United States Department of the Interior

U.S. Fish and Wildlife Service

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Michael J. Lidgard, Manager
NPDES Permits Unit
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Subject: NPDES Permit for the Hecla Mining Company Grouse Creek Unit—Custer County, Idaho —Biological Opinion
In Reply Refer To: 01EIFW00-2016-F-0166

Dear Mr. Lidgard:

Enclosed is the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the U.S. Environmental Protection Agency's (EPA) determinations of effect on species listed under the Endangered Species Act (Act) of 1973, as amended, for the proposed reissuance of a National Pollutant Discharge Elimination System (NPDES) permit to the Grouse Creek Unit (GCU), operated by the Hecla Mining Company in Custer County, Idaho. In a letter dated July 6, 2017, and received by the Service on the same day by email, EPA requested formal consultation on the determination under section 7 of the Act that reissuance of the permit is likely to adversely affect bull trout (*Salvelinus confluentus*) and bull trout critical habitat. EPA also determined that the permits will have no effect on the Canada lynx (*Lynx canadensis*), yellow-billed cuckoo (*Coccyzus americanus*), or whitebark pine (*Pinus albicaulis*). The Service acknowledges these determinations.

The enclosed Opinion is based primarily on our review of the proposed action, as described in your July 2017 Biological Evaluation (BE), subsequent documentation, and the anticipated effects of the action on listed species, and was prepared in accordance with section 7 of the Act. Our Opinion concludes that the proposed reissuance of the permit will not jeopardize the survival and recovery of bull trout and will not adversely modify bull trout critical habitat. A complete record of this consultation is on file at this office.

Thank you for your continued interest in the conservation of threatened and endangered species. Please contact Clay Fletcher at 971-701-1497 or Russ Holder at 208-378-5384 if you have questions concerning this Opinion.

Sincerely,

RUSSELL HOLDER Digitally signed by RUSSELL HOLDER Date: 2018.04.30 09:17:14 -06'00'

for Gregory M. Hughes
State Supervisor

Enclosure

cc: EPA, Seattle (Nickel)
NMFS, Boise (Sandow)
USFWS, Chubbuck (Fisher)

BIOLOGICAL OPINION FOR THE ISSUANCE OF AN NPDES PERMIT FOR THE HECLA MINING COMPANY GROUSE CREEK UNIT

01EIFW00-2016-F-0166

U.S. FISH AND WILDLIFE SERVICE
IDAHO FISH AND WILDLIFE OFFICE
BOISE, IDAHO

Supervisor RUSSELL HOLDER Digitally signed by RUSSELL HOLDER Date: 2018.04.30 09:16:32 -06'00'
for Gregory M. Hughes

Date _____

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ACRONYMS

°C	Degrees Celsius
°F	Degrees Fahrenheit
AML	Average Monthly Limit
BE	Biological Evaluation
BMPs	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic feet per second
CORMIX	Cornell Mixing Zone Expert System
CWA	Clean Water Act
DC	Direct Current
DMR	Discharge Monitoring Report
DOC	Dissolved Organic Carbon
DQA	Data Quality Act
dw	Dry weight
EIFAC	European Inland Fisheries Advisory Commission
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera Taxa
ft	Feet
GCU	Grouse Creek Unit
GEI	GEI Consultants, Inc.
Hecla	Hecla Mining Company
IC_x	Inhibition Concentration for a specified percent reduction
LC_x	Lethal Concentration for a specified proportion of organisms
m^2	Square meters
MDL	Maximum Daily Limit
MFSR	Middle Fork Salmon River
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
ng/L	Nanogram per liter
NOEC	No Observed Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
PDC	Pulsed Direct Current
QAP	Quality Assurance Plan
RPM	Reasonable and Prudent Measures
RWC	Receiving Water Concentration

SBT	Shoshone-Bannock Tribes
SMI	Stream Macroinvertebrate Index
TAN	Total Ammonia Nitrogen
TBELs	Technology Based Effluent Limits
TIE	Toxicity Identification Evaluation
TR	Total Recoverable
TRE	Toxicity Reduction Evaluation
TSD	Technical Support Document
TSS	Total Suspended Solids
TU_a	Toxic Units, acute
TU_c	Toxic Units, chronic
µg/L	Microgram per liter
µm	Micrometer
WAD	Weak Acid Dissociable
WET	Whole Effluent Toxicity
WTP	Water Treatment Plant
WQBELs	Water Quality Based Effluent Limits
ww	Wet weight

1. BACKGROUND

1.1 Introduction

The U.S. Fish and Wildlife Service (Service) has prepared this Biological Opinion (Opinion) of the effects to bull trout (*Salvelinus confluentus*) and bull trout critical habitat from the reissuance of a National Pollutant Discharge Elimination System (NPDES) permit for the Hecla Mining Company (Hecla) Grouse Creek Unit (GCU). In a letter dated July 6, 2017 and received on the same day by email, the U.S. Environmental Protection Agency (EPA) requested formal consultation with the Service under section 7 of the Endangered Species Act (Act) of 1973, as amended, for its proposal to reissue the NPDES permit. EPA determined that the proposed action is likely to adversely affect bull trout and bull trout critical habitat. As described in this Opinion, and based on the Biological Evaluation (BE) (EPA 2017, entire) and supplemental information developed by EPA, the Service has concluded that the action, as proposed, is not likely to jeopardize the continued existence of bull trout and is not likely to destroy or adversely modify bull trout critical habitat

EPA also determined that the permits will have no effect on the Canada lynx (*Lynx canadensis*), yellow-billed cuckoo (*Coccyzus americanus*), or whitebark pine (*Pinus albicaulis*). The Service acknowledges these determinations.

1.2 Consultation History

The Service has had the following communication and coordination with EPA and others on the proposed action.

March 6, 2015:	The Service received an email from EPA advising that they would be sending the draft BE within a few weeks. The email also had the draft NPDES permit, fact sheet, and the State of Idaho draft Clean Water Act (CWA) Section 401 certification attached.
June 1, 2015:	The Service received an email from EPA with the draft BE attached.
June 12, 2015:	The Service received a letter from EPA, dated June 5, with the draft BE, draft NPDES permit, and fact sheet from EPA enclosed. The letter requested our concurrence on the determination that the reissuance of the NPDES permit is not likely to adversely affect listed species.
July, 9, 2015:	The Service indicated in a telephone conversation with EPA that we would not concur with the not likely to adversely affect determination for bull trout because of conflicting information in the BE pertaining to incidental take. EPA said they would discuss this with the contractor writing the BE.
August 4, 2015:	The Service sent an email to EPA stating that additional work is needed on the BE and specifically identifying areas of concern such as the need to be consistent with our 2015 Opinion on Idaho Water Quality Standards for

	Toxic Pollutants (Idaho Toxics Opinion; USFWS 2015i) and the need to address the physical and biological features (PBFs) of bull trout critical habitat.
October 20, 2015:	The Service received an email from EPA requesting a conference call to discuss the proposed action and containing a revised fact sheet and draft NPDES permit as attachments.
October 26, 2015:	The Service participated in a conference call with EPA and National Marine Fisheries Service (NMFS) to discuss the draft BE and proposed action.
November 2, 2015:	The Service sent an email to EPA with comments on the draft BE attached.
December 23, 2015:	The Service received an email from EPA with a revised draft BE attached
January 5, 2016:	The Service sent comments on the revised draft BE to EPA via email. Later on the same day, the Service participated in a conference call with EPA and NMFS to discuss the project and the BE.
March 21, 2016:	The Service received the final BE and letter requesting formal consultation.
April 20, 2016:	The Service sent an email to EPA stating that additional information on biomonitoring is needed in the BE before formal consultation can be initiated.
June 1, 2016:	The Service received an email from EPA with a revised Fact Sheet attached. The revisions addressed some aspects on biomonitoring. EPA also sent Hecla's comments on the draft permit and the BE.
July 8, 2017:	The Service received the final BE, draft Permit, and request letter from EPA by email.
February 22, 2018:	The Service sent the draft Opinion to EPA for their review by email.
March 23, 2018:	The Service received comments on the draft Opinion from EPA by email. EPA's comments included some minor changes to the proposed action, namely, establishing a new downstream monitoring site on the Yankee Fork and a change to the average monthly limit for whole effluent toxicity for Jordan Creek.

2. BIOLOGICAL OPINION

2.1 Description of the Proposed Action

This section describes the proposed Federal action, including any measures that may avoid, minimize, or mitigate adverse effects to listed species or critical habitat, and the extent of the geographic area affected by the action (i.e., the action area). The term "action" is defined in the implementing regulations for section 7 as "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." The term "action area" is defined in the regulations as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

2.1.1 Action Area

The Grouse Creek Unit (GCU) consists of an inactive open pit gold mine and mill and support facilities located in Custer County, Idaho, approximately 19 miles northeast of Stanley. The facility is owned and operated by the Hecla Mining Company (Hecla). The facility operated from December 1994 through April 1997 and is currently undergoing closure and reclamation.

The GCU covers approximately 590 acres on both private lands and Federal lands. The Federal land area is managed by the U.S. Forest Service (Salmon-Challis National Forest). The mine facilities are located in the Grouse Creek, Pinyon Creek, Washout Creek, and Jordan Creek drainages. Grouse, Pinyon, and Washout creeks are tributaries to Jordan Creek which flows into Yankee Fork approximately 4 miles downstream of the mine site. The Yankee Fork of the Salmon River (Yankee Fork) flows into the Salmon River approximately 8 miles downstream from its confluence with Jordan Creek. The Jordan Creek and Yankee Fork watersheds are within the Upper Salmon River Basin (HUC # 17060201).

The action area is within the Yankee Fork Creek subwatershed, and consists of the stream reaches of Jordan Creek from outfall 002 downstream, the Yankee Fork below the confluence of Jordan Creek to the confluence of the Yankee Fork with the Salmon River (see Figure 1).

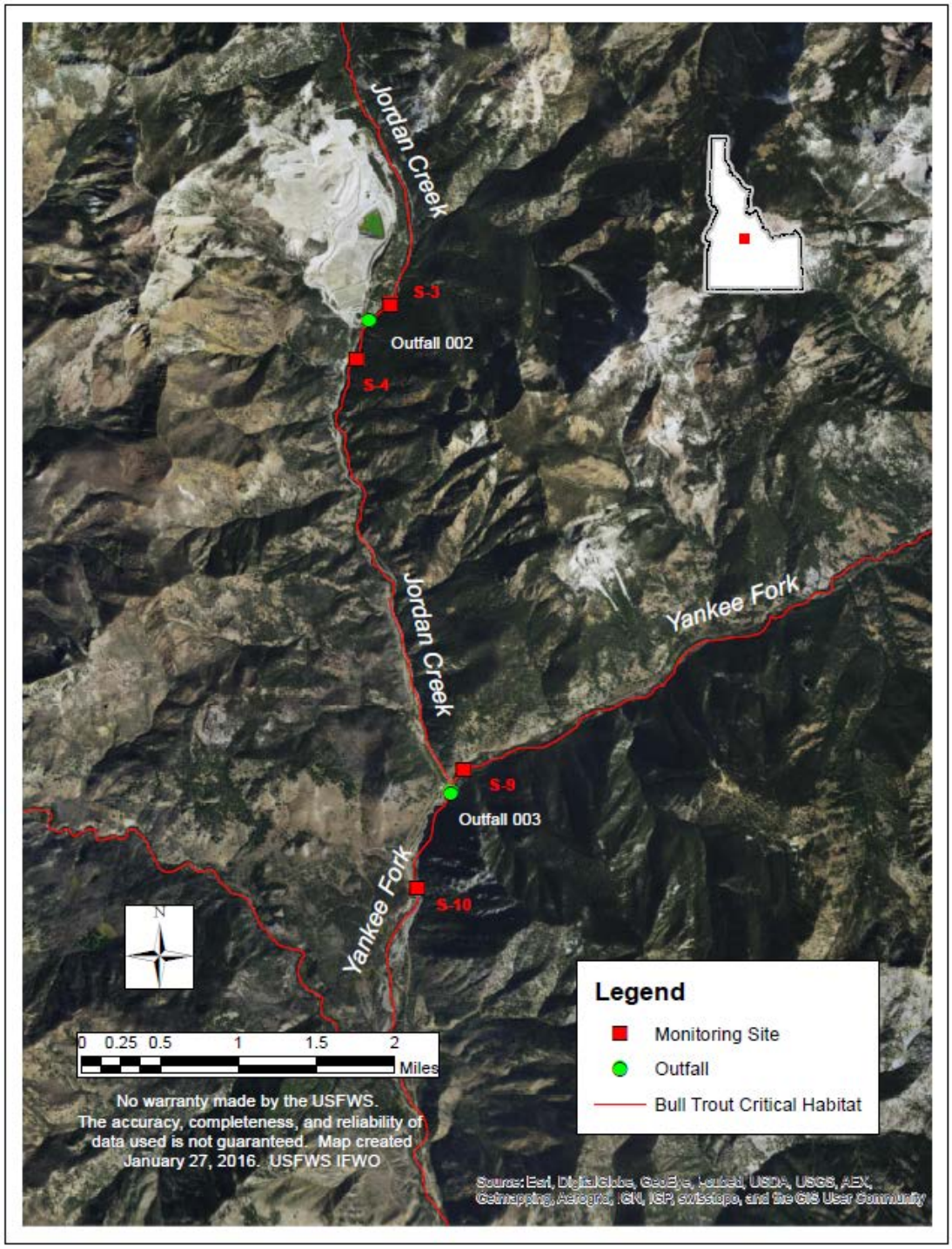

Figure 1. Map of GCU showing outfalls, monitoring sites, and bull trout critical habitat (adapted from BE Map 1). Note: Monitoring site S-6 is not shown on the map but is an important sampling reference site located upstream of S-3. S-6 shows little impact from legacy mining activities.

2.1.2 Proposed Action

The following description of the proposed action is excerpted and adapted from the BE (EPA 2017), the Fact Sheet (EPA 2016a), the draft Permit (EPA 2016b), and NMFS' Biological Opinion on the proposed action (NMFS 2018).

EPA is proposing to reissue the National Pollutant Discharge Elimination System (NPDES) permit for the GCU inactive gold mine and mill (NPDES Permit No. ID0026468). The proposed NPDES permit authorizes the discharge from existing outfall 002 to Jordan Creek. The permit application requests authorization of a new outfall, outfall 003, which discharges to the Yankee Fork just downstream from its confluence with Jordon Creek. The NPDES permit also requires physiochemical and biological monitoring and requires Hecla to develop and implement a Best Management Practices (BMP) Plan to control pollutants through proper operation and maintenance of the water management and treatment systems.

Although the EPA is proposing to authorize discharges from outfall 003 under an NPDES permit for the first time, discharges from outfall 003 had previously been authorized under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), commonly known as Superfund.

2.1.2.1 Outfall Description

Outfall 002

The facility is permitted under the previous NPDES permit to discharge wastewater through outfall 002 to Jordan Creek. Outfall 002 discharges to Jordan Creek, approximately 3.2 miles upstream of its confluence with the Yankee Fork (Figure 1). From the settling pond, treated water is discharged to the old Pinyon Creek channel, and travels approximately 300 feet before entering Jordan Creek. Discharge from outfall 002 is variable, but is restricted to maintain an 8:1 dilution ratio relative to Jordan Creek flows. The maximum design capacity of the water treatment plant (WTP) is 5.57 cubic feet per second (cfs), which can be accommodated by outfall 002.

Outfall 003

Outfall 003 discharges to the Yankee Fork, approximately 300 feet downstream from the confluence with Jordan Creek (Figure 1). This discharge location is approximately 8 miles upstream of the Yankee Fork and Salmon River confluence. When discharging through outfall 003, treated water flows from the settling pond into a pipeline and is subsequently discharged through a diffuser into the Yankee Fork. The diffuser is 11 feet long with eleven ports and is situated approximately mid-channel. The proposed maximum permitted discharge rate for outfall 003 is 2 cfs.

There is potential for both outfalls 002 and 003 to discharge during all times of the year. Discharge patterns are similar to the basin flow discharge characteristics, with higher discharges typically occurring between April and June.

Sources of Wastewater

Components of the facility that result in the generation of wastewater discharged through both outfalls 002 and 003 include mined areas and other disturbed areas, the waste rock storage area,

the former tailings impoundment, and stormwater. The tailings impoundment cap was completed in the summer of 2012. A general description of these components is provided below.

Mine Water

The GCU includes two deposits of gold-bearing ore: the Sunbeam deposit and the Grouse Creek deposit. Mining of the Sunbeam deposit is completed; no mining of the Grouse Creek deposit has occurred. When the mine was operating, gold ore was mined primarily via open pit methods. Runoff from the mined areas and mine drainage from the inactive Sunbeam mine adit are routed to sediment ponds located below the former tailings impoundment prior to treatment and discharge via outfalls 002 and 003. See below for a description of the treatment process.

Waste Rock Runoff and Seepage

Waste rock (rock that is removed from the mine in order to gain access to the ore) was deposited in an area adjacent to the Sunbeam pit in the upper Pinyon Creek drainage. The waste rock dump is currently undergoing reclamation. Underdrains constructed underneath the waste rock dump collect seepage. Seepage and runoff from the waste rock dump is routed to the west ditch. The west ditch water flows to the wastewater treatment plant prior to discharge through outfall 002 or 003.

Tailings Impoundment Wastewaters

During operations, mined ore was processed at the mill by cyanide leaching to recover gold. Tailings (the residuals from leaching) were disposed in a lined tailings impoundment. The tailings impoundment was constructed in the Pinyon Creek basin and covered approximately 197 acres. The impoundment served to separate the water and solids portions of the tailings via settling. During mining operations, water was collected from the surface of the impoundment for reuse in the mill. The impoundment was lined with an underdrain system to collect seepage and groundwater. The underdrain water and runoff from the impoundment embankment flowed to a collection pond at the base of the impoundment. Diversion ditches were used to reduce water inflow to the tailings impoundment. Portions of Washout Creek were diverted around the impoundment via the west ditch.

In the spring of 1999, cyanide was detected in Jordan Creek at levels exceeding Idaho aquatic life water quality criteria. The major source of the cyanide was leakage from the tailings impoundment. EPA, the State of Idaho, the U.S. Forest Service, and Hecla negotiated a Consent Order under the Comprehensive Environmental Response, Compensation, and Liability Act (also known as CERCLA or “Superfund”) to address these exceedances. The CERCLA Consent Order required Hecla to dewater the tailings impoundment to eliminate leakage and facilitate reclamation. Reclamation of the tailings impoundment began in 2007. Construction of the final engineered cover over the tailings impoundment was completed in 2012.

A gravity flow drain system was constructed beneath the engineered cover to drain residual pore water as the tailings consolidate. There are also 13 underdrains beneath the former tailings impoundment. The tailings are continuing to express pore water as they continue to consolidate. The pore water and underdrain water is comingled with all site waters, treated at the treatment plant, and discharged through outfalls 002 and 003.

Stormwater

Stormwater run-off from most areas of the mine site (e.g., run-off from on-site roads, mined areas, and other disturbed areas) flow to the tailings impoundment or is routed through outfalls 002 and 003. Storm water is controlled through the use of BMPs. Storm water that is not routed through outfalls 002 or 003 is regulated under the Multi-Sector Storm Water General Permit.

Since 2008, treatment has been required to meet effluent limits established for outfall 003 under the CERCLA discharge authorization. Due to the inability to separate the tailings impoundment water from other site waters in the site's single treatment plant, the EPA authorized discharges from both outfall 002 and 003 under CERCLA, and the sources of wastewater for outfalls 002 and 003 have been the same.

The stream flow is continuous yet variable as influenced by precipitation and snow melt. Peak flows occur during May and June.

