock grazing), and residential development. Conservation measures or recovery actions implemented include habitat improvement, fish passage, and removal of nonnative species.

Upper Snake Recovery Unit

The Upper Snake recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015e, entire). The Upper Snake Recovery Unit is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake Recovery Unit is divided into seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This recovery unit contains 22 Core Areas and 207 local populations (USFWS 2015, p. 47), with almost 60 percent being present in the Salmon River Region. The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing). Conservation measures or recovery actions implemented include instream habitat restoration, instream flow requirements, screening of irrigation diversions, and riparian restoration.

St. Mary Recovery Unit

The St. Mary recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015f). The Saint Mary Recovery Unit is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada. Most of the Saskatchewan River watershed which the St. Mary flows into is located in Canada. The United States portion includes headwater spawning and rearing habitat and the upper reaches of FMO habitat. This recovery unit contains four Core Areas, and seven local populations (USFWS 2015f, p. F-1) in the U.S. Headwaters. The current condition of the bull trout in this recovery unit is attributed primarily to the outdated design and operations of the Saint Mary Diversion operated by the Bureau of Reclamation (e.g., entrainment, fish passage, instream flows), and, to a lesser extent habitat impacts from development and nonnative species.

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).

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APPENDIX C
STATUS OF CRITICAL HABITAT: BULL TROUT

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Appendix C

Status of Designated Critical Habitat: Bull Trout

Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical and biological features" (PCEs) 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 PCEs 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 PCEs, PCEs, and essential habit features are synonymous in meaning, we are only referring to PCEs herein. Therefore, if a past critical habitat designation defined essential habitat features or PCEs, they will be referred to as PCEs 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, PCEs or essential features.

Current Legal Status of the Critical Habitat

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (USFWS 2010, entire); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on the Service's 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).

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

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 several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 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 Service; or 3) waters where impacts to national security have been identified (USFWS 2010, 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.

The Physical and Biological Features

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable Core Area populations (USFWS 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 (PCEs) 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 PCEs 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 PCEs, as described within USFWS 2010, are essential for the conservation of bull trout. A summary of those PCEs 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 PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE 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 PCEs 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 PCEs 1 and 6. Additionally, all except PCE 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 PCEs 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 PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (USFWS 2010, pp. 63898:63943; USFWS 2004a, pp. 140-193; USFWS 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 (USFWS 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 (USFWS 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 (USFWS 2010, pp. 63898:63943).

Current Critical Habitat Condition Rangelwide

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 (USFWS 1998, pp. 31648-31649; USFWS 1999, 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 PCEs, 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 PCEs 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 PCEs 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.

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APPENDIX D
ELEVATED UNDERWATER SOUND PRESSURE LEVEL CALCULATION SHEETS

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Appendix D
Elevated Underwater Sound Pressure Level Calculation Sheets

This spreadsheet was developed as an in-house tool for USFWS staff to use when assessing the effects to bull trout from impact pile driving.

Table 1. Calculated elevated underwater sound pressure levels resulting from Impact Pile Driving.

Sound Exposure Level Calculator for Marbled Murrelet and Bull Trout				
Inputs		Attenuated		Other data
Select from drop-down menu or enter project-specific data				
Pile Material	Steel	Peak Single Strike (dB re: 1 μ Pa)	195	
Pile Type	Pipe	RMS Single Strike (dB re: 1 μ Pa)	182	
Pile Diameter (inches)	12-inch	SEL Single Strike (dB re: 1 μ Pa ² s)	168	
	SteelPipe12-inch	Cumulative SEL (dB re: 1 μ Pa ² s)	195	
		Distance of Sound Pressure Level measurements from source:	30	
		Data Source:	Laughlin 2004, with attenuation	
Piles Per Day (Maximum)	2	Bull Trout Effects		
Pile Strikes Per Pile (Maximum)	240	Effects Category	Bull Trout Injury Threshold	Area of Effects
Pile Strikes Per Day (Maximum)	480			km ²
Minutes of pile driving per day (assuming 40 strikes per minute)	12.0	Bull Trout $\leq$ 2 grams	183 dB _{SEL} re: 1 μ Pa ² s	0.11
dB Attenuation	5	Bull Trout $>$ 2 grams	187 dB _{SEL} re: 1 μ Pa ² s	0.03
			206 dB _{Peak} re: 1 μ Pa	0.00
Constants and Thresholds / Guidelines		Bull Trout & Marbled Murrelet Effects		
Single Strike SEL for Effective Quiet	150	Effects Category	Criteria	Area of Effects
Transmission Loss Constant	15			km ²
		Effective Quiet	150 dB _{SEL} re: 1 μ Pa ² s	0.71
		Potential Behavioral Response	150 dB _{RMS} re: 1 μ Pa	52.25

Table 3. Calculated elevated underwater sound pressure levels associated with vibratory pile driving.

Inputs Select from drop-down menu or enter project-specific data		Unattenuated		Other data	
Pile Material	Steel	Peak Single Strike (dB re: 1 μ Pa)			
Pile Type	Pipe	RMS Single Strike (dB re: 1 μ Pa)	177		
Pile Diameter (inches)	12-inch	SEL Single Strike (dB re: 1 μ Pa ² s)			
	SteelPipe12-inch	Cumulative SEL (dB re: 1 μ Pa ² s)			
		Distance of Sound Pressure Level measurements from source:	30		
		Data Source:	Laughlin 2004, with 10dB reduction for method (WSDOT 2018, p. 7.37)		
Piles Per Day (Maximum)		Bull Trout Effects		Radii of Area of Effects	Area of Effects
Pile Strikes Per Pile (Maximum)		Effects Category	Bull Trout Injury Threshold	meter s	feet
Pile Strikes Per Day (Maximum)	0	Bull Trout $\leq$ 2 grams	183 dB _{SEL} re: 1 μ Pa ² s	0	0
Minutes of pile driving per day (assuming 40 strikes per minute)	0.0	Bull Trout $>$ 2 grams	187 dB _{SEL} re: 1 μ Pa ² s	0	0
dB Attenuation (Verified w/Hydroacoustic Monitoring)	0		206 dB _{Peak} re: 1 μ Pa	0	0
					0.00000

Constants and Thresholds / Guidelines	
Single Strike SEL for Effective Quiet	150
Transmission Loss Constant	15

<i>Bull Trout & Marbled Murrelet Effects</i>		Radii of Area of Effects		Area of Effects
Effects Category	Criteria	meters	feet	km ²
Effective Quiet	150 dB _{SEL} re: 1 μPa ² s	0	0	0.00
Potential Behavioral Response	150 dB _{RM} re: 1 μPa	1,893	6,209	11.26