The draft permit proposes to authorize this discharge under the CWA, subject to effluent limits that ensure compliance with technology-based requirements and water quality standards, including the State of Idaho's antidegradation policy.

As described above, the sources of wastewater in outfalls 002 and 003 discharge include runoff and seepage from the waste rock dump, mine drainage from the Sunbeam adit, storm water, and wastewater from the tailings impoundment underdrains.

Treatment Process

Wastewater is treated prior to discharge. Treatment consists of hydroxide and sulfide precipitation and settling. Lime and sodium sulfide are added to mixed reactor tanks in the precipitation stage. Following precipitation, coagulant and flocculant are added to aid settling and the wastewater flows to a lined settling pond. The flow of wastewater from the settling pond for discharge through outfall 002 is variable since the quantity of storm water, waste rock run off, and mine drainage is highly dependent upon precipitation and snow melt. The average yearly discharge rate is 450 gallons per minute (gpm) (1 cfs) based on Hecla's NPDES permit application and supplemental information. The maximum flow rate of the treatment plant is 2,500 gpm (5.57 cfs).

2.1.2.2 Receiving Water

Outfall 002

Jordan Creek is not designated for specific uses in Idaho's water quality standards. However, Idaho Administrative Procedures Act (IDAPA) 58.01.02.101.01 designates all undesignated waters for cold water aquatic life and primary and secondary contact recreation uses.

Outfall 003

Yankee Fork Creek is designated for the uses of cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply (IDAPA 58.01.02.130.03). These are surface waters that are recognized as needing intensive protection (a) to preserve outstanding or unique characteristics, or (b) to maintain current beneficial use.

Table 1. Idaho Water Quality Criteria Applicable to the Grouse Creek Permit (from Table 3 of the BE).

Idaho Water Quality Criteria Applicable to the Grouse Creek Permit[3]			
Parameter	**Criteria**		**Uses**
	Jordan Creek	**Yankee Fork Creek**	
Ammonia[2]	Acute: 8.31 mg/L Chronic: 3.24 mg/L	Acute: 10.3 mg/L Chronic: 3.74 mg/L	Cold Water Aquatic Life
Arsenic[4]	10 µg/L		Human Health
Cadmium[1]	Dependent upon hardness		Cold Water Aquatic Life
Copper[1]	Dependent upon hardness.		Cold Water Aquatic Life
Cyanide	Acute: 22 µg/L Chronic: 5.2 µg/L		Cold Water Aquatic Life
Lead[1]	Dependent upon hardness		Cold Water Aquatic Life
Mercury, Water Column	Acute: 2.1 µg/L Chronic: 0.012 µg/L		Cold Water Aquatic Life
Methyl Mercury, Fish Tissue	0.3 mg/kg		Human Health (consumption of fish)
Nitrate + Nitrite (Yankee Fork Creek only)	10 mg/L		Domestic Water Supply
Nitrate + Nitrite (Statewide)	100 mg/L		Agricultural Water Supply
pH	6.5 – 9.0 standard units		Aquatic Life
Sediment	Narrative criterion		Various uses
Selenium	Acute: 20 µg/L Chronic: 5 µg/L		Cold Water Aquatic Life
Silver[1]	Dependent upon hardness.		Cold Water Aquatic Life
Temperature[5]	Max. daily avg.: 19 °C Instantaneous max.: 22 °C	Max. daily avg.: 9 °C Instantaneous max.: 13 °C	Cold Water Aquatic Life (Jordan Creek) Salmonid Spawning (Yankee Fork Creek)
Whole Effluent Toxicity	"Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses."		Cold Water Aquatic Life, other designated uses.
Zinc[1]	Dependent upon hardness.		Cold Water Aquatic Life

1. Applicable criteria for five of the metals are hardness dependent (see Section 2.1.2.3)
2. Applicable criteria for ammonia are dependent upon pH and temperature. See the Fact Sheets for details.
3. Water Quality Criteria for the parameters copper, cyanide, mercury, selenium and zinc received a Jeopardy/Adverse Modification conclusion in the Idaho Toxics Biological Opinions (NMFS 2014 and USFWS 2015i). Compliance with the Reasonable and Prudent Alternatives listed in the Opinions are discussed in this Opinion in Section 2.1.2.5.
4. There are also aquatic life criteria applicable to arsenic: an acute criterion of 340 µg/L and a chronic criterion of 150 µg/L. Since the human health criterion of 10 µg/L is an order of magnitude more stringent, it will be the basis for water quality-based controls on arsenic in nearly all cases.
5. The temperature criteria listed for Yankee Fork Creek are for the salmonid spawning use. These criteria apply in areas used for spawning and during the time spawning and incubation occurs. Otherwise, the cold water aquatic life criteria (19/22 °C) apply.

In addition, all waters of the State of Idaho are designated for industrial and agricultural water supply, wildlife habitats, and aesthetics (IDAPA 58.01.02.100).

The Idaho water quality criteria applicable to these waters are based on these use designations. For each water quality parameter, water quality-based effluent limits must be based on the most stringent water quality criterion applicable to the receiving water, in order to ensure that all of the uses are protected. The applicable water quality criteria are listed in Table 1.

2.1.2.3 Permit Effluent Limits

NPDES permits can include both technology-based and water quality-based permit limits. Technology-based limits are based on section 301(b)(1)(A) and 301(b)(2) of the CWA and are designed to assure that all industries throughout the country install a baseline level of treatment for their wastewaters. Water quality-based limits are based on section 301(b)(1)(C) of the CWA and are intended to ensure that effluent from facilities do not adversely affect the waterbodies into which they discharge. The implementing regulations at 40 CFR 122.44(d) require that permits contain limits for all pollutants or parameters that "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard, including state narrative criteria for water quality." The proposed permit uses technology-based limits for total suspended solids (TSS) only as the EPA determined that the technology-based effluent limit is stringent enough to ensure compliance with water quality standards. All other effluent limits included in the permit are water quality-based.

To determine whether water quality-based limits for a particular discharge are needed, EPA follows guidance in its *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991, entire) from here on referred to as the TSD. EPA evaluated the outfall 002 and 003 discharges to determine if "reasonable potential" to exceed the criteria in the receiving water exists. Effluent limits were developed for those pollutants where there was "reasonable potential." These pollutants are pH, metals (cadmium, copper, lead, mercury, and zinc), whole effluent toxicity (WET), and, for outfall 002, cyanide. Effluent limits are not needed for those parameters that did not exhibit reasonable potential. A description of the reasonable potential evaluation for the draft final permit is included in Appendix C of the 2015 Fact Sheet (EPA 2015) and Appendix B of the 2016 Fact Sheet (EPA 2016).

Although some constituents of the discharge may not have exhibited reasonable potential to exceed water quality standards, these still require scrutiny to ensure protection of listed species. These constituents are aluminum, arsenic, selenium, silver, ammonia, and nitrate + nitrite.

For those parameters that require water quality-based effluent limits, the effluent limits are developed by converting the applicable water quality criteria into permit limits. EPA converts the criteria into effluent limits following the procedures in the TSD. Factors that influence the development of effluent limits include: effluent flow, receiving water critical low flows, effluent variability, water quality upstream of the discharge, water hardness (for metals with hardness-dependent criteria), and water temperature. Reasonable worst case estimates of each of these factors were used to develop the effluent limits to ensure that they are protective of the water quality criteria under critical conditions. Each of these factors is discussed in the Fact Sheets.

The toxicity of certain metals is influenced by water hardness. Idaho's aquatic life criteria for several of the metals of concern are calculated as a function of hardness measured in milligrams

per liter (mg/L) as calcium carbonate ($CaCO_3$). As the hardness of the receiving water increases, the toxicity of the metals decreases and the numerical values of the criteria increase. For the purposes of calculating a conservative value for metals criteria, the EPA uses the 5th percentile of measured hardness values. In the case of the GCU, the hardness that is used to calculate the value of the water quality criteria for cadmium, copper, lead, silver, and zinc (for the purpose of calculating the various effluent limits) varies to be consistent with the varying conditions of receiving water flow and dilution. For parameters with "concave down" criteria (i.e., the slope of the criteria, when plotted against hardness, decreases with increasing hardness) such as cadmium, copper, and zinc, the EPA used a calculated hardness value expected to occur at the edge of the mixing zone, based on conservative values (minimum or 5th percentile) for the measured effluent and upstream measured hardness and the dilution factor associated with the authorized mixing zone. For parameters with "concave up" criteria (i.e., the slope of the criteria, when plotted against hardness, increases with increasing hardness) such as lead and silver, the EPA used a conservative (minimum or 5th percentile) hardness measured downstream from the appropriate outfall (i.e., at the downstream monitoring stations S-4 and S-10, outside the mixing zones for metals).

Idaho water quality criteria for mercury and selenium are expressed as total recoverable and are independent of hardness. Arsenic criteria for the protection of aquatic life is also independent of hardness, and has a conversion factor of one (1), meaning that the dissolved and total recoverable criteria are the same. Water quality criteria for these parameters are the same for waters throughout Idaho unless a site-specific criterion is in effect.

Mixing Zones

Under Idaho's water quality standards, mixing zones may be authorized for discharges to meet water quality standards. Mixing zones are limited areas or volumes of receiving water where wastewater mixes with the receiving water and where water quality standards may be exceeded. The dilution provided by mixing zones was factored into the development of effluent limits for some constituents of the GCU outfalls. Mixing zones are authorized for ammonia, arsenic, cadmium, copper, cyanide, lead, mercury, silver, selenium, WET and zinc for both outfalls (Table 2). Mixing zone dilution was also used for the determination of reasonable potential for nitrate + nitrite, for outfall 002.

Table 2. Authorized mixing zones by parameter and flow tier (from Table 4 of the BE).

Parameter	Jordan Creek (002)				Yankee Fork (003)					
	Flow < 30 cfs		**Flow ≥ 30 cfs**		**Flow < 15 cfs**		**Flow ≥ 15 and < 45 cfs**		**Flow ≥ 45 cfs**	
	Auth. Fraction of Critical Flow	Modeled Down-stream Distance (m)	Auth. Fraction of Critical Flow	Modeled Down-stream Distance (m)	Auth. Fraction of Critical Flow	Modeled Down-stream Distance (m)	Auth. Fraction of Critical Flow	Modeled Down-stream Distance (m)	Auth. Fraction of Critical Flow	Modeled Down-stream Distance (m)
Ammonia	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Arsenic	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Cadmium	25%	25	25%	24.7	9%	0.10	18%	0.53	19%	1.2
Copper	25%	25	5%	2.3	13%	0.21	25%	0.99	13%	0.6
Cyanide	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Lead	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Mercury	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Nitrate+ Nitrite	25%	25	25%	24.7	N/A	N/A	N/A	N/A	N/A	N/A
Selenium	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Silver	25%	25	25%	24.7	25%	0.76	25%	0.99	25%	35.2
Zinc	25%	25	8%	24.1	23%	0.64	25%	0.99	25%	35.2
WET (002)[1]	50%	26	50%	25.9	N/A					
WET (003)[1]	N/A				**Flow < 15 cfs**		**Flow ≥ 15 and < 80cfs**		**Flow ≥ 80 cfs**	
					75%	200	75%	341	75%	649

Notes:
1. For WET, the modeled downstream distance is the distance at which the receiving water concentration falls below 1.0 chronic toxic units (TUc), if the effluent WET is equal to the average monthly limit.

Effluent limits

For outfall 002 (Table 3), two sets of effluent limits were developed to allow for variability of the effluent and receiving water (Jordan Creek) flows. For outfall 003 (Table 4), three sets of limits were developed, to allow for variability of the effluent and receiving water (Yankee Fork Creek) flows. In addition to changes in dilution ratios, the hardness varies with flow. Therefore, effluent limits for the flow tiers are different for those parameters with water quality criteria based on hardness. The basis for these effluent limits and how they were developed are detailed in the Fact Sheets.

The effluent limits are expressed in terms of concentration (e.g., µg/L [micrograms per liter). In order to ensure that total loadings to the receiving water are controlled, the permit also proposes effluent limits for flow, and, for outfall 002, the dilution ratio (ratio of receiving water flow to effluent flow) was also established as an effluent limit. Limits were added for whole effluent toxicity (WET) based on Idaho state water quality standards that require surface waters to be free from toxic substances in concentrations that impair designated or existing beneficial uses of the receiving water (IDAPA 58.01.02.200.02). Idaho's narrative water quality criterion for toxic substances was interpreted using recommendations in the TSD.

Table 3. Effluent limits for outfall 002 (from Table 5 of the BE).

Effluent Limits for outfall 002								
Parameter and Units	**Draft Permit**				**2002 Permit**			
	Jordan Creek Flow < 30 CFS		Jordan Creek Flow ≥ 30 CFS		Jordan Creek Flow < 30 CFS		Jordan Creek Flow ≥ 30 CFS	
	Average Monthly Limit	Max. Daily Limit	Average Monthly Limit	Max. Daily Limit	Average Monthly Limit	Max. Daily Limit	Average Monthly Limit	Max. Daily Limit
Effluent Flow, CFS	—	5.57	—	5.57	No limits. Monitor and report only.			
Cadmium, total recoverable (TR), µg/L	1.44	2.72	1.32	2.50	3.7	7.5	2.2	4.4
Copper, TR, µg/L	18.6	41.9	14.9	33.5	14	35	5.6	14
Cyanide, weak acid dissociable (WAD), µg/L	7.47	21.3	7.47	21.3	21	47	21	47
Dilution Ratio	8:1 (minimum)				8:1 (minimum)			
Lead, TR, µg/L	1.80	4.84	0.84	2.28	9.5	19	4.0	8.1
Mercury, Total, µg/L	0.022	0.057	0.022	0.057	0.088	0.18	0.088	0.18
pH, standard units	6.5 – 9.0				6.5 – 9.0			
Selenium, µg/L	No limits. Monitor and report only.				No limits. Monitor and report only.			
Silver, TR	No limits. Monitor and report only.				1.8	3.6	0.60	1.1
Total Suspended Solids (TSS), mg/L	20	30	20	30	20	30	20	30
Zinc, TR, µg/L	141	304	107	230	110	250	50	110
WET, chronic, TUc	4.6	9.2	4.6	9.2	9.8	16	9.8	16

Some permit limits in outfall 002 for copper and zinc are less restricted than in the past permit. The draft permit also proposes to delete the prior permit's effluent limits for silver. One reason for this is that the prior permit limits were based on limited receiving stream water quality data where EPA assumed a conservative value for water hardness. Hardness is a measure of the concentration of divalent metal cations (mostly calcium and magnesium) in the water. Some metals are less toxic to aquatic life in hard water than in soft water; therefore, the water quality criteria become less stringent (i.e., numerically greater) in harder waters. Currently, there are 5 years of water quality data indicating that the effluent water is considerably harder than the receiving stream water than had to be assumed for the first permit. Thus, the toxicity of some metals (e.g., copper) is reduced because of the effect of higher water hardness, allowing for higher end-of-pipe concentrations. In addition, effluent concentrations of silver have declined over time due to the cleanup and closure of the site, such that the discharges no longer have the reasonable potential to cause or contribute to excursions above water quality standards for silver. The revised and deleted effluent limits are consistent with the State of Idaho's antidegradation policy and implementation methods (IDAPA 58.01.02.051 – 052).

Table 4. Effluent limits for outfall 003 (from Table 6 of the BE).

Effluent Limits for outfall 003						
Parameter and Units	**Yankee Fork Creek Flow < 15 CFS**		**Yankee Fork Creek Flow ≥ 15 and < 45 CFS**		**Yankee Fork Creek Flow ≥ 45 CFS**	
	Average Monthly Limit	Max. Daily Limit	Average Monthly Limit	Max. Daily Limit	Average Monthly Limit	Max. Daily Limit
Flow (CFS)	—	0.668	—	1.11	—	2.01
Cadmium, TR, µg/L	2.22	4.08	2.50	4.59	2.96	5.42
Copper, TR, µg/L	21.6	39.8	21.8	40.3	20.8	38.5
Lead, TR, µg/L	1.40	4.84	0.75	2.60	0.96	3.32
Mercury, total, µg/L	0.026	0.053	0.025	0.050	0.035	0.069
pH, standard units	6.5 – 9.0 at all times					
TSS	20	30	20	30	20	30
Zinc, TR, µg/L	158	344	147	319	167	364
WET, chronic, TUc	**Yankee Fork Creek Flow < 15 CFS**		**Yankee Fork Creek Flow ≥ 15 and < 80 CFS**		**Yankee Fork Creek Flow ≥ 80 CFS**	
	10	20	9.1	18	25	51

Discharge Authorization

During the effective period of this permit, the permittee is authorized to discharge pollutants from the outfalls specified herein to Jordan Creek and Yankee Fork, within the limits and subject to the conditions set forth herein. The proposed permit authorizes the discharge of only those pollutants resulting from facility processes, waste streams, and operations that have been clearly identified in the permit application process.

2.1.2.4 Monitoring Requirements

Consistent with 40 CFR 122.44(i), 122.48, section 308 of the Clean Water Act, the State of Idaho's Clean Water Act Section 401 certification, and the non-discretionary reasonable and prudent measures (RPMs) in NMFS Biological Opinion on the effects of EPA approving the Idaho Water Quality Standards for toxic substances (NMFS 2014), the required monitoring

includes effluent monitoring, stream water quality monitoring, and biological monitoring. Monitoring locations are described in Table 5. Results of the monitoring are required to be reported to the EPA.

Table 5. Monitoring location descriptions.

Monitoring Site	Location Description	Type of Monitoring
Outfall 002	Pipe at outlet of the settling pond	Water quality
Outfall 003	Pipe at outlet of the settling pond	Water quality
S-6	Jordan Creek, about 5 miles upstream of outfall 002. Just downstream of the Grouse Creek confluence.	Biological
S-3	Jordan Creek, upstream of outfall 002.	Water quality
S-4	Jordan Creek, about 1,000 feet downstream of outfall 002. Downstream of the Washout Creek confluence.	Water quality, Biological
S-9	Yankee Fork, about 0.6 mile upstream of outfall 003. Upstream of the Jordan Creek confluence.	Water quality, Biological
S-10 (or S-14 once established)*	Yankee Fork, about 0.6 mile downstream of outfall 003.	Biological

*S-14 will be located approximately 800 feet downstream of outfall 003.

2.1.2.4.1 Effluent Monitoring

Effluent monitoring is necessary for pollutants subject to effluent limits, in order to determine compliance with such limits. Monitoring of additional pollutants not subject to effluent limits is required to characterize the effluent to determine the effects of the effluent water chemistry upon metals toxicity, and if additional effluent limits may be necessary in the future. Effluent monitoring requirements are summarized in Tables 6 and 7, below.

Table 6. Effluent monitoring requirements for outfall 002 (from BE Table 7).

Parameter and Units	Sample Frequency	Sample Type
Effluent Flow, CFS	Continuous	Recording
Jordan Creek Flow, CFS	Daily	Recording
Cadmium, total recoverable (TR), µg/L	Monthly	Grab
Copper, TR, µg/L	Monthly	Grab
Cyanide, weak acid dissociable (WAD), µg/L	Monthly	Grab
Dilution Ratio	Daily	Calculated
Lead, TR, µg/L	Monthly	Grab
Mercury, Total, µg/L	Monthly	Grab
Floating, suspended or submerged matter	Monthly	Visual
pH, Standard Units	Daily	Grab
Total Suspended Solids (TSS), mg/L	Twice per Month	Grab
Zinc, TR, µg/L	Monthly	Grab
Whole Effluent Toxicity (WET), Chronic, TU_c	4x/year	24-hour composite
Aluminum, TR, µg/L	4x/year	Grab
Ammonia, Total as N, mg/L	4x/year	Grab
Arsenic, µg/L	4x/year	Grab
Conductivity, µmhos/cm	Monthly	Grab
Dissolved organic carbon, mg/L	Monthly	Grab
Hardness, total as CaCO3, mg/L	Monthly	Grab
Nitrate + Nitrite, as N, mg/L	4x/year	Grab
Selenium, TR, µg/L	4x/year	Grab
Silver, µg/L	4x/year	Grab
Temperature, °C	Continuous	Recording
WET, Acute, TU_a	Annual	24-hour composite

Table 7. Effluent monitoring requirements for outfall 003 (from BE Table 8).

Parameter and Units	Monitoring Requirements	
	Sample Frequency	Sample Type
Effluent Flow, CFS	Continuous	Recording
Yankee Fork Creek Flow, CFS	Daily	Recording
Cadmium, TR, µg/L	Monthly	Grab
Copper, TR, µg/L	Monthly	Grab
Lead, TR, µg/L	Monthly	Grab
Mercury, Total, µg/L	Monthly	Grab
Floating, suspended or submerged matter	Monthly	Visual
pH, Standard Units	Daily	Grab
Total Suspended Solids (TSS), mg/L	Monthly	Grab
Zinc, TR, µg/L	Monthly	Grab
Aluminum, TR, µg/L	4x/year	Grab
Ammonia, Total as N, mg/L	4x/year	Grab
Arsenic, µg/L	4x/year	Grab
Cyanide, Weak Acid Dissociable, µg/L	Monthly	Grab
Conductivity, µmhos/cm	Monthly	Grab
Dissolved organic carbon, mg/L	Monthly	Grab
Hardness, total as CaCO3, mg/L	Monthly	Grab
Nitrate + Nitrite, as N, mg/L	4x/year	Grab
Selenium, TR, µg/L	4x/year	Grab
Silver, µg/L	4x/year	Grab
Temperature, °C	Continuous	Recording
WET, Acute, TU_a	Annual	24-hour Composite
WET, Chronic, TU_c	4x/year	24-hour Composite

Part I.C of the NPDES permit outlines the acute and chronic WET testing requirements, which are designed to assess the aggregate toxicity of the effluent. The permit requires both acute and chronic WET testing. Both types of tests are required to be performed using a series of five test dilutions and a control to determine the concentration of effluent that causes an adverse effect on a group of test organisms during a short-term exposure. Both the control and dilution water must be receiving water collected upstream from the corresponding outfall. The dilution series must include the receiving water concentration (RWC), two dilutions above the RWC, and two dilutions below the RWC. Table 8 below lists the RWC for acute and chronic WET testing.

Table 8. Receiving water concentrations for acute and chronic WET testing.

Receiving Stream, flow tier	Chronic Effluent Limit RWC (% effluent)	Acute and Chronic Trigger RWC (% effluent)
Outfall 002		
Jordan Creek, both flow tiers	22	33
Outfall 003		
Yankee Fork, < 15 cfs	10	21
Yankee Fork, 15 to 80 cfs	11	23
Yankee Fork, > 80 cfs	4	9.1

The NPDES permit requires acute WET testing be performed as 96-hour static renewal tests with rainbow trout (*O. mykiss*). The presence of acute toxicity will be determined as specified in EPA guidance (2002a). For chronic WET testing, Hecla is required to perform static renewal tests that vary in duration (either 4 or 7 days), depending on the test species. Hecla is required to conduct the first three tests with the water flea (*Ceriodaphnia dubia*), fathead minnow (*Pimephales promelas*), and a green algae (*Raphidocelis subcapitata*). Using information from these tests, the permit allows for testing to continue with only the most sensitive species. The presence of chronic toxicity will be determined as specified in EPA guidance (2002b).

If the effluent is more toxic than the acute or chronic toxicity triggers listed in Table 8 above, Hecla is required to conduct four more biweekly tests, using the species and test method(s) for which triggers were exceeded over an 8 week period. If none of the tests exceed the applicable triggers, then Hecla can return to the normal testing frequency. If any of the tests exceed the applicable triggers, then Hecla must implement their initial investigation toxicity reduction evaluation (TRE) workplan within 48 hours of receipt of the accelerated toxicity test result.

The initial investigation TRE is intended to: (1) identify the potential cause or source of toxicity; (2) characterize effluent variability; and (3) characterize treatment system efficacy. If the investigation clearly identifies a source of toxicity to the satisfaction of EPA (e.g., a temporary plant upset), then Hecla may return to the normal testing frequency. If the source of toxicity is not clearly identified, then Hecla must implement a more detailed TRE and toxicity identification evaluation (TIE) as described in the permit.

2.1.2.4.2 Stream Water Quality Monitoring

The permit also requires monitoring of the receiving waters for chemical and physical parameters. This monitoring is necessary to determine the background concentrations of pollutants for the purpose of determining the need for and developing water quality-based effluent limits, determining the value of water quality criteria for parameters such as ammonia and metals, which vary based on the receiving water chemistry, and for measuring the discharges' impacts upon receiving water quality. Receiving water quality monitoring requirements are summarized in Table 9, below.

Table 9. Surface water monitoring requirements for Jordan Creek (S-3 and S-4)[1] and Yankee Fork (S-9 and S-10)[2*].

Parameter and Units	Units	Frequency	Sample Type
Ammonia, Total as N	mg/L	4x/year	Grab
Conductivity	µmhos/cm	4x/year	Grab
Copper, dissolved	µg/L	4x/year	Grab
Dissolved organic carbon	mg/L	4x/year	Grab
Hardness, total as $CaCO_3$	mg/L	4x/year	Grab
Lead, dissolved	µg/L	4x/year	Grab
Mercury, total	µg/L	4x/year	Grab
Nitrate + Nitrite	mg/L	4x/year	Grab
pH	standard units	4x/year	Grab
Selenium, TR	µg/L	4x/year	Grab
Temperature	°C	Continuous from May 1st through October 31st	Recording
Turbidity	NTU	4x/year	Grab
Zinc, dissolved, µg/L	µg/L	4x/year	Grab

[1]Monitoring is required at station S-4 only if the permittee is discharging from Outfall 002 at the time samples are taken at station S-3.

[2]Monitoring is required at station S-10 only if the permittee is discharging from Outfall 003 at the time samples are taken at station S-9.

*****Due to instream disturbance in the Yankee Fork from the Bonanza Reach Floodplain Reconnection Project, station S-10 will be abandoned and a new station, S-14, will be established upstream of the disturbance, approximately 800 feet downstream of outfall 003.

2.1.2.4.3 Biological Monitoring

In its Clean Water Act Section 401 certification of the Grouse Creek Unit permit, the State of Idaho included a requirement that biologic monitoring consistent with or more rigorous than Idaho's Beneficial Use Reconnaissance Program protocols shall be conducted and completed annually in both Jordan Creek and the Yankee Fork. The EPA must incorporate requirements specified in the States' certifications of NPDES permits (40 CFR 124.53(e) and 124.55(a)(2)).

In addition, the non-discretionary reasonable and prudent measures (RPMs) in the National Marine Fisheries Service's Biological Opinion (NMFS 2014) on the effects of approving the Idaho Water Quality Standards for toxic substances require biomonitoring for this permit.

Specifically, biomonitoring is necessary under RPM #1 (minimize the effects of toxicity resulting from simultaneous exposure to mixtures) and RPM #5 (monitoring and reporting). When biomonitoring is required to implement the RPMs, such biomonitoring shall be consistent with Appendix E of the NMFS Opinion.

The permit requires biomonitoring in Jordan Creek upstream and downstream of outfall 002 and in Yankee Fork Creek upstream and downstream of outfall 003. Biomonitoring for macroinvertebrates must be conducted annually, between July 1st and September 30th. Biomonitoring for fish, must be conducted at least once every 5 years, using electrofishing methods consistent with the National Marine Fisheries Service's *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (June 2000) and Sections 3.3.13, 6.3, and Appendices G and I of IDEQ's *Beneficial Use Reconnaissance Program Field Manual for Streams* (IDEQ 2016). Third-party fish biomonitoring data may be used for compliance with the permit if it meets the requirements of the permit. The permit requires that reference and disturbed sites be compared using the metrics in Table 10, below.

Table 10. Biomonitoring metrics (from Table 11 of the BE).

Macroinvertebrates	
Idaho Stream Macroinvertebrate Index (SMI)	
SMI component metrics (9 metrics related to taxa richness, dominance and tolerance)	
Total macroinvertebrate biomass	
Abundance of invertebrates considered vulnerable to predation by juvenile salmonids	
Biomass of invertebrates considered vulnerable to predation by juvenile salmonids	
Similarity between reference and assessment stations (Jaccard similarity or comparable index, e.g. observed/expected—O/E comparison)	
Fish (if monitoring occurred during the report year)	
Community Surveys (Idaho Stream Fish Index)	
Relative abundance (catch per unit effort—CPUE)	
Mean condition factor of salmonid species (Jaccard similarity)	
Evaluate at least one of the following:	Abundance of sentinel species (e.g., sculpins)
	Age classes of sentinel species (e.g., sculpins)
Evaluate at least one of the following:	Length-frequency analysis for salmonids or sculpins
	Age classes of salmonids or sculpins

A summary of past biomonitoring is included in Appendix B of this Opinion.

2.1.2.4.4 Reporting

Hecla is required to electronically submit a discharge monitoring report (DMR) each month. The DMR contains results from the effluent monitoring, WET testing (if performed), and surface water monitoring (if performed). If accelerated WET testing is performed, the data must be reported within 2 weeks of receipt of the results from the lab. The full report must be submitted within 4 weeks of receipt of the results from the lab. In addition, Hecla is required to prepare an annual surface water monitoring report and an annual biomonitoring report. These reports are required to be submitted to EPA and IDEQ by March 31st of the following year.

2.1.2.5. Incorporation of RPAs in the Idaho Water Quality Standards Biological Opinions

NMFS (2014) and USFWS (2015i) issued Biological Opinions on the EPA's approval of Idaho's water quality standards for toxic substances. These Opinions concluded that the water quality criteria for several of the parameters discharged by the Grouse Creek Unit are likely to jeopardize the continued existence of Snake River basin steelhead, Snake River fall Chinook salmon, Snake River sockeye salmon, Snake River Spring/Summer Chinook salmon, and bull trout. NMFS also concluded that these criteria would have an adverse effect on Essential Fish Habitat (EFH).

All of the criteria considered in the 2014 and 2015 Opinions remain in effect; thus, the EPA must implement these criteria in Clean Water Act actions, including NPDES permits. The Opinions include reasonable and prudent alternatives (RPAs), including "interim" RPAs that apply prior to the State of Idaho's adoption and the EPA's approval of revised criteria. The draft permit complies with the RPAs in the Opinions, as described below.

Arsenic

The interim RPA for arsenic in the Service Opinion for protection of bull trout, applies to discharges where geometric mean concentrations of arsenic are higher than 5 µg/L above background at the edge of the mixing zone. The geometric mean effluent concentration of arsenic at outfall 003 is 2.6 µg/L. Effluent data for arsenic are not available for outfall 002; however, since the sources of water for both outfalls are the same, the effluent concentration of arsenic at outfall 002 is expected be similar to concentrations at outfall 003. Because the geometric mean effluent concentration of arsenic is less than 5 µg/L, the geometric mean arsenic concentration will not be higher than 5 µg/L above background at the edge of the mixing zone. The arsenic RPA in the Service's Opinion for protection of bull trout therefore does not apply to this discharge.

The interim RPA for arsenic in the NMFS Opinion is to apply the State of Idaho's 10 µg/L human health criterion. The EPA has applied this criterion in the reasonable potential analysis for outfall 003. No arsenic effluent data are available for outfall 002, however, as discussed above, the effluent concentrations of arsenic for outfall 002 are expected to be similar to outfall 003, so outfall 003 effluent arsenic data were used to perform a reasonable potential analysis for outfall 002. The discharges do not have the reasonable potential to cause or contribute to excursions above the 10 µg/L human health criterion at the edges of the authorized mixing zones under critical conditions.

Copper

The interim RPAs for copper in the Service and NMFS Opinions for protection of bull trout, Snake River fall run Chinook salmon, Snake River sockeye salmon, and Snake River Spring/Summer Chinook salmon, are to maintain a zone of passage sufficient to allow unimpeded passage of adult and juvenile salmonids. The Opinions state that, "if the regulatory mixing zone is limited to less than or equal to 25 percent of the volume of a stream, then a sufficient zone of passage is presumed to be present."

The mixing zones for copper are less than or equal to 25 percent of the volume of the stream for both outfalls and all flow tiers. Furthermore, as discussed in the effects section below, CORMIX modeling shows that the mixing zones for copper are small and do not span the stream channels.

The State of Idaho has begun negotiated rulemaking to adopt water quality criteria for copper based on the biotic ligand model, consistent with EPA recommendations. Effluent and receiving water monitoring for conductivity and dissolved organic carbon, in addition to pH, temperature and hardness, is required in the draft permit so that, when the State of Idaho adopts water quality criteria for copper based on the biotic ligand model, water quality criteria for copper can be evaluated.

Cyanide

The RPAs for cyanide in the Service and NMFS Opinions for protection of bull trout, Snake River fall Chinook salmon, Snake River sockeye salmon, and Snake River Spring/Summer Chinook salmon, is to maintain a zone of passage sufficient to allow unimpeded passage of adult and juvenile salmonids. The Service's Opinion states that, "if the regulatory mixing zone is limited to less than or equal to 25 percent of the volume of a stream, then a sufficient zone of passage is presumed to be present." The NMFS Opinion references the mixing zone limitations in the RPA for copper, which, as stated above, is to provide a zone of passage and that a sufficient zone of passage is presumed to be present if the regulatory mixing zone is less than or equal to 25 percent of the stream volume.

The mixing zones for cyanide are less than or equal to 25 percent of the volume of the stream for both outfalls and all flow tiers. Furthermore, CORMIX modeling shows that the mixing zones for cyanide are small and do not span the stream channels.

Selenium

The interim RPAs for selenium in the Service and NMFS Opinions, for protection of bull trout, Snake River fall Chinook salmon, Snake River sockeye salmon, and Snake River Spring/Summer Chinook salmon, are triggered when annual geometric mean concentrations of selenium at the edge of the mixing zone are higher than 2 µg/L. The geometric mean effluent concentrations of selenium at outfalls 002 and 003 are 1.6 and 1.4 µg/L, respectively. Because the geometric mean effluent concentration of selenium is less than 2 µg/L, the geometric mean selenium concentration will not be higher than 2 µg/L at the edge of the mixing zone. The fish tissue monitoring requirements of the RPAs therefore are inapplicable to the Grouse Creek Unit discharges.

Mercury

The RPAs for mercury in the Service and NMFS Opinions, for protection of bull trout, Snake River run Chinook salmon, Snake River sockeye salmon, and Snake River Spring/Summer Chinook salmon, is to implement the applicable human health fish tissue criterion of 0.3 mg/kg wet weight.

As explained in the Fact Sheets, the EPA followed EPA and IDEQ guidance in evaluating reasonable potential of the Grouse Creek Unit to cause or contribute to excursions above the methylmercury fish tissue criterion. The EPA found that the Grouse Creek Unit does not have

the reasonable potential to cause or contribute to excursions above the methylmercury fish tissue criterion.

Zinc

The RPA for zinc in the Service Opinion, for protection of bull trout, is to ensure a zone of passage sufficient to allow unimpeded passage of adult and juvenile bull trout. The opinion states that, "if the regulatory mixing zone is limited to less than or equal to 25 percent of the volume of a stream, then sufficient zone of passage is presumed to be present."

The mixing zones for zinc are less than or equal to 25percent of the volume of the stream for both outfalls and all flow tiers. Furthermore, CORMIX modeling shows that the mixing zones for zinc are small and do not span the stream channel.

2.1.2.6 Incorporation of RPMs and Terms and Conditions from the NMFS Opinion on Idaho WQS

The NMFS Opinion specified the following reasonable and prudent measures (RPMs).

The EPA shall:

1. Minimize the potential for mixture toxicity in discharges.
2. Minimize the potential adverse effects that occur when discharging under NPDES permits.
3. Minimize exposure of aquatic life to pentachlorophenol.
4. Use updated procedures for calculating any WERs developed for determining discharge limits.
5. Ensure completion of a monitoring and reporting program to confirm that the terms and conditions in this incidental take statement are effective in avoiding and minimizing incidental take from permitted activities and ensure the amount of incidental take is not exceeded.

The NMFS Opinion specified the following terms and conditions:

> To implement RPM #1, the Opinion specifies that the EPA shall calculate the cumulative criterion units (CCU) to be allowed in the receiving waters. CCU are defined for this purpose as $CCU = \Sigma (C_d \div CCC)$ where C_d is the projected authorized concentration in the fully mixed receiving waters downstream of the effluent discharge and the CCC is the applicable chronic criterion concentration of each regulated constituent calculated for that location. If discharges and the permit limits are authorized such that greater than 1 CCU would be calculated to be allowed in receiving waters, then WET testing and biomonitoring consistent with Appendix E to the NMFS Opinion shall be included in the permit provisions.
>
> For the Grouse Creek Unit permit, greater than 1 CCU is authorized in the receiving waters for both outfalls and all flow tiers. The permit requires WET testing for both outfalls and biomonitoring of the receiving waters, consistent with RPM #1 and Appendix E to the NMFS Opinion.

> To implement RPM #2, the Opinion specifies that, for existing discharges that include silver, nickel and zinc, a zone of passage shall be ensured. If the regulatory mixing zone is limited to less than or equal to 25 percent of the volume of the stream, then sufficient zone of passage is presumed to be present. As discussed above, the regulatory mixing zone for all chemical specific parameters is less than or equal to 25 percent of the volume of the stream. Furthermore, CORMIX modeling shows that the mixing zones are small and do not span the stream channels.
>
> The Opinion also specifies that, to implement RPM #2, the conservative assumptions described in Appendix D to the Opinion shall be applied when calculating effluent limits. In developing the effluent limits for the Grouse Creek Unit, the EPA applied conservative assumptions as described in Appendix D to the Opinion, including assuming only a portion of the stream and using the maximum permitted discharge volumes to calculate dilution. In general, the effluent limits in the Grouse Creek Unit are tiered based on stream flow and thus not based on critical low flows as described in Appendix D. However, discharge limits were calculated for critical flow conditions (i.e., maximum effluent flow and minimum stream flow) within each flow tier. The flow-tiered limits also provide certainty that the assumptions upon which the effluent limits were calculated are, in fact, valid.
>
> The Grouse Creek Unit is not a source of pentachlorophenol; thus, RPM #3 is inapplicable to the Grouse Creek Unit permit.
>
> No water effect ratios have been used in the development of the Grouse Creek Unit permit, therefore, RPM #4 is inapplicable to the Grouse Creek Unit permit.
>
> To implement RPM #5, the EPA shall perform certain monitoring and reporting "each time a new NPDES permit is issued that discharges a toxic substance evaluated in this Opinion into waters containing Snake River salmon or steelhead or their critical habitat." Specifically, the EPA shall provide a copy of the NPDES permit issued to the facility and calculate the total area of mixing zones granted for the new permit and for existing permits that discharge a toxic substance into waters occupied by listed salmon or steelhead. In addition, the EPA is to require biomonitoring consistent with Appendix E to the NMFS Opinion.
>
> Consistent with RPM #5, the EPA has notified NMFS and Service of the availability of draft permits for this facility and provided copies of the draft permits to NMFS and the Service. Mixing zones are described in Section 2.5.1.1.3 of this Opinion. The draft permit requires biomonitoring of the receiving waters consistent with Appendix E to the NMFS opinion.

Appendix E to the NMFS opinion states that, when biomonitoring is necessary to implement RPAs or RPMs, sampling for tissue residues of arsenic in benthic invertebrate prey organisms and selenium in juvenile salmonids and sculpins is to be performed. As explained above, the EPA does not believe that tissue monitoring for arsenic or selenium is necessary or appropriate for the Grouse Creek Unit permit.

As explained above, the interim RPA for arsenic in the NMFS Opinion is to implement the State of Idaho's human health criterion for arsenic (10 µg/L). The maximum measured concentration of arsenic in the effluent was 6.7 µg/L, the arithmetic mean effluent concentration was 2.7 µg/L, and the standard deviation was 1.3 µg/L. In the 2016 Fact Sheet, the EPA performed a reasonable potential analysis using the 99th percentile of the effluent data, which resulted in a

reasonable potential multiplying factor of 2.16, and, in turn, a maximum projected effluent concentration of 14.5 µg/L. Although the maximum projected effluent concentration exceeded the 10 µg/L human health criterion, the concentration of arsenic would be less than 10 µg/L at the edges of the mixing zones for both outfalls and all flow tiers. Thus, the EPA concluded that the discharges do not have the reasonable potential to cause or contribute to excursions above Idaho's human health water quality criterion for arsenic.

In addition, Section 3.3.2 of the TSD states that, "although (the 99th percentile) does represent a measure of the upper bound of an effluent distribution, other percentiles could be selected by a regulatory agency." Using the 95th percentile effluent concentration instead of the 99th yields a reasonable potential multiplying factor of about 1.4 (see the TSD at Table 3-2), and a maximum projected effluent concentration of 9.4 µg/L. Thus, there is less than a 5 percent probability that the effluent concentration of arsenic will exceed 10 µg/L at the end of the pipe. Because of the low concentration of arsenic in the discharges, the EPA has not required monitoring for arsenic in benthic invertebrate prey organisms.

As explained above, fish tissue monitoring for selenium may be required as part of the interim RPA for selenium. However, tissue monitoring is required under the interim RPA only if concentrations of selenium at the edge of the mixing zone are higher than 2 µg/L as an annual geometric mean. In this case, the geometric mean effluent concentrations of selenium are less than 2 µg/L at the end of pipe, for both outfalls, and will be even lower at the edge of the mixing zone. Thus, fish tissue monitoring for selenium is not necessary under the interim RPA. Since fish tissue monitoring for selenium is not required under the interim RPA due to low effluent concentrations of selenium, the EPA has not required fish tissue monitoring for selenium.

2.1.2.7 Other Management Actions

The following actions are included in the draft final permit. Most monitoring actions are similar to those that were required in the 2002 permit. A change from the 2002 permit is that monitoring for cadmium, cyanide, silver, dissolved oxygen, and TSS will be will be discontinued in Jordan Creek as monitored concentrations indicate no water quality concerns (see the Fact Sheets).

See the draft permit and Fact Sheets for more details.

1. Effluent monitoring: The permit requires effluent monitoring for outfalls 002 and 003 on the limited parameters. The permit includes additional monitoring for other parameters of potential concern such as arsenic for the purpose of effluent characterization (see Tables 3 and 4 of the 2016 Fact Sheet (EPA 2016a)).
2. WET monitoring: In order to determine compliance with the WET effluent limit and determine potential toxic effects of the discharge, the draft final permit requires annual acute WET testing and quarterly chronic WET testing of effluent from outfall 002 and outfall 003.
3. Fish population monitoring: The permit requires that fish population data must be collected every years unless there are data from external sources (e.g. Idaho Department of Environmental Quality (IDEQ) BURP data, Idaho Department of Fish and Game (IDFG) population sampling) that are sufficient for evaluating changes in the fish assemblage in the receiving water, specifically, if the results indicate significant differences between upstream and downstream stations or declining trends over time.

Electrofishing is the primary sampling method for collecting these data. As described in Section 2.5.1.1.3 of this Opinion, the harmful effects to fish from electrofishing are well known. The permit has stipulations to minimize possible impacts to fish from electrofishing. These include following NMFS' Electrofishing Guidance (NMFS 2000), conforming to all stipulations on the required state collection permit, sampling at times to avoid affecting sensitive life stages, and training field personnel to recognize and avoid redds.

4. Receiving water monitoring: for both Jordan Creek and Yankee Fork, the draft permit requires surface water monitoring four times per year for ammonia, conductivity, copper, dissolved organic carbon, lead, mercury, selenium, zinc, ammonia, nitrate + nitrite, pH, selenium, turbidity and hardness both upstream and downstream of the outfalls. Also, continuous monitoring of temperature is required upstream and downstream of the outfalls from May through October.

5. Best Management Practices (BMP) Plan: Best management practices (BMPs) are measures that are intended to prevent or minimize the generation and the potential for release of pollutants from industrial facilities to waters of the U.S. The draft final permit requires Hecla to prepare and implement a BMP Plan to minimize the quantity of pollutants discharged, reduce the toxicity of the discharges to the extent practicable, prevent the entry of pollutants into waters, and minimize storm water contamination. See Section II of the permit for more details regarding the BMP requirements. Hecla's 2014 BMP Plan addresses the following practices: (1) Storage of petroleum products and water treatment plant (WTP) reagents, (2) preventative maintenance, (3) inspections, (4) security, (5) employee training, and (6) recordkeeping and reporting. The BMP Plan also specifically addresses sludge removal and disposal. Sludge is waste material (e.g., flocculated metals) generated as part of the water treatment process. According to the BMP Plan, removed sludge is first dewatered through a filter press. The resultant filter cake is then collected and transported to lined containment ponds where it is spread and compacted. All runoff from the containment ponds is routed to the WTP. Hecla routinely tests the sludge following the toxicity characteristic leachate procedure to determine if it is a hazardous waste.

6. Quality Assurance Plan (QAP): The draft final permit requires the development and implementation of a Quality Assurance Plan (QAP) to ensure that monitoring data is accurate and to explain data anomalies if they occur. Other provisions of the draft permit require Hecla to use analytical methods that can achieve method detection limits less than the effluent limits (for the effluent monitoring) and less than the water quality criteria (for the receiving water monitoring). The QAP must specify analytical methods to achieve these method detection limits.

2.2 Analytical Framework for the Jeopardy and Adverse Modification Determinations

2.2.1 Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components:

1. The *Status of the Species*, which evaluates the bull trout's rangewide condition, the factors responsible for that condition, and its survival and recovery needs.
2. The *Environmental Baseline*, which evaluates the condition of the bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the bull trout.
3. The *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the bull trout.
4. *Cumulative Effects*, which evaluates the effects of future, non-Federal activities reasonably certain to occur in the action area on the bull trout.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the bull trout's current status, taken together with cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the bull trout in the wild.

Recovery Units (RUs) for the bull trout were defined in the final *Recovery Plan for the Coterminus United States Population of [the] Bull Trout* (USFWS 2015a). Pursuant to Service policy, when a proposed Federal action impairs or precludes the capacity of a RU from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the Biological Opinion describes how the proposed action affects not only the capability of the RU, but the relationship of the RU to both the survival and recovery of the listed species as a whole.

The jeopardy analysis for the bull trout in this Biological Opinion considers the relationship of the action area and affected core areas (discussed below under the *Status of the Species* section) to the RU and the relationship of the RU to both the survival and recovery of the bull trout as a whole as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Within the above context, the Service also considers how the effects of the proposed Federal action and any cumulative effects impact bull trout local and core area populations in determining the aggregate effect to the RU(s). Generally, if the effects of a proposed Federal action, taken together with cumulative effects, are likely to impair the viability of a core area population(s) such an effect is likely to impair the survival and recovery function assigned to a RU(s) and may represent jeopardy to the species (USFWS 2005a, 70 FR 56258).

2.2.2 Adverse Modification Determination

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

The destruction or adverse modification analysis in this Opinion relies on four components:

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

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

Note: Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical and biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations (USFWS and NMFS 2016, 81 FR 7214) discontinue use of the terms "PCEs" or "essential features" and rely exclusively on use of the term PBFs for that purpose because that term is contained in the statute. To be consistent with that shift in terminology and

in recognition that the terms PBFs, PCEs, and essential habit features are synonymous in meaning, we are only referring to PBFs herein. Therefore, if a past critical habitat designation defined essential habitat features or PCEs, they will be referred to as PBFs in this document. This does not change the approach outlined above for conducting the ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features.

2.3 Status of the Species and Critical Habitat

This section presents information about the regulatory, biological and ecological status of the bull trout and its critical habitat that provides context for evaluating the significance of probable effects caused by the proposed action.

2.3.1 Bull Trout

2.3.1.1 Listing Status

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (USFWS 1999, 64 FR 58910-58933). The threatened bull trout 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. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Howell and Buchanan 1992, entire; Leary and Allendorf 1997, pp. 716-719; USFWS 1999, 64 FR 58910).

The final listing rule for the United States coterminous population of the bull trout discusses the consolidation of five Distinct Population Segments (DPSs) into one listed taxon and the application of the jeopardy standard under section 7 of the Endangered Species Act (Act) relative to this species, and established five interim recovery units for each of these DPSs for the purposes of Consultation and Recovery (USFWS 1999, 64 FR 58930).

The 2010 final bull trout critical habitat rule (USFWS 2010a, 75 FR 63898-64070) identified six draft recovery units based on new information that confirmed they were needed to ensure a resilient, redundant, and representative distribution of bull trout populations throughout the range of the listed entity. The final bull trout recovery plan (RP) (USFWS 2015a, pp. 36-43) formalized these six recovery units: Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Saint Mary, and Upper Snake. The final recovery units replace the previous five interim recovery units and will be used in the application of the jeopardy standard for section 7 consultation procedures.

2.3.1.2 Reasons for Listing and Emerging Threats

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are

pulled through a diversion or other device) into diversion channels; and introduced non-native species (USFWS 1999, 64 FR 58910).

Since the time of coterminous listing the species (64 FR 58910) and designation of its critical habitat (USFWS 2004a, 69 FR 59996; USFWS 2005a, 70 FR 56212; USFWS 2010a, 75 FR 63898) a great deal of new information has been collected on the status of bull trout. The Service's Science Team Report (Whitesel et al. 2004, entire), the bull trout core areas templates (USFWS 2005a, entire; 2009, entire), Conservation Status Assessment (USFWS 2005b, entire), and 5-year Reviews (USFWS 2008, entire; 2015h, entire) have provided additional information about threats and status. The final RP lists many other documents and meetings that compiled information about the status of bull trout (USFWS 2015a, p. 3). As did the prior 5-year review (2008), the 2015 5-year status review maintains the listing status as threatened based on the information compiled in the final bull trout RP (USFWS 2015a, entire) and the Recovery Unit Implementation Plans (RUIPs) (USFWS 2015b-g, entire).

When first listed, the status of bull trout and its threats were reported by the Service at subpopulation scales. In 2002 and 2004, the draft recovery plans (USFWS 2002a, entire; 2004a, entire; 2004b, entire) included detailed information on threats at the recovery unit scale (i.e., similar to subbasin or regional watersheds), thus incorporating the metapopulation concept with core areas and local populations. In the 5-year Reviews, the Service established threats categories (i.e., dams, forest management, grazing, agricultural practices, transportation networks, mining, development and urbanization, fisheries management, small populations, limited habitat, and wild fire) (USFWS 2008, pp. 39-42; USFWS 2015h, p. 3). In the final RP, threats and recovery actions are described for 109 core areas, forage/migration and overwintering areas, historical core areas, and research needs areas in each of the six recovery units (USFWS 2015a, p 10). Primary threats are described in three broad categories: Habitat, Demographic, and Nonnative Fish for all recovery areas within the coterminously listed range of the species.

The 2015 5-year status review references the final RP and the RUIPs and incorporates by reference the threats described therein (USFWS 2015h, pp. 2-3). Although significant recovery actions have been implemented since the time of listing, the 5-year review concluded that the listing status should remain as "threatened" (USFWS 2015h, p. 3).

New or Emerging Threats

The 2015 RP (USFWS 2015a, entire) describes new or emerging threats such as climate change and other threats. Climate change was not addressed as a known threat when bull trout was listed. The 2015 bull trout RP and RUIPs summarize the threat of climate change and acknowledge that some bull trout local populations and core areas may not persist into the future due to anthropogenic effects such as climate change. The RP further states that 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 2015a, pp. vii, 17-20).

Mote et al. (2014, pp. 487-513) summarized climate change effects in the Pacific Northwest to include rising air temperature, changes in the timing of streamflow related to changing snowmelt, increases in extreme precipitation events, lower summer stream flows, and other changes. A warming trend in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, reduce summer stream flows, and increase summer water temperatures (Poff et al. 2002, p. 34; Koopman et al. 2009, entire; Point Reyes Bird Observatory

(PRBO) Conservation Science 2011, p. 13). Lower flows as a result of smaller snowpack could reduce habitat, which might adversely affect bull trout reproduction and survival. Warmer water temperatures could lead to physiological stress and could also benefit nonnative fishes that prey on or compete with bull trout. Increases in the number and size of forest fires could also result from climate change (Westerling et al. 2006, p. 940) and could adversely affect watershed function by resulting in faster runoff, lower base flows during the summer and fall, and increased sedimentation rates. Lower flows also may result in increased groundwater withdrawal for agricultural purposes and resultant reduced water availability in certain stream reaches occupied by bull trout (USFWS 2015c, p. B-10).

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 (Rieman et al. 2007, p. 1552). Climate change is expected to reduce the extent of cold water habitat (Isaak et al. 2015, p. 2549, Figure 7), and increase competition with other fish species (lake trout, brown trout, brook trout, and northern pike) for resources in remaining suitable habitat. Several authors project that brook trout, a fish species that competes for resources with and predates on the bull trout, will continue increasing their range in several areas (an upward shift in elevation) due to the effects from climate change (e.g., warmer water temperatures) (Wenger et al. 2011, p. 998, Figure 2a, Isaak et al. 2014, p. 114).

2.3.1.3 Species Description

Bull trout, member of the family Salmonidae, are char native to the Pacific Northwest and western Canada. The bull trout and the closely related Dolly Varden (*Salvelinus malma*) were not officially recognized as separate species until 1980 (Robins et al. 1980, p. 19). Bull trout historically occurred in major river drainages in the Pacific Northwest from the southern limits in the McCloud River in northern California (now extirpated (Rode 1990, p. 1)), Klamath River basin of south central Oregon, and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, pp. 165-169; Bond 1992, pp. 2-3). To the west, the bull trout's current range includes Puget Sound, coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992, p. 2-3). East of the Continental Divide bull trout are found in the headwaters of the Saskatchewan River in Alberta and the MacKenzie River system in Alberta and British Columbia (Cavender 1978, p. 165-169; Brewin and Brewin 1997, pp. 209-216). Bull trout are wide spread throughout the Columbia River basin, including its headwaters in Montana and Canada.

2.3.1.4 Life History

Bull trout exhibit resident and migratory life history strategies throughout much of the current range (Rieman and McIntyre 1993, p. 2). Resident bull trout complete their entire life cycle in the streams where they spawn and rear. Migratory bull trout spawn and rear in streams for 1 to 4 years before migrating to either a lake (adfluvial), river (fluvial), or, in certain coastal areas, to saltwater (anadromous) where they reach maturity (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Resident and migratory forms often occur together and it is suspected that individual bull trout may give rise to offspring exhibiting both resident and migratory behavior (Rieman and McIntyre 1993, p. 2).

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993, p. 4). Watson and Hillman (1997, p. 248) concluded that watersheds must have specific physical characteristics to provide habitat requirements for bull trout to successfully spawn and rear. It was also concluded that these characteristics are not necessarily ubiquitous throughout these watersheds, thus resulting in patchy distributions even in pristine habitats.

Bull trout are found primarily in colder streams, although individual fish are migratory in larger, warmer river systems throughout the range (Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2 and 1995, p. 288; Buchanan and Gregory 1997, pp. 121-122; Rieman et al. 1997, p. 1114). Water temperature above 15°C (59°F) is believed to limit bull trout distribution, which may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989, p. 133; Rieman and McIntyre 1995, pp. 255-296). Spawning areas are often associated with cold water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Goetz (1989, pp. 22, 24) suggested optimum water temperatures for rearing of less than 10°C (50°F) and optimum water temperatures for egg incubation of 2 to 4°C (35 to 39°F).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Goetz 1989, pp. 22-25; Pratt 1992, p. 6; Thomas 1992, pp. 4-5; Rich 1996, pp. 35-38; Sexauer and James 1997, pp. 367-369; Watson and Hillman 1997, pp. 247-249). Jakober (1995, p. 42) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that suitable winter habitat may be more restrictive than summer habitat. Bull trout prefer relatively stable channel and water flow conditions (Rieman and McIntyre 1993, p. 6). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 368-369).

The size and age of bull trout at maturity depend upon life history strategy. Growth of resident fish is generally slower than migratory fish; resident fish tend to be smaller at maturity and less fecund (Goetz 1989, p. 15). Bull trout normally reach sexual maturity in 4 to 7 years and live as long as 12 years. Bull trout are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, p. 95; Fraley and Shepard 1989, p. 135; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133).

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Migratory bull trout frequently begin spawning migrations as early as April, and have been known to move upstream as far as 250 kilometers (km) (155 miles (mi)) to spawning grounds (Fraley and Shepard 1989, p. 135). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p.1) and, after hatching, fry remain in the substrate. Time from egg deposition to emergence may exceed 200 days. Fry normally emerge from early April through May depending upon water temperatures and increasing stream flows (Pratt 1992, p. 1).

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up and downstream, not only for repeat spawning, but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous (fishes that spawn once and then die, and therefore require only one-way passage upstream) salmonids. 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.

Bull trout are opportunistic feeders with food habits primarily a function of size and life history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro zooplankton and small fish (Boag 1987, p. 58; Goetz 1989, pp. 33-34; Donald and Alger 1993, pp. 239-243). Adult migratory bull trout are primarily piscivores, known to feed on various fish species (Fraley and Shepard 1989, p. 135; Donald and Alger 1993, p. 242).

2.3.1.5 Population Dynamics

Population Structure

As indicated above, 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). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. 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; Starcevich et al. 2012, p. 10; Barrows et al. 2016, p. 98). 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) and Wenatchee River (Ringel et al. 2014, pp. 61-64). Parts of these river systems have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem rivers. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes.

Benefits of connected habitat 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 Service identified additional genetic units within the coastal and interior lineages (Ardren et al. 2011, pp. 519-523). Based on a recommendation in the USFWS's 5-year review of the species' status (USFWS 2008, p. 45), the Service reanalyzed the 27 recovery units identified in the 2002 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 USFWS and NMFS Distinct Population Segment (DPS) policy (USFWS and NMFS 1996, 61 FR 4722-4725) 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 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 2010a, 75 FR 63898). These six recovery units, which were identified in the final bull trout recovery plan (USFWS 2015a) and described further in the RUIPs (USFWS 2015b-g)

include: Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Saint Mary, and Upper Snake.

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).

A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meefe 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). Research does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho (Whiteley et al. 2003, entire). Whitesel et al. (2004 pp. 14-23) summarizes metapopulation models and their applicability to bull trout).

2.3.1.6 Status and Distribution

The following is a summary of the description and current status of the bull trout within the six recovery units (RUs) (shown in Figure 2, below). A comprehensive discussion is found in the Service's 2015 RP for the bull trout (USFWS 2015a, entire) and the 2015 RUIPs (USFWS 2015b-g, entire). Each of these RUs 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.

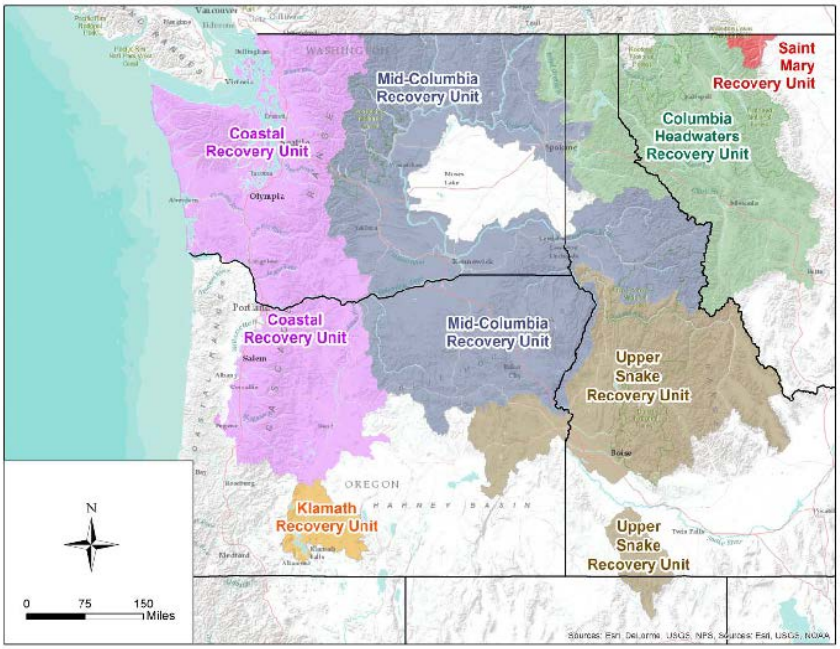

Figure 2. Map showing the location of the six bull trout Recovery Units.

Coastal Recovery Unit

The Coastal RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015b, entire). The Coastal RU is located within western Oregon and Washington. The RU is divided into three regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River Regions. This RU 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 2015a, p. 47; USFWS 2015b, p. A-2). Core areas within Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This RU also contains ten shared foraging, migrating, and overwintering (FMO) habitats which are outside core areas and allows for the continued natural population dynamics in which the core areas have evolved (USFWS 2015b, p. A-5).

There are four core areas within the Coastal RU that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River (USFWS 2015a, p.79). These are the most stable and abundant bull trout populations in the RU.

Most core areas in the Puget Sound region 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 the Puget Sound region are likely stable overall, although some at depressed abundances. 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).

Within the Olympic Peninsula region, 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).

Across the Lower Columbia River region, status is highly variable, 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. Adult abundances within the majority of core areas in this region are relatively low, generally 300 or fewer individuals.

The current condition of the bull trout in this RU 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 in-stream 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, in-stream 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.

The RP identifies three categories of primary threats[1]: Habitat (upland/riparian land management, in-stream impacts, water quality), demographic (connectivity impairment, fisheries management, small population size), and nonnatives (nonnative fishes). Of the 20 core areas in the Coastal RU, only one (5 percent), the Lower Deschutes River, has no primary threats identified (USFWS 2015b, Table A-1).

Conservation measures or recovery actions implemented in this RU 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

[1] Primary Threats are factors known or likely (i.e., non-speculative) to negatively impact bull trout populations at the core area level, and accordingly require actions to assure bull trout persistence to a degree necessary that bull trout will not be at risk of extirpation within that core area in the foreseeable future (4 to 10 bull trout generations, approximately 50 years).

important nearshore marine habitats. For more information on conservation actions see section 2.3.1.8 below.

Klamath Recovery Unit

The Klamath RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015c, entire). This RU is located in southern Oregon and northwestern California. The Klamath RU is the most significantly imperiled RU, 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 2015a, p. 39). This RU currently contains three core areas and eight local populations (USFWS 2015a, p. 47; USFWS 2015c, p. B-1). Nine historic local populations of bull trout have become extirpated (USFWS 2015c, p. B-1). All three core areas have been isolated from other bull trout populations for the past 10,000 years (USFWS 2015c, p. B-3).

The current condition of the bull trout in this RU 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. Identified primary threats for all three core areas include upland/ riparian land management, connectivity impairment, small population size, and nonnative fishes (USFWS 2015c, Table B-1).

Conservation measures or recovery actions implemented include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for in-stream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culvert replacement, and habitat restoration. For more information on conservation actions see section 2.3.1.8 below.

Mid-Columbia Recovery Unit

The Mid-Columbia RUIP 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 Mid-Columbia RU is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia RU is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, Lower Snake, and Mid-Snake Geographic Regions. This RU contains 24 occupied core areas comprising 142 local populations, two historically occupied core areas, one research needs area, and seven FMO habitats (USFWS 2015a, p. 47; USFWS 2015d, p. C-1 – C4).

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 RU, 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. More detailed description of bull trout distribution, trends, and

survey data within individual core areas is provided in Appendix II of the RUIP (USFWS 2015d).

The current condition of the bull trout in this RU 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. Of the 24 occupied core areas, six (25 percent) have no identified primary threats (USFWS 2015d, Table C-2).

Conservation measures or recovery actions implemented include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and in-stream flow requirements. For more information on conservation actions see section 2.3.1.8 below.

Columbia Headwaters Recovery Unit

The Columbia Headwaters RUIP 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 Columbia Headwaters RU is located in western Montana, northern Idaho, and the northeastern corner of Washington. The RU is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene Geographic Regions (USFWS 2015e, pp. D-2 – D-4). This RU 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 2015e, p. D-1). Fish passage improvements within the RU have reconnected some previously fragmented habitats (USFWS 2015e, p. D-1), while others remain fragmented. Unlike the other RUs in Washington, Idaho and Oregon, the Columbia Headwaters RU does not have any anadromous fish overlap. Therefore, bull trout within the Columbia Headwaters RU do not benefit from the recovery actions for salmon (USFWS 2015e, p. D-41).

Conclusions from the 2008 5-year review (USFWS 2008, Table 1) were that 13 of the Columbia Headwaters RU core areas were at High Risk (37.1 percent), 12 were considered At Risk (34.3 percent), 9 were considered at Potential Risk (25.7 percent), and only 1 core area (Lake Koocanusa; 2.9 percent) was considered at Low Risk. Simple core areas, due to limited demographic capacity and single local populations were generally more inherently at risk than complex core areas under the model. While this assessment was conducted nearly a decade ago, little has changed in regard to individual core area status in the interim (USFWS 2015e, p. D-7).

The current condition of the bull trout in this RU 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 in-stream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e.g., logging, roads), agriculture practices (e.g. irrigation, livestock grazing), and residential development. Of the 34 occupied core areas, nine (26 percent) have no identified primary threats (USFWS 2015e, Table D-2).

Conservation measures or recovery actions implemented include habitat improvement, fish passage, and removal of nonnative species. For more information on conservation actions see section 2.3.1.8 below.

Upper Snake Recovery Unit

The action area for the proposed action is within the Upper Snake River RU.

The Upper Snake RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015f, entire). The Upper Snake RU is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake RU is divided into seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This RU contains 22 core areas and 207 local populations (USFWS 2015a, p. 47), with almost 60 percent being present in the Salmon River Region.

The population trends for the 22 core areas in the Upper Snake RU are summarized in Table E-2 of the Upper Snake RUIP (USFWS 2015f, pp. E-5 – E-7): six are classified as increasing, two are stable; two are likely stable; three are unknown, but likely stable; two are unknown, but likely decreasing; and, seven are unknown.

The current condition of the bull trout in this RU is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing). Of the 22 occupied core areas, 13 (59 percent) have no identified primary threats (USFWS 2015f, Table E-3).

Conservation measures or recovery actions implemented include in-stream habitat restoration, in-stream flow requirements, screening of irrigation diversions, and riparian restoration. For more details on conservation actions in this unit see section 2.3.1.8 below.

St. Mary Recovery Unit

The St. Mary RUIP describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015g). The Saint Mary RU 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 RU contains four core areas (St. Mary River, Slide Lake, Cracker Lake, and Red Eagle Lake), and seven local populations (USFWS 2015g, p. F-1) in the U.S. headwaters.

Current status of bull trout in the Saint Mary River complex core area (U.S.) is considered strong. The three simple core areas (Slide Lake, Cracker Lake, and Red Eagle Lake) appear to be self-sustaining and fluctuating within known historical population demographic bounds. Note: the NatureServe status assessment tool ranks this RU as imperiled (Figure 4).

The current condition of the bull trout in this RU 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, in-stream flows), and, to a lesser extent habitat impacts from development and nonnative species. Of the four core areas, the three simple core areas (all lakes) have no identified primary threats (USFWS 2015g, Table F-1).

For more information on conservation actions see section 2.3.1.8 below.

Status Summary

The Service applied the NatureServe status assessment tool[2] to evaluate the tentative status of the six RUs. The tool rated the Klamath RU as the least robust, most vulnerable RU and the Upper Snake RU the most robust and least vulnerable recovery unit, with others at intermediate values (Figure 4).

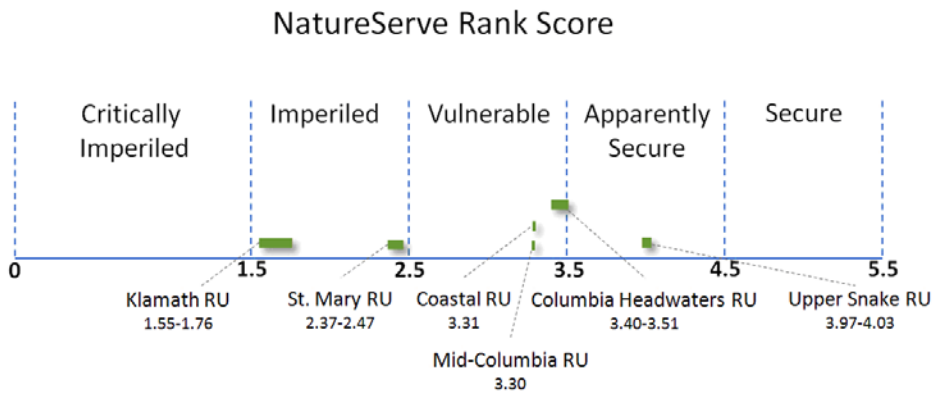

Figure 3. NatureServe status assessment tool scores for each of the six bull trout recovery units. The Klamath RU is considered the least robust and most vulnerable, and the Upper Snake RU the most robust and least vulnerable (from USFWS 2015a, Figure 2).

2.3.1.7 Conservation Needs

The 2015 RP 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 stable in six RUs; (2) effectively manage and ameliorate the primary threats in each of six RUs 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 2015a, p. 24.).

Information presented in prior draft recovery plans published in 2002 and 2004 (USFWS 2002a, entire; 2004b, entire; 2004c, entire) provided information that identified recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions

[2] This tool consists of a spreadsheet that generates conservation status rank scores for species or other biodiversity elements (e.g. bull trout Recovery Units) based on various user inputs of status and threats (see USFWS 2015, p. 8 and Faber-Langendoen et al. 2012, entire, for more details on this status assessment tool).

by our partner agencies, local working groups, and others with an interest in bull trout conservation. Many recovery actions were completed prior to finalizing the RP in 2015.

The 2015 RP (USFWS 2015a, entire) 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 coterminous range of the bull trout.

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 2015a, p. 45-46).

To implement the recovery strategy, the 2015 RP establishes three categories of recovery actions for each of the six RUs (USFWS 2015a, pp. 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 biological-based recovery units: (1) Coastal Recovery Unit; (2) Klamath Recovery Unit; (3) Mid-Columbia Recovery Unit; (4) Columbia Headwaters Recovery Unit (5) Upper Snake Recovery Unit; and (6) Saint Mary Recovery Unit (USFWS 2015a, 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 2015a, p. 33).

Each of the six recovery units contain multiple bull trout core areas, 109 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 2015a, pp. 3, 47, Appendix F). 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

2015a, p. 3). Core areas can be further described as complex or simple (USFWS 2015a, 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 habitat. 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 core area is a combination of core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) and constitutes the basic unit on which to gauge recovery within a recovery unit. Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. A core area represents the closest approximation of a biologically functioning unit for bull trout. Core areas are presumed to reflect the metapopulation structure of bull trout.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system (USFWS 2015a, 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.

2.3.1.8 Federal, State, and Tribal Conservation Actions Since Listing

Since our listing of bull trout in 1999, numerous conservation measures that contribute to the conservation and recovery of bull trout have been and continue to be implemented across its range in the coterminous United States. These measures are being undertaken by a wide variety of local and regional partnerships, including State fish and game agencies, State and Federal land management and water resource agencies, Tribal governments, power companies, watershed working groups, water users, ranchers, and landowners.

In many cases, these bull trout conservation measures incorporate or are closely interrelated with work being done for recovery of salmon and steelhead, which are limited by many of the same threats. These include removal of migration barriers (culvert removal or redesign at stream crossings, fish ladder construction, dam removal, etc.) to allow access to spawning or FMO habitat; screening of water diversions to prevent entrainment into unsuitable habitat in irrigation systems; habitat improvement (riparian revegetation or fencing, placement of coarse woody debris in streams) to improve spawning suitability, habitat complexity, and water temperature; in-stream flow enhancement to allow effective passage at appropriate seasonal times and prevent channel dewatering; and water quality improvement (decommissioning roads, implementing best management practices for grazing or logging, setting pesticide use guidelines) to minimize impacts from sedimentation, agricultural chemicals, or warm temperatures.

At sites that are vulnerable to development, protection of land through fee title acquisition or conservation easements is important to prevent adverse impacts or allow conservation actions to

be implemented. In several bull trout core areas, fisheries management to manage or suppress non-native species (particularly brown trout, brook trout, lake trout, and northern pike) is ongoing and has been identified as important in addressing effects of non-native fish competition, predation, or hybridization.

A more comprehensive overview of conservation successes since 1999, described for each recovery unit, is found in the Summary of Bull Trout Conservation Successes and Actions since 1999 (Available at: (http://www.fws.gov/pacific/ecoservices/endangered/recovery/documents/USFWS_2013_summary_of_conservation_successes.pdf).

2.3.1.9 Consulted-on Effects

Consulted-on effects are those effects that have been analyzed through Section 7 consultation as reported in a Biological Opinion. These effects are an important component of objectively characterizing the current condition status of the species.

Projects subject to section 7 consultation under the Act have occurred throughout the range of bull trout. Singly or in aggregate, these projects could affect the species' status. The Service reviewed 137 opinions produced by the Service from the time of listing in June 1998 until August 2003 (Nuss 2003, entire). The Service analyzed 24 different activity types (e.g., grazing, road maintenance, habitat restoration, timber sales, hydropower, etc.). Twenty opinions involved multiple projects, including restorative actions for bull trout.

The geographic scale of projects analyzed in these opinions varied from individual actions (e.g., construction of a bridge or pipeline) within one basin, to multiple-project actions, occurring across several basins. Some large-scale projects affected more than one recovery unit.

The Service's assessment of opinions from the time of listing until August 2003 (137 opinions), confirmed that no actions that had undergone section 7 consultation during this period, considered either singly or cumulatively, would appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any (sub) populations (USFWS 2006, pp. B-36 – B-37).

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

Since July 2006, a review of the data in our national Tracking and Integrated Logging System (TAILS) reveal this trend has changed. One Biological Opinion, the Idaho Water Quality Standards for Numeric Water Quality Criteria for Toxic Pollutants completed in 2015 (USFWS 2015i) resulted in a "Jeopardy" determination and issued Reasonable and Prudent Alternatives.

2.3.2 Bull Trout Critical Habitat

2.3.2.1 Legal Status

Ongoing litigation resulted in the U.S. District Court for the District of Oregon granting the Service a voluntary remand of the 2005 critical habitat designation. Subsequently the Service published a proposed critical habitat rule on January 14, 2010 (USFWS 2010b, 75 FR 2270) and a final rule on October 18, 2010 (USFWS 2010a, 75 FR 63898). The rule became effective on November 17, 2010. A justification document was also developed to support the rule (USFWS 2010c, entire). The scope of the designation involved the species' coterminous range within the Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Upper Snake, and St. Mary recovery units[3].

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles in 32 critical habitat units (CHU) as bull trout critical habitat (see Table 11). Designated bull trout critical habitat is of two primary use types: (1) spawning and rearing (SR); and (2) foraging, migrating, and overwintering (FMO).

Table 11. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

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	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	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	**19,729.0**	**31,750.8**	**488,251.7**	**197,589.2**

Compared to the 2005 designation, the final rule 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.

This 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

[3] Note: the adverse modification analysis does not rely on recovery units.

unoccupied areas often include lower mainstem 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, 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 2010a,75 FR 63898). 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 CHU text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

2.3.2.2 Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63943). 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.

As previously noted, 32 CHUs within the geographical area occupied by the species at the time of listing are designated under the final 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 PBFs 5 and 6, which relate to breeding habitat (see list below).

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 (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 (MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, migrating, and overwintering.

In determining which areas to propose as critical habitat, the Service considered the physical and biological features that are essential to the conservation of bull trout and that may require special management considerations or protection. These features are the PBFs laid out in the appropriate quantity and spatial arrangement for conservation of the species. The PBFs of designated critical habitat are:

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 to 15 degrees Celsius (°C) (36 to 59 degrees Fahrenheit (°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 departures 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 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.

2.3.2.3 Current Rangewide Condition of Bull Trout Critical Habitat

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 (USFWS 2002b, 67 FR 71240). This condition reflects the condition of bull trout habitat.

The primary land and water management activities impacting the physical and biological features essential to the conservation of bull trout include timber harvest and road building, agriculture and agricultural diversions, livestock grazing, dams, mining, urbanization and residential development, and nonnative species presence or introduction (USFWS 2010b, 75 FR 2282).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PBFs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows:

1. Fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7).
2. Degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45).
3. The introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76).
4. In the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development.
5. Degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

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

2.4 Environmental Baseline of the Action Area

This section assesses the effects of past and ongoing human and natural factors that have led to the current status of the species, its habitat and ecosystem in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have already undergone section 7 consultations, and the impacts of state and private actions which are contemporaneous with this consultation.

2.4.1 Bull Trout

2.4.1.1 Status of the Bull Trout in the Action Area

The Yankee Fork and Jordan Creek are located in the Upper Salmon River core area within the Upper Snake River RU. This core area is located in Custer County, Idaho and encompasses the fourth field Hydrologic Unit that extends from the mouth of the Pahsimeroi River to the headwaters in the Sawtooth Mountains, including the mainstem Salmon River and tributaries. Eighty-nine percent of this core area is in public ownership, and most of this public land is managed by the Federal government.

In the Upper Salmon River core area, bull trout are currently known to use spawning and rearing habitat in at least 18 streams or stream complexes (i.e., local populations), including the Yankee Fork.

The Snake River RUIP identified no primary threats to bull trout in the Upper Salmon River core area. However, the 5-year status review found that the core area was at “Potential Risk” because of threats that were moderate and imminent (USFWS 2008, p. 34).

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 core area (USFWS 2015f, p. E-2).

Within the action area, bull trout use FMO habitat in Jordan Creek and the Yankee Fork; the action area does not contain bull trout spawning and rearing (SR) habitat. According to the U.S. Bureau of Reclamation (USBR 2012), “Information on bull trout population productivity and abundance in the Yankee Fork watershed is currently limited and considered a data gap.” However, the BE contains fish monitoring data for both Jordan Creek and the Yankee Fork as shown in Tables 11 and 12.

Bull Trout in Jordan Creek

Jordan Creek supports a small resident population of bull trout. Based on sampling from 1981-2013, bull trout are not abundant in Jordan Creek. During annual electrofishing sampling from 1997-2013, the capture of bull trout has continued to be infrequent and differences between captures above and below outfall 002 are not significant (Table 11). The bull trout present are either juveniles or resident adults with size ranging from 88 to 282mm (GEI 2014a, Table 2). Gamet and Bartel (2008, pp. 17, 42) report that no bull trout were captured at three sampling sites in Jordan Creek in 2006 (one site was located near outfall 002).

The presence of small numbers of bull trout both upstream and downstream of the outfall in most of the years surveyed since 2000 indicate that Outfall 002 is having no apparent adverse effect on the limited bull trout population in this reach of Jordan Creek (GEI 2015a, p. 5-9).

Table 11. Jordan Creek fish monitoring data 1997-2014 (modified from BE Table 8).

Year	Site S-6 (above outfall 002)[1]	Site S-4 (below outfall 2)[2]
1997	0	0
1998	0	0
1999	0	0
2000	1	0
2001	2	3
2002	0	1
2003	0	0
2004	2	0
2005	2	2
2006	1	0
2007	0	2
2008	1	0
2009	0	1
2010	1	0
2011	0	0
2012	1	3
2013	5	1
2014	1	2

1 = S-6 located above outfall 002 near Grouse Creek confluence appears to be physically unaffected by historical placer and hydraulic mining activities that once occurred at this location.
2 = S-4 located below outfall 002, just below Washout Creek confluence.
Note: Because bull trout could not be individually identified during monitoring (i.e., they were not tagged or otherwise marked), the actual number of bull trout documented in Jordan Creek may be lower than the numbers shown in Table 11 as some fish were probably captured and counted in multiple years.

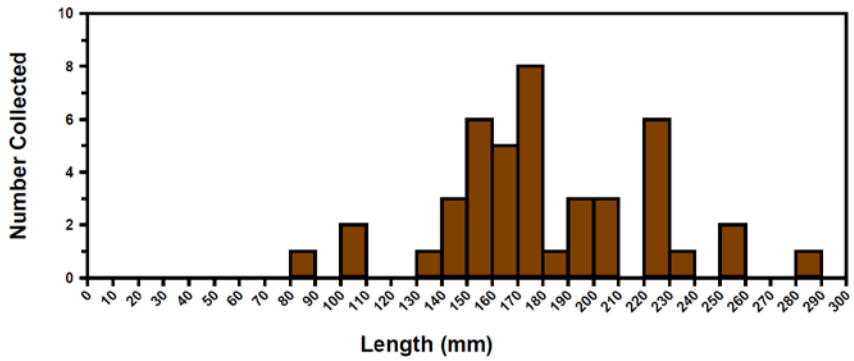

Figure 4 Length-frequency histogram for bull trout collected from all sampling sites on Jordan Creek, Idaho, from 1997 through 2012 (GEI 2015a, Figure 5-4).

Bull Trout in the Yankee Fork

The main fork of the Yankee Fork provides FMO habitat for bull trout. Spawning and early rearing occurs in the headwater streams where habitat and temperature conditions are more favorable. Electrofishing surveys between 2006 and 2008 collected only four bull trout (all in 2007) which ranged in size from 140 to 200 millimeters. This, as well as survey data collected from the Salmon-Challis National Forest Fisheries database, indicates that 95 percent of the bull trout occupancy is located in the upper watershed of the Yankee Fork (BPA 2017, entire).

Limited data on bull trout collected at a screw trapping location below Pole Flat indicate that juvenile bull trout primarily migrate through the lower Yankee Fork in September and October, and adults migrate in July and August (BPA 2017, entire).

The SBT operate a PIT tag detection array as part of a research effort, which was approved by the Service and NMFS in 2012. The array is located at approximately RM 3, about halfway between the proposed Yankee Fork weir facility and the confluence of the Yankee Fork and the Salmon River. PIT tag array detections are shown by month for the period of record, 2012 to 2016 (Table 12). It is not possible to determine if detections correspond to movements upstream or downstream. The PIT tag data do indicate that bull trout activity at the array is highest from June through September, and much lower from October through March.

Table 12. Summary of Bull Trout PIT Tag Detections in the Lower Yankee Fork, 2012–2016 (from BPA 2017, Table 4).

Months	Total	2012	2013	2014	2015	2016
January	2	0	0	2	0	0
February	7	0	1	1	0	5
March	3	0	0	0	0	3
April	2	0	2	0	0	0
May	6	0	4	2	0	0
June	65	2	24	6	16	17
July	123	19	27	28	9	40
August	77	3	35	5	9	25
September	96	8	31	19	22	16
October	32	17	13	1	1	0
November	8	4	4	0	0	0
December	1	0	1	0	0	0

The SBT have also been collecting data on bull trout passing upstream through the temporary weir that was installed on the Yankee Fork from 2008 to 2016 (Table 13). Substantial numbers of bull trout were encountered in 2013, 2014, and 2016, but numbers were low in previous years and in 2015.

Table 13. Yankee Fork Bull Trout Capture Summary, Pole Flat Weir, Yankee Fork (from BPA 2017, Table 5).

Year	Count
2008	12
2009	7
2010	2
2011	38
2012	22
2013	207
2014	136
2015	18
2016	102

2.4.1.2 Factors Affecting the Bull Trout in the Action Area

The action area has a long history of mining, both hard rock and placer, for gold, silver, lead, and zinc beginning in the 1870s. Alluvial areas of Yankee fork from Polecamp Flat (several miles downstream of Jordan Creek confluence) to about 1.5 miles of above the Jordan Creek confluence and lower 1 mile of Jordan Creek were intensively dredged for gold (Frost and Box 2009, pp. 1, 3). Numerous hard rock mines operated in the area.

Prior to 1952, the mining practice of dredging left about 7.2 miles of unconsolidated and unvegetated dredge tailings along the Yankee Fork and Jordan Creek valley floors. These tailings are located along the Yankee Fork valley bottom for about 5.8 miles and along the Jordan Creek valley bottom for about 1.4 miles. Dredge tailing mounds have disconnected tributaries and floodplains and have altered channel processes and channel form. Impacts to habitat include the isolation of perennial drainages, loss of rearing habitat and high water refugia, alteration of hydraulic conditions that result in undesirable instream high-flow conditions and loss of instream habitat diversity (USBR 2012, p. 19).

Jordan Creek

The lower 1 mile was used for dredge mining in the past and has substrate consisting of tailings (unconsolidated cobbles). Based on habitat surveys and other data, the quality of physical habitat features in Jordan Creek are summarized in Table 14. Although the habitat of Jordan Creek is in generally poor condition, there are no apparent physical habitat conditions that would preclude fish species from using the habitat in the vicinity of outfall 002.

Table 14. Habitat condition ratings in Jordan Creek from 1994 survey data.

Habitat Feature	Rating	Comment
water temperature	good	<14°C based on limited data. High altitude stream expected to be cool. Modified riparian zone, road likely have reduced stream shading.
instream cover	poor	All cover sources except for some large sized substrate (pools, LWD, bank associated cover) are low. Pocket water and turbidity are considered the most common cover type.
riparian vegetation	poor	Dredge spoils and stream adjacent roads have reduced riparian vegetation as well as reducing its interaction with the stream. Reduced riparian functions are: contribution to bank stability, moderation of stream temperature, providing cover (overhanging vegetation, roots, and undercuts).
pool frequency	poor	Pools with sufficient depth and cover to provide habitat diversity are extremely rare.
width/depth ratio	poor	Abundant coarse unconsolidated material from past instream mining has reduce depth. There is probably insufficient stream power and lack of large roughness elements for the stream to work this material into a sequence of deeper pools and shallower riffles
bank stability	poor	Eroding cutbanks contribute fine sediment.

Habitat Feature	Rating	Comment
fine sediment	poor	Bank instability, surface erosion from roads and episodic mass wasting contribute fine sediment to stream. Generally low except during storm events.

Despite the poor condition of these habitat features, Idaho's 2014 303(d)/305(b) integrated report shows that the segments of Jordan Creek that receives discharges from the Grouse Creek mine is fully supporting its designated uses (IDEQ 2017).

In addition, benthic macroinvertebrate monitoring reports in Jordan Creek (GEI 2008, p. 37) conclude that "long-term data indicate that benthic macroinvertebrate populations have been abundant and diverse, with several statistically significant increasing trends during the monitoring period since 1999, and with no apparent impact from outfall 002."

Yankee Fork

Physical and ecological processes have been negatively impacted by gold dredging operations along the Yankee Fork and at the Yankee Fork/West Fork confluence area. The Yankee Fork is now slightly straighter and more confined than it was prior to the mining activity with reduced access to the limited floodplain areas that existed. This results in higher in-stream velocities and reduced access to floodplain and side channel areas. These changes impact fish by reducing juvenile rearing and refugia habitat (USBR 2012, pp. 1-2).

The 2006 benthic macroinvertebrate monitoring data indicate abundant and diverse communities in the Yankee Fork upstream and downstream of outfall 003. All macroinvertebrate parameters analyzed were comparable between sites except that the site upstream of the outfall had significantly higher number of taxa than the site downstream. As the number of pollution-sensitive EPT taxa[4] and the relative abundance of metal-sensitive mayflies were statistically similar between the two sites, the lower total number of taxa at Site S-10 indicates that riffle habitat at the upstream site is more diverse and abundant, thus supporting a larger number of taxa. High diversity values, number of EPT taxa, and relative abundance of metal-sensitive mayflies at the sites both upstream and downstream of the outfall indicate balanced, healthy macroinvertebrate populations that are not adversely affected by the discharge from outfall 003 (GEI 2007, pp.1-2).

In Idaho's 2014 303(d)/305(b) integrated report, the segment of the Yankee Fork that receives discharges from the Grouse Creek mine is fully supporting its designated uses (IDEQ 2017).

Refer to Appendix A of this Opinion for the condition of habitat indicators in the Yankee Fork.

Summary of Habitat Conditions

- Historic placer mining activities in the Jordan Creek and Yankee Fork sub-watersheds have negatively impacted stream processes.
- Riparian conditions are at natural levels except where dredging has occurred.

[4] EPT taxa refers to three orders of aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

- Contamination from historical mining affects water quality.
- Fish passage is not hindered by man-made barriers

Restoration Actions

Many restoration projects have been implemented in the Yankee Fork drainage since the late 1980s to restore habitat and stream channel characteristics. In the late 1980s, the SBT reconnected the Yankee Fork to old dredging ponds in order to increase off-channel rearing habitat. In the mid-1990s, reclamation projects at Preacher's Cover were implemented to remove hazardous materials and stabilize the mill site in an effort to reduce risks to the Yankee Fork fisheries (IDEQ 2003). Since 2011, a number of restoration actions aimed at removing tailings, restoring floodplain connectivity, increasing off-channel rearing habitat, planting riparian vegetation, and increasing instream habitat complexity (i.e., placing large woody debris in the channel) have occurred. The environmental baseline includes effects from these actions along with the CERCLA mine closure actions completed by Hecla.

Climate Change

Changes in hydrology and temperature caused by changing climate have the potential to negatively impact aquatic ecosystems in Idaho, with salmonid fishes being especially sensitive. Average annual temperature increases due to increased carbon dioxide are affecting snowpack, peak runoff, and base flows of streams and rivers (Mote et al. 2003, p. 45). Increases in water temperature may cause a shift in the thermal suitability of aquatic habitats (Poff et al. 2002, p. iii). For species that require colder water temperatures to survive and reproduce, warmer temperatures could lead to significant decreases in available suitable habitat. Increased frequency and severity of flood flows during winter can affect incubating eggs and alevins in the streambed and over-wintering juvenile fish. Eggs of fall spawning fish, such as bull trout, may suffer high levels of mortality when exposed to increased flood flows (Independent Scientific Advisory Board (ISAB) 2007, p. iv).

Isaak et al's 2010 (p. 1350) study of changing stream temperatures over a 13 year period in the Boise River Basin estimated an 11 to 20 percent loss of suitable coldwater bull trout spawning and early juvenile rearing habitats. These results suggest that a warming climate is already affecting suitable bull trout instream habitats. This is consistent with Rieman et al. (2007) and Wenger et al. (2011) conclusions that bull trout distribution is strongly influenced by climate, and predicted warming effects could result in substantial loss of suitable bull trout habitats over the next several decades. Wenger et al. (2011) also noted that bull trout already seem to inhabit the coldest available streams in study areas, and in several watersheds bull trout do not have the potential to shift upstream with warming stream temperatures at lower elevations.

2.4.2 Bull Trout Critical Habitat

2.4.2.1 Status of Bull Trout Critical Habitat in the Action Area

Yankee Fork and Jordan Creek are located in the Upper Salmon River Critical Habitat Subunit (CHSU) within the Salmon River Basin Critical Habitat Unit (CHU).

2.4.2.1.1 Salmon River CHU

The Salmon River Basin CHU, Unit 27, is located in the Upper Snake River RU, and extends across portions of Adams, Blaine, Custer, Idaho, Lemhi, Nez Perce, and Valley counties in Idaho. This CHU includes 4,584 miles of streams and 4,161 acres of lakes and reservoirs designated as critical habitat. This CHU is the largest in the Upper Snake RU and contains the largest populations of bull trout in the RU. It supports adfluvial, fluvial, and resident bull trout. Large portions of this CHU occur within the Frank Church—River of No Return Wilderness and, as such, many of the critical habitat subunits (CHSUs) in the Salmon River Basin CHU face few threats (USFWS 2010c, p. 673).

The Salmon River Basin CHU has 10 CHSUs that provide SR and FMO habitat. Yankee Fork and Jordan Creek are located in the Upper Salmon River CHSU (USFWS 2010c, p. 671).

Upper Salmon River CHSU

The Upper Salmon River CHSU is essential to bull trout conservation because it provides a rare adfluvial life history expression in the Upper Snake RU. It contains many individuals, a large amount of habitat, and few threats. This CHSU contains populations that contain fluvial life history expressions that are important in the long-term recovery of the species (USFWS 2010c, p.779).

Located within Custer County in east-central Idaho, including the towns of Challis, Idaho, and Stanley, Idaho, designated critical habitat in this CHSU includes 1,135.5 km (705.6 mi) of streams and 1,256.3 ha (3,104.2 ac) of lake surface area.

Yankee Fork from its confluence with the Salmon River upstream 9 miles to its confluence with Jordan Creek contains FMO habitat, and from its confluence with Jordan Creek upstream 20 miles to its headwaters provides SR habitat (USFWS 2010c, pp. 780-781). Outfall 003 on Yankee Fork is located in FMO habitat.

Jordan Creek from its confluence with Yankee Fork upstream 6.4 km (4.0 mi) to an unnamed tributary contains FMO habitat; Jordan Creek from its confluence with an unnamed tributary upstream 6.2 km (3.9 mi) to its headwaters provides spawning and rearing habitat (USFWS 2010c, p. 781). Outfall 002 on Jordan Creek in located in FMO habitat.

2.4.2.2 Factors Affecting Bull Trout Critical Habitat in the Action Area

The same factors described above for bull trout in section 2.4.1.2 also apply to bull trout critical habitat, including climate change.

With a warming climate, thermally suitable bull trout spawning and rearing areas are predicted to shrink during warm seasons, in some cases very dramatically, becoming even more isolated from one another under moderate climate change scenarios (Rieman et al. 2007, pp. 1558–1562; Porter and Nelitz 2009, pp. 5–7). Climate change will likely interact with other stressors, such as habitat loss and fragmentation (Rieman et al. 2007, pp. 1558–1560; Porter and Nelitz 2009, p. 3); invasions of nonnative fish (Rahel et al. 2008, pp. 552–553); diseases and parasites (McCullough et al. 2009, p. 104); predators and competitors (McMahon et al. 2007, pp. 1313–1323; Rahel et al. 2008, pp. 552–553); and flow alteration (McCullough et al. 2009, pp. 106–108), rendering

some current spawning, rearing, and migratory habitats marginal or wholly unsuitable. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PBFs 1, 2, 3, 5, 7, 8 and 9.

2.5 Effects of the Proposed Action

Effects of the action considers the direct and indirect effects of an action on the listed species and/or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. These effects are considered along with the environmental baseline and the predicted cumulative effects to determine the overall effects to the species. Direct effects are defined as those that result from the proposed action and directly or immediately impact the species or its habitat. Indirect effects are those that are caused by, or will result from, the proposed action and are later in time, but still reasonably certain to occur. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation.

2.5.1 Bull Trout

2.5.1.1 Direct and Indirect Effects of the Proposed Action

The permit contains discharge limits for these potential pollutants:

- 5 metallic elements: cadmium, copper, lead, zinc, and mercury
- selenium
- cyanide (weak acid dissociable) (outfall 002 only)
- total suspended solids(TSS)
- whole effluent toxicity (WET)
- pH

Several other toxics that may be of concern for bull trout are present in the effluent. Limits were not included in the draft permit for arsenic (a metalloid), cyanide (except at outfall 002), selenium, and aluminum because the water quality-based analysis indicated that there was not ‘reasonable potential’ for these constituents to cause or contribute to an exceedance of State water quality criteria. Although the concentrations of these toxics are small they are discussed in terms of their potential effects. Finally, effects to fish as a result of population monitoring are described.

For the toxic constituents of the discharge, effects of chronic and acute toxicity are described. For the conventional pollutants (e.g., TSS, pH), the potential effects to aquatic biota or other beneficial uses are described. For descriptions of the toxicity of metal constituents refer to the Service’s Opinion for Idaho’s numeric water quality criteria (USFWS 2015i), which is incorporated by reference. Table 15 and Table 16 list the water quality criteria for the

constituents that require adjustment due to variable toxicity caused by water hardness. Note that metals with a mixing zone are cadmium, copper, lead, silver, and zinc.

Table 15. Hardness based criteria for outfall 002 (from Table 17 of the BE).

Parameter	Flow <30 CFS		Flow ≥ 30 CFS	
	Acute Criterion (µg/L)	Chronic Criterion (µg/L)	Acute Criterion (µg/L)	Chronic Criterion (µg/L)
Cadmium	1.19	0.52	1.06	0.48
Copper	14.8	10.0	23.6	15.3
Zinc	103	104	140	141
Lead	24.1	0.938	13.9	0.541
Silver	0.74	N/A	0.318	N/A

Table 16. Hardness based criteria for outfall 003 (from Table 18 of the BE).

Parameter	<15 CFS		>45 CFS		15-45 CFS	
	Acute Criterion (µg/L)	Chronic Criterion (µg/L)	Acute Criterion (µg/L)	Chronic Criterion (µg/L)	Acute Criterion (µg/L)	Chronic Criterion (µg/L)
Cadmium	1.98	1.02	1.03	0.622	1.43	0.797
Copper	14.3	9.69	10.9	7.581	10.4	7.255
Lead	22.2	0.865	13.9	0.54	15.1	0.59
Silver	0.653	N/A	0.32	N/A	0.363	N/A
Zinc	79.4	80.1	57.8	58.2	75.2	75.8

Factors Considered in the Effects Analysis

The Service considered the following in analyzing effects of the proposed action. These factors reduce the likelihood for adverse effects to bull trout.

1. The proposed action incorporates effects determinations (Table 17) and RPAs from the Service's (USFWS 2015i) and NMFS's (2014) Biological Opinions on Idaho's water quality standards (IWQS). The action also incorporates NMFS's reasonable and prudent measures and terms and conditions from the same 2014 Opinion (see Section 2.1.2.6).
2. Our analysis incorporates the Service's 2011concurrence on EPA's determination that Idaho's acute and chronic criteria for cadmium are not likely to adversely affect bull trout (USFWS 2011, *in litt*).
3. As required by the RPAs, the proposed action incorporates mixing zones for the parameters of concern, such that a zone of passage is present for migrating bull trout to access habitat up- and downstream of the two effluent outfalls.
4. The proposed action includes BMP and QA plans.
5. The proposed action includes monitoring of effluent, WET, receiving water quality, and fish populations.

6. The outfalls on Jordan Creek and the Yankee Fork are located in FMO habitat, not SR habitat. We are not expecting any bull trout spawning or the presence of more pollutant sensitive eggs, alevins, or fry at or downstream of the outfalls.

Table 17. Effects determinations from the Idaho Toxics Opinion (USFWS 2015i) for some of the parameters of concern in the proposed action.

Toxic Pollutant	Acute/Chronic	Bull Trout	Critical Habitat
Arsenic	acute	NLAA/	NLAA
	chronic	LAA	LAA
Copper	acute	LAA	LAA
	chronic	LAA	LAA
Cyanide	acute	LAA	LAA
	chronic	LAA	LAA
Lead:	acute	NLAA	NLAA
	chronic	NLAA	NLAA
Mercury:	acute	NLAA	NLAA
	chronic	LAA	LAA
Selenium:	acute	NLAA	NLAA
	chronic	LAA	LAA
Zinc	acute	LAA	LAA
	chronic	LAA	LAA
Silver	acute	LAA	LAA

Refer to the Service's Idaho Toxics Opinion (USFWS 2015i, entire) for details on toxicity and the effects analysis for the toxics shown in Table 17.

The Service's Toxic Opinion (2015) did not address aluminum, ammonia, nitrate+nitrite, TSS, or pH; these are discussed below.

2.5.1.1.3 Effects Analysis and Determinations

This section is organized into the follow subsections:

- Species with limited exposure
- Metals with effluent limits: cadmium, copper, lead, mercury, and zinc
- Metals without effluent limits: arsenic, aluminum, and silver
- Non-metals with effluent limits: WAD cyanide, Total Suspended Solids (TSS), Whole Effluent Toxicity (WET), and pH
- Non-metals without effluent limits: ammonia, nitrate-nitrite, and selenium
- Temperature
- Biomonitoring

Note: For most of these subsections, the Service relied on NMFS' expertise in aquatic toxicology as applied in their 2018 Biological Opinion on the proposed action.

Species Presence and Exposure Pathways

This subsection summarizes the information presented in Section 2.4 regarding the presence of bull trout in the permit action area and combines this information with exposure pathways of concern.

The timing of effluent discharge determines the exposure of particular life history stages for the fish species present. Both outfalls 002 and 003 have the potential to discharge during all times of the year (Figures 5 and 6). Discharge pattern is similar to the basin flow discharge characteristic of higher discharge April –June. Based on information presented in Section 2.4, the life history stages of bull trout present in the action area are as shown in Table 18. Fish species that are exposed to the effluent have two routes of exposure from direct contact (internal and external) and diet (through prey consumption).

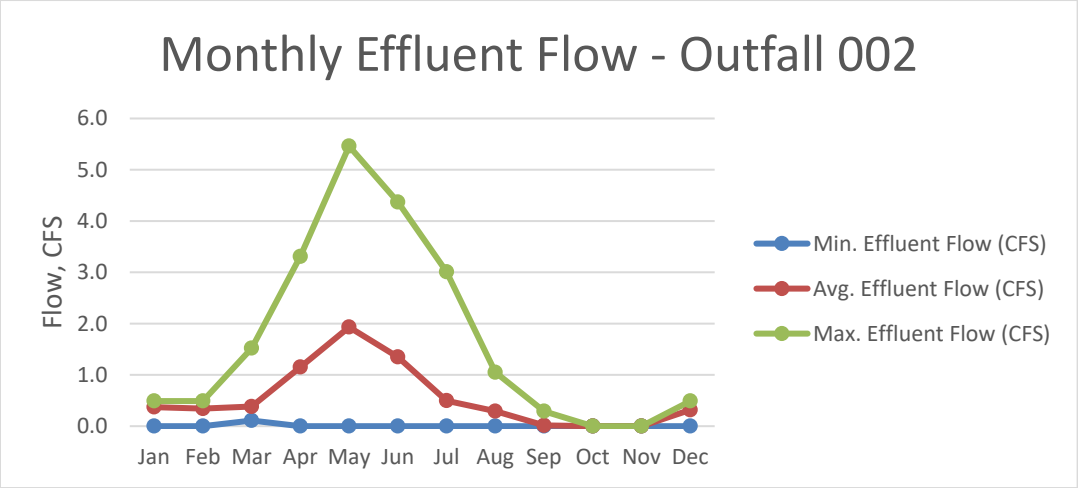

Figure 5. Outfall 002 monthly discharge based on data 2012 through February 2016 (BE Figure 10).

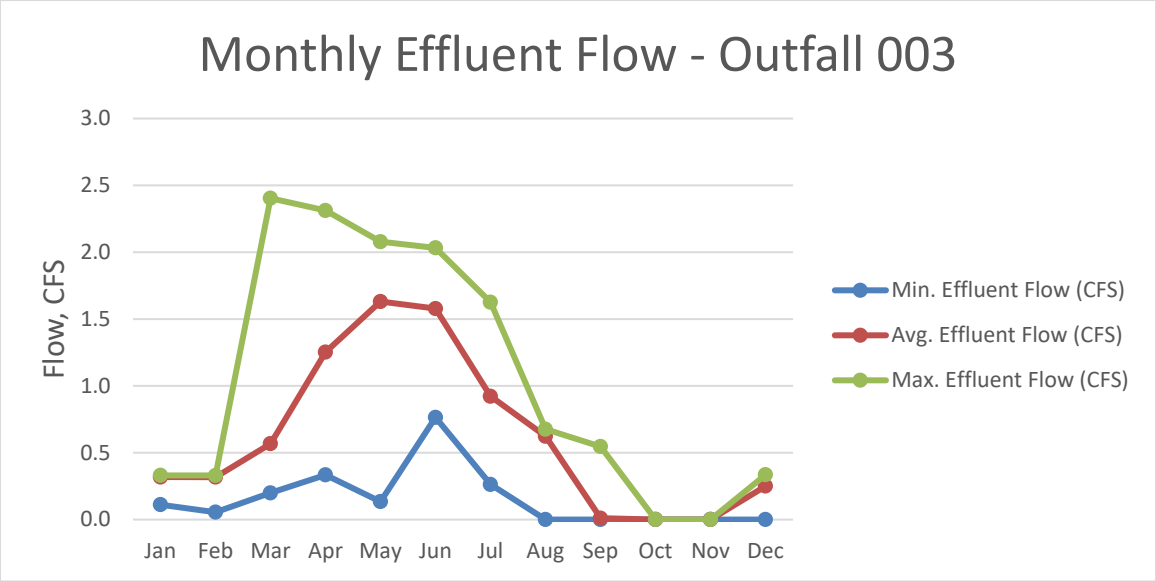

Figure 6. Outfall 003 monthly discharge based on data 2012 through February 2016 (BE Figure 11).

Table 18. Overview of likely exposure of bull trout at each outfall (BE Table 20).

Species	Jordan Creek (002)	Yankee Fork (003)	Salmon River
Bull Trout	FMO Habitat- resident bull trout	FMO Habitat – migrating adult and subadult bull trout	FMO Habitat – migrating adult and subadult bull trout

As noted previously, because the outfalls are located in FMO habitat only and not SR habitat, the Service does not expect the presence of bull trout eggs, alevins, or fry. Only migrating adults and subadults (i.e., juveniles migrating downstream from natal habitat to larger river systems or lakes) in the Yankee Fork, or adult and subadult resident bull trout moving within the same system in Jordan Creek are likely to be exposed to effluent discharges; these are the only life history stages that will be addressed in the remainder of this Opinion.

Adult and subadult migratory bull trout are not expected to experience adverse effects from exposures to elevated concentrations of contaminants near the outfalls because adults are generally more tolerant of elevated metals concentrations and more mobile (compared to alevins and fry), and there is a low likelihood that adult migrating fish will spend a significant amount of time in affected reaches (NMFS 2018).

Most fluvial subadult bull trout migrate downstream from their natal habitat to larger river systems (e.g., Salmon River) at 2 - 3 years of age and may be exposed to effluent. However, based on field observations by NMFS (2018), there appears to be little rearing habitat in the Yankee Fork below outfall 003; therefore migrating subadult bull trout are expected to move quickly through these reaches and have minimal exposure to effluent.

By definition, the resident population in Jordan Creek is non-migratory. This population spawns in headwater areas above outfall 002 and individuals are expected to move throughout Jordan Creek, provided suitable habitat is present. If suitable rearing habitat is present, individuals may occupy habitat in lower Jordan Creek before moving upstream to spawn. These fish may have multiple or prolonged exposures to outfall 002 discharges. The Jordan Creek resident population is small; an average of less than one fish per year has been collected below outfall 002 in 18 years of sampling. The relative absence of bull trout below outfall 002 further minimizes the risk of exposure and adverse effects. Finally, as described below, mixing zones for effluent discharges are required to not span the entire stream channel, which leaves a zone of passage for bull trout movement.

Metals with effluent limits: cadmium, copper, lead, mercury, and zinc

Cadmium

The acute and chronic criteria values for cadmium are 1.3 and 0.6 µg/L, respectively, as calculated from the following equations using a hardness value of 100 mg/L:

$$\text{Acute cadmium criterion } (\mu g/L) = e^{(0.8367[\ln(\text{hardness})]-3.560)} * 0.944$$

$$\text{Chronic cadmium criterion } (\mu g/L) = e^{(0.6247[\ln(\text{hardness})]-3.344)} * 0.909$$

The effluent limits for cadmium for outfalls 002 (Table 3) and 003 (Table 4) exceed the applicable acute and chronic criteria in Jordan Creek and the Yankee Fork. The effluent limits account for the authorized mixing zones that vary in size from 9 to 25 percent (Table 2). The highest allowable concentrations that are authorized to be discharged from outfalls 002 and 003 are 2.72 and 5.42 µg/L, respectively. Cadmium concentrations are expected to drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume. The maximum concentration of total cadmium measured in either outfall was 0.9 µg/L, which is more than an order of magnitude lower than the lowest effluent limitation (NMFS 2018).

NMFS (2018) reports that for Jordan Creek, mixing modeling indicates acute criteria, under the worst-case scenario for either flow tier, will be achieved within roughly 80 feet downstream of outfall 002. At this location, the regulatory mixing zone is modeled to extend approximately 3 feet into the channel. The regulatory mixing zone encompasses about 24 percent of the wetted width. The travel time to reach the downstream edge of the regulatory acute mixing zone is 53 seconds in flows less than 30 cfs and 28 seconds in flows greater than or equal to 30 cfs. The chronic regulatory mixing zone in Jordan Creek is similar to that of the acute regulatory mixing zone. Under the worst-case scenario, the dimensions of the regulatory mixing zone for the chronic cadmium criteria are about 80-feet long by 4-feet wide.

For the Yankee Fork, mixing modeling indicates acute and chronic criteria will be achieved within four feet downstream of the diffuser for all flow tiers. The full width of the regulatory mixing zone is about 10 feet, which represents anywhere from 6 to 33 percent of the wetted width, depending on the flow tier.

NMFS (2011, entire) reported acute LC_{50} values (normalized to a hardness of 50 mg/L) of 2.3 to 3.3 µg/L for Chinook salmon and 0.55 to 9.3 µg/L for rainbow trout. For chronic exposures (i.e., 53 to 120 days), Mebane et al. (2008) calculated LC_{10} values using the most comprehensive hardness-toxicity relationship (Mebane 2006). Those values ranged from 0.67 to 2.3 µg/L, as adjusted to a hardness of 50 mg/L. Scott et al. (2003) found a significant decrease in behavioral response to an alarm substance when rainbow trout were exposed to 2 µg/L cadmium for 7 days (water hardness of 120 mg/L). Short exposures (i.e., 1-day duration) to this same concentration did not elicit any change in behavior. The authors observed decreased antipredator behaviors when exposed to 0.5 µg/L cadmium for 7 days, although the response was not statistically distinguishable from controls.

NMFS (2018) determined that if cadmium is discharged in concentrations at the permit limits, cadmium will be present in localized areas within the stream at concentrations greater than those known to elicit adverse effects. If discharging at permit limits, it is possible that fish inhabiting areas near outfalls or within the centerline of the plume dilution for sufficient periods of time may experience some behavioral changes that could increase their susceptibility to predation. Within the Yankee Fork, this area is very small (no more than 40 ft^2) relative to the stream, and overlaps habitat that is not ideal for rearing. Based on observations during a NMFS field visit, habitat near the diffuser is relatively shallow, stream velocities are fast, and there did not appear to be any suitable holding habitats such as pools.

The mixing zone in Jordan Creek is modeled to be larger and has the potential to overlap more suitable rearing habitat. Once fully mixed (which is modeled to occur within 540 ft.),

concentrations are not likely to be greater than 0.3 µg/L in Jordan Creek, even if Hecla discharges at the maximum daily limit (MDL). Water quality data indicate that Hecla has not discharged concentrations of cadmium near the permit limits (NMFS 2018).

Given NMFS' (2018) analysis and the Service's (USFWS 2011, *in litt*) determination that the Idaho criteria for cadmium are not likely to adversely affect bull trout, the Service concludes that the presence of a small area of potentially elevated cadmium concentrations in the Yankee Fork is not likely to adversely affect migrating adult and subadult bull trout. The mixing zone in Jordan Creek is modeled to be larger and potentially overlaps more rearing habitat. However, because resident bull trout in Jordan Creek are present at very low densities, it is unlikely that an individual would be exposed to potentially elevated levels of cadmium. In addition, the authorized 25 percent mixing zone retains a zone of passage for migrating bull trout outside the mixing zone. The Service therefore concludes that discharges of cadmium at outfall 002 are not likely to adversely affect bull trout in Jordan Creek.

Copper

The acute and chronic criteria values for copper are 17 and 11 µg/L, respectively, as calculated from the following equations using a hardness value of 100 mg/L:

$$\text{Acute copper criterion } (\mu g/L) = e^{(0.9422[\ln(\text{hardness})]-1.464)} * 0.96$$

$$\text{Chronic copper criterion } (\mu g/L) = e^{(0.8545[\ln(\text{hardness})]-1.465)} * 0.96$$

The proposed acute and chronic criteria values for copper are also referred to as the "criterion maximum concentration" (CMC) and "criterion continuous criterion" (CCC) respectively (EPA 1985c). With copper and several other hardness-dependent aquatic life criteria, the actual criteria are defined as an equation. For example, at water hardness values of 10, 25, 50, and 250 mg/L, the acute copper criterion equation produces copper acute values of 4.6, 4.6, 8.9, and 40 µg/L. With the chronic criterion, the same water hardness values of 10, 25, 50, and 250 mg/L produce chronic criterion values of 3.5, 3.5, 6.3, and 25 µg/L. The hardness-adjusted criteria for Jordan Creek and the Yankee Fork are shown in Tables 15 and 16, respectively. The Service (USFWS 2015i) found that the acute and chronic copper criteria are likely to adversely affect bull trout.

The effluent limits for copper in outfalls 002 (Table 3) and 003 (Table 4) exceed the applicable acute and chronic criteria in Jordan Creek and the Yankee Fork. The effluent limits account for the authorized mixing zones that vary in size from 5 to 25 percent (Table 2). The highest allowable total concentration that is authorized to be discharged is 41.9 µg/L from outfall 002 and 40.3 µg/L for outfall 003. Copper concentrations are expected to drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume.

For Jordan Creek, the acute regulatory mixing zone is modeled to extend about 80 feet downstream under the worst-case scenario when discharging at the MDL for the less than 30 cfs flow tier. At this location, the regulatory mixing zone is modeled to extend approximately 3 feet into the channel. The travel time to reach the downstream edge of the regulatory acute mixing zone is 54 seconds. A much smaller mixing zone (i.e., 5 percent) was authorized for copper in the greater than 30 cfs flow tier; therefore, the acute regulatory mixing zone is distinctly smaller and only extends about 14 feet downstream and is about 2.5 feet wide. The travel time to reach

the downstream edge of the regulatory acute mixing zone is less than 5 seconds in flows greater than or equal to 30 cfs. The chronic regulatory mixing zone in Jordan Creek, when discharging at the average monthly limit (AML) under the worst-case scenario, is modeled to be about 8-feet long by 2-feet wide. The regulatory mixing zones encompass approximately 24 percent or less of the wetted width.

In the Yankee Fork, the acute and chronic regulatory mixing zones are modeled to extend no more than 3 feet downstream of the diffuser, regardless of flow tier. The regulatory mixing zone is also modeled to be less than 10 feet wide, representing between 16 and 28 percent of the channel width.

The Service (2015i) and NMFS (2018) report that copper is highly toxic to aquatic life; adverse effects are expected to occur even when concentrations are below the current water quality criteria. Reduced olfactory function, leading to diminished predator avoidance appears to be among the most sensitive endpoints. Unlike for other toxicity endpoints, hardness is not likely to ameliorate toxicity of copper relative to olfaction (Hecht et al. 2007). Sandahl et al. (2007) reported reduced olfaction function after short-term (i.e., 3-hour) exposures to copper concentrations as little as 0.18 µg/L over background (i.e., less than 3 µg/L). This exposure concentration was associated with an 8 percent reduction in predatory avoidance behavior. Hecht et al. (2007) suggested 0.59 µg/L, which was associated with a 25 percent reduction in olfactory function, is a more biologically relevant lower threshold. Reported EC_{10}[5] values for reduced growth in Chinook salmon (Chapman 1982, *in litt*) and rainbow trout (Marr et al. 1996) chronically exposed (i.e., 120 days) to elevated levels of copper were 1.9 µg/L and 2.8 µg /L, respectively.

NMFS (2018) determined that if copper is discharged in concentrations at the permit limits, copper will be present within the stream at concentrations greater than those known to elicit adverse effects. Permit limits are proposed at levels greater than 96-hour LC_{50} values reported for salmon and steelhead by NMFS (2018); however, the hardness of the effluent is expected to ameliorate much of this type of toxicity. While acutely toxic conditions are not anticipated, sublethal effects may occur. Fish temporarily exposed to concentrations of copper sufficiently greater than background levels may experience reduced olfactory function and be less capable of detecting and avoiding predators. Because copper concentrations below the existing water quality criteria may adversely affect water quality, the regulatory mixing zones do not capture the full potential extent of adverse effects. To assess the full potential extent of adverse effects, NMFS examined potential changes in downstream water quality after the effluent fully mixes with the receiving stream by using a mass balance approach and by evaluating past monitoring data. These approaches are described below.

NMFS (2018) applied the conservative assumptions utilized for permit limit development and assumed discharge concentrations equivalent to the permit limits to calculate (using a mass balance approach) that downstream copper concentrations would increase between 1.5 and 4.4 µg/L in Jordan Creek and between 0.8 and 1.9 µg/L in the Yankee Fork. These concentrations generally reflect increases above background that are greater than the lower thresholds Hecht et al. (2007) associated with reduced olfactory function. For Jordan Creek, this suggests that

[5] Concentration that causes effects to 10 percent of the test population.

additional dilution is necessary to achieve a concentration of less than or equal to 0.59 ug/L above background. For the Yankee Fork, interpretation of the CORMIX model output (assuming discharging at the AML) for the highest flow tier suggests that a concentration of 0.59 µg/L above background may be achieved within 3,704 feet of the diffuser, which is just downstream of monitoring location S-10.

NMFS (2018) examined past monitoring data to gain a better understanding of realized environmental conditions. Over the period of record, the maximum concentrations of copper measured in outfalls 002 and 003 were 20.4 and 100.8 µg/L, respectively. Since 2012, 174 effluent samples have been collected from outfall 003, and 123 samples have been collected from outfall 002 and analyzed for copper. The highest measured dissolved copper concentration in outfall 003 was 8.3 µg/L and was 9.3 µg/L in outfall 002. These concentrations are at least three times lower than the MDL and at least 1.5 times lower than the AML.

Paired monitoring of outfall 002 and Jordan Creek water quality has occurred 23 times since 2008, with seven of those events occurring after 2012 (Figure 7). During these sample events, dissolved copper concentrations in the effluent ranged from about 1 to 10 µg/L. The greatest difference between downstream and upstream concentrations was 2.1 µg/L, recorded on April 21, 2014. Interestingly, this difference occurred when discharge concentrations were relatively low in comparison to other data. Similarly, paired monitoring of outfall 003 quality and Yankee Fork water quality has occurred 28 times since 2008, with 12 of those events occurring after 2012 (Figure 8). During these sample events, dissolved copper concentrations in the effluent ranged from about 1 to 8 µg/L. The greatest difference between downstream and upstream concentrations in the Yankee Fork was 1.5 µg/L, recorded on August 5, 2013 (NMFS 2018).

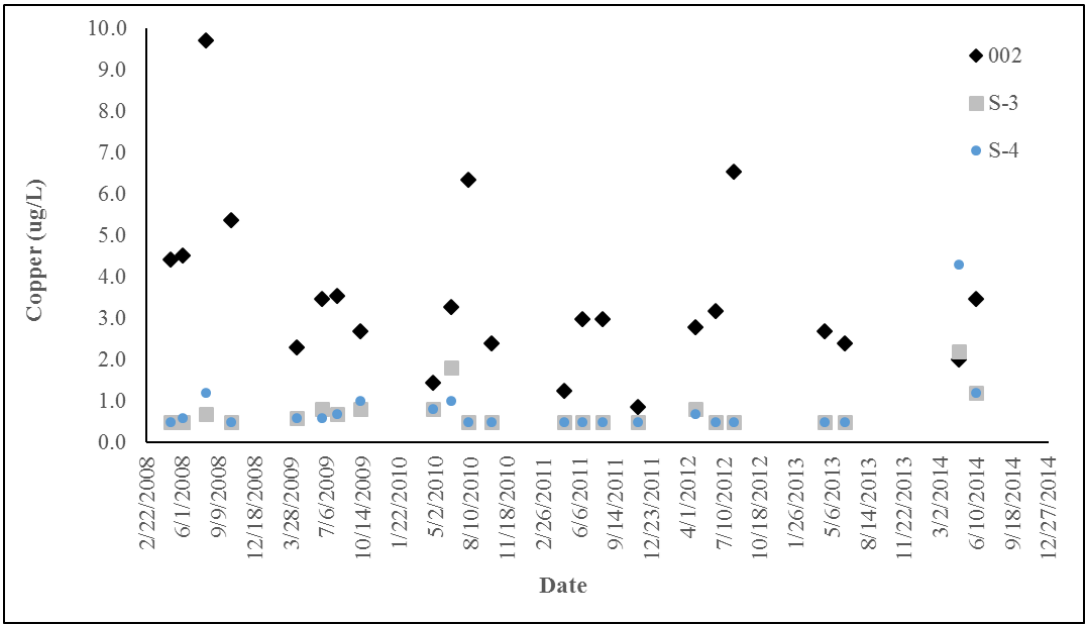

Figure 7. Dissolved copper concentrations measured in outfall 002 and Jordan Creek, upstream (S-3) and downstream (S-4) of the discharge (from NMFS 2018, Table 23).

Oftentimes, downstream concentrations were not measurably greater than upstream concentrations; however, this assessment is limited because the majority of paired samples with

no measurable difference were not detected above the detection limit (0.5 µg/L). Use of a lower detection limit would facilitate a more complete assessment. Regardless of our inability to examine potential differences for most of the data, it is reasonable to conclude that differences were less than 0.59 µg/L, with only a few exceptions. Additionally, copper concentrations in the effluent were not reliable predictors of downstream copper concentrations, suggesting other factors (other nonpoint sources, copper partitioning, etc.) may play a role in receiving water copper concentrations (NMFS 2018).

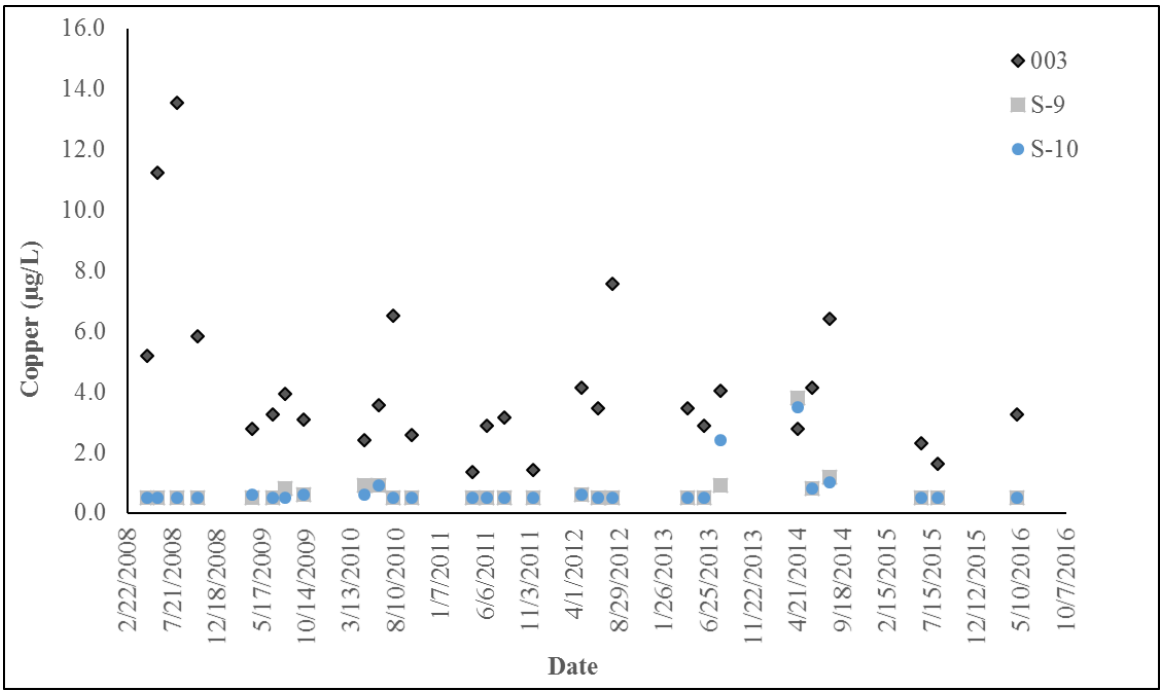

Figure 8. Dissolved copper concentrations measured in outfall 003 and Yankee Fork, upstream (S-8) and downstream (S-9) of the discharge (from NMFS 2018, Table 24).

As previously described, existing water quality data provides insight into the future effects related to discharges from these outfalls. While downstream water quality indicates some increases in copper concentrations above background have occurred, they do not reach levels calculated using a mass-balance approach while assuming conservative estimates for effluent and instream flows and water quality. This is not surprising because: (1) co-occurrence of worst-case conditions of effluent flow and quality, and instream flow and quality is expected to occur very infrequently, if at all; and (2) the mass-balance approach assumes copper is conserved downstream (NMFS 2018).

It is not possible to identify the downstream point at which concentrations will fall below those known to elicit adverse sublethal effects with any degree of certainty. The mixing zone modeling indicates that full mixing will generally be achieved before reaching sample location S-4 in Jordan Creek; however, the modeling also suggests that additional dilution is needed for copper concentrations to fall below the sublethal effects threshold. The mixing zone modeling for the Yankee Fork indicates full mix may not be achieved prior to reaching monitoring location S-10. Yet, when copper was detected above the detection limit at sample location S-10,

concentrations were generally lower than background concentrations detected at sample location S-9.

Considering this information, NMFS (2018) conservatively estimates that copper concentrations may affect water quality in the reaches between the outfalls and downstream monitoring locations, which is 1,000 feet for Jordan Creek and approximately 0.6 mile (3,168 ft) of stream for the Yankee Fork.

Based on NMFS' analysis, the Service concludes that effluent discharges of copper are likely to adversely affect sensitive life stages (eggs, alevins, and fry) of bull trout; however, these life stages are not expected to be present in the action area. Migrating adult and subadult bull trout are present in the action area, but are not likely to be adversely affected by copper discharges because they are not expected to occupy habitat in the mixing zones, they are less sensitive to toxics compared to early life stages, and they have a zone of passage because the permit requires a 25 percent mixing zone in compliance with USFWS 2015i RPAs.

Lead

The acute and chronic criteria values for lead are 65 and 2.5 µg/L, respectively, as calculated from the following equations using a hardness value of 100 mg/L:

$$\text{Acute lead criterion } (\mu g/L) = e^{(1.273[\ln(\text{hardness})]-1.46)} * (1.46203-(\text{Ln}(\text{hardness})*0.145712)$$

$$\text{Chronic lead criterion } (\mu g/L) = e^{(0.8545[\ln(\text{hardness})]-4.705)} * (1.46203-(\text{Ln}(\text{hardness})*0.145712)$$

The acute and chronic criteria values are also referred to as the CMC and CCC, respectively (EPA 1985a). With lead and several other hardness-dependent aquatic life criteria, the actual criteria are defined using an equation. For example, at a water hardness of 10, 25, 50, and 250 mg/L, based on the acute lead criterion equation, the lead acute values are 5, 14, 30, and 172 µg/L, respectively. With the chronic criterion, at water hardness values of 10, 25, 50, and 250 mg/L, the lead chronic criterion values are 0.2, 0.5, 1.2, and 6.7 µg/L, respectively. The hardness-adjusted criteria for Jordan Creek and the Yankee Fork are shown in Tables 15 and 16, respectively.

The AMLs for lead in outfalls 002 (Table 3) and 003 (Table 4) exceed the applicable chronic criteria in Jordan Creek and the Yankee Fork. The effluent limits account for authorized 25 percent mixing zones (Table 2). The highest allowable total concentration that is authorized to be discharged from both outfall 002 and 003 is 4.84 µg/L. This equates to a dissolved concentration of roughly 4.8 µg/L based on a minimum mixed hardness of about 20 mg/L $CaCO_3$. Lead concentrations will drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume. The maximum concentrations of total lead measured in outfalls 002 and 003 were 0.2 and 1.4 µg/L, respectively. The vast majority of samples (i.e., more than 90 percent) have been below the detection limit of 0.1 µg/L for both outfalls (NMFS 2018).

The effluent limits for outfall 002 and outfall 003 are below the acute criteria for lead; therefore, an acute regulatory mixing zone does not exist. For Jordan Creek, the chronic regulatory mixing zone is modeled to extend about 80 feet downstream under the worst-case scenario when discharging at the MDL for the less than 30 cfs flow tier. At this location, the regulatory mixing

zone is modeled to extend approximately 4 feet into the channel, encompassing about 30 percent of the wetted width.

In the Yankee Fork, the chronic regulatory mixing zone is modeled to extend no more than 3 feet downstream of the diffuser, when flows are less than 45 cfs. When flows are greater than or equal to 45 cfs, the regulatory mixing zone is modeled to extend about 115 feet downstream. The regulatory mixing zone is also modeled to be less than 10 feet wide, with the majority of the plume being generally less than 4 feet in width (NMFS 2018).

NMFS (2018) reported that lead is not nearly as toxic to aquatic life as other metals. Short-term LC_{50} values for rainbow trout were reported as low as 50 µg/L in very soft water (i.e., 50 mg/L $CaCO_3$) to upwards of 3,000 µg/L in hard water (i.e., 135 mg/L $CaCO_3$). Chronic exposures to elevated concentrations of lead (i.e., as low as 7 µg/L in soft water) during early life stages can lead to spinal deformities (Davies et al. 1976) in very soft water (28 mg/L $CaCO_3$). Mebane (2008) reported the lowest EC_{10} values for spinal deformities to range between 12 and 15 µg/L at a hardness of 50 mg/L $CaCO_3$.

Although the permit limits allow for exceedances of chronic water quality criteria within the mixing zone, the maximum concentration of lead that may be discharged is 4.8 µg/L. Juvenile rainbow trout exposed to similar concentrations in much softer water did not develop black tails or spinal deformities (Davies et al. 1976). Furthermore, discharge at the effluent limit will co-occur with high levels of hardness which will ameliorate toxicity. Past effluent monitoring indicates lead is discharged at concentrations that are at least four times lower than concentrations observed to cause sublethal effects. The maximum concentrations of dissolved lead measured in Jordan Creek and the Yankee Fork, downstream of the outfalls were 0.3 and 0.2 µg/L. respectively (NMFS 2018).

Based on NMFS' (2018) analysis, and the Service's (2015i) determination that the lead water quality criteria are not likely to adversely affect bull trout, the Service concludes that the effluent limits for lead are also not likely to adversely affect bull trout in Jordan Creek and the Yankee Fork.

Mercury

The acute and chronic aquatic life criteria for dissolved mercury are 2.1 µg/L and 0.012 µg/L (12 ng/L), respectively (EPA 1999, p.41). The EPA has also developed a human health criterion for mercury, in which fish tissue concentrations are not to exceed 0.3 mg/kg ww (milligrams per kilogram wet weight) (66 FR 1344; EPA 2001). This standard was adopted in Idaho in 2005 and is applicable to all designated critical habitats and waters inhabited by listed aquatic species in Idaho (IDEQ 2005, pp. 141-148).

The Service (2015i) reported that available information on the toxicity to salmonids of short-term exposure to mercury in water indicates that adverse effects at 2.1 µg/L of mercury (the acute criterion) are unlikely. EPA (1985b, Table 1) lists LC50s for salmonids exposed to acute concentrations of mercury in the range 24-84 µg/L, based on tests where the water chemistry was measured. These concentrations are approximately 12 to 40 times higher than the acute criterion; on that basis, the Service concluded that the acute criterion for mercury is not likely to adversely affect bull trout.

The chronic criterion for protection of aquatic life relative to mercury is considerably more complex to evaluate. Food chain transfer is by far the most important exposure pathway in aquatic ecosystems (Wiener et al. 2003). Aquatic systems have complex food webs including several trophic levels. Aquatic predators including salmonids are most susceptible to bioaccumulating mercury, and thus their tissue concentrations may best reflect the amount of mercury available to aquatic organisms in the environment. For example, in comparisons of fish and invertebrates across trophic levels, McIntyre and Beauchamp (2007, p. 577) determined that the greatest mercury concentrations were found in piscivorous fish species and that mercury content increased with higher trophic levels and the age of the organisms.

Diet is the primary route of methylmercury uptake by fish in natural waters, and contributes more than 90 percent of the amount accumulated (Wiener et al. 2003, p. 17). Sediments are an important reservoir for mercury in freshwater systems. Mercury in sediments can become available for food chain transfer, and instances of elevated mercury in sediment corresponding with elevated mercury in fish have been documented (Scudder et al. 2009, pp. 27-30). One well documented instance was from Onondaga Lake, NY where dissolved mercury in the epiliminion was about 1 ng/L (nanogram per liter) and mercury in the hypolimnium was up to 10 ng/L (Bloom and Effler 1990, p. 260). Mercury in sediments were always above 1 mg/kg dw (milligram per kilogram dry weight), often above 5 mg/kg dw, and exceeded 25 mg/kg dw in some samples. Mercury in sediments was strongly correlated with mercury in invertebrate tissues (Becker and Bigham 1995, 563-571).

Sandheinrich and Wiener (2010) concluded that effects on biochemical processes, damage to cells and tissues, and reduced reproduction in fish have been documented at methylmercury concentrations of about 0.3 to 0.7 mg Hg/kg ww (milligrams mercury per kilogram wet weight) in the whole body and about 0.5 to 1.2 mg Hg/kg ww in axial muscle. NMFS (2014, p. 152) concluded that mercury tissue concentrations of less than about 0.2 to 0.3 mg/kg were unlikely to be linked to appreciable adverse effects to salmonids. The lowest recommended threshold reviewed was for concentrations of mercury in the diet of fish rather than the tissues of the fish themselves. DePew et al. (2012) concluded that 0.5 mg/kg ww in the diet of fish had been linked to reproductive impairment, and thus thresholds for mercury concentrations to avoid adverse effects to fish need to be lower than 0.5 mg/kg ww (Depew et al. 2012, p. 1542).

Using 0.3 mg/kg ww as an estimate of a low-risk mercury tissue concentration for bull trout, the next question is whether the proposed 12 ng/L chronic water quality criterion for mercury would be sufficient to avoid tissue concentrations of mercury in the bull trout from exceeding 0.3 mg/kg ww. Available information indicates that mercury would be expected to bioaccumulate to concentrations exceeding 0.3 mg/kg ww in bull trout and other piscivorous fish in waters with waterborne mercury concentrations much lower than 12 ng/L (USFWS 2015i,Table 8). Therefore, the Service concluded (USFWS 2015i) that the chronic mercury criterion is likely to adversely affect bull trout.

The effluent limits for lead in outfalls 002 (Table 3) and 003 (Table 4) exceed the applicable chronic criteria in Jordan Creek and the Yankee Fork. The effluent limits account for authorized 25 percent mixing zones (Table 2). The highest allowable total concentration that is authorized to be discharged from outfalls 002 and 003 is 57 and 69 ng/L, respectively. Mercury concentrations will drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume. The maximum concentration of total mercury

measured in outfall 002 was 37 ng/L. The maximum concentration of total mercury detected in outfall 002 was 0.8 ng/L. It is unlikely that this is an accurate estimate of the potential maximum concentration of mercury because the detection limit for 98 percent of the samples was 200 ng/L (NMFS 2018).

For Jordan Creek, the chronic regulatory mixing zone for mercury is modeled to extend about 80 feet downstream under the worst-case scenario when discharging at the MDL for both flow tiers. At this location, the regulatory mixing zone is modeled to extend approximately 4 feet into the channel, encompassing about 30 percent of the wetted width (NMFS 2018).

In the Yankee Fork, the chronic regulatory mixing zone is modeled to extend no more than 3 feet downstream of the diffuser when flows are less than 45 cfs. When flows are greater than or equal to 45 cfs, the regulatory mixing zone is modeled to extend about 115 feet downstream. The regulatory mixing zone is also modeled to be less than 11 feet wide, with the majority of the plume being generally less than 4 feet in width (NMFS 2018).

Bioaccumulation of mercury through the food chain is the most important pathway of toxicity for fish (USFWS 2015i). NMFS (2014) found that if water column concentrations of total mercury were less than 12 ng/L, then fish would not likely experience adverse effects. The maximum water column concentration detected in Jordan Creek, downstream of outfall 002 was 4.9 ng/L. For the Yankee Fork, the maximum concentration of total mercury detected at location S-10 was 6.9 ng/L (NMFS 2017).

Monitoring of mercury in stream sediments and in both macroinvertebrate and fish tissue was conducted in Jordan Creek in 2000 and in the Yankee Fork from 2000 – 2015. These data do not indicate a substantial signal between the upstream and downstream monitoring locations. Documented whole body fish tissue mercury concentrations in female mountain whitefish were below what NMFS (2014) considered a low-risk tissue threshold (i.e., 2 to 3 mg/kg ww). Considering this information, it is reasonable to conclude that mercury has not been historically discharged at concentrations that would lead to substantial accumulation of mercury in fish tissues. NMFS (2018) believes existing data reflects the potential effects of the discharge into the future, and existing fish tissue data are below low-risk tissue thresholds.

The Service therefore concludes that discharges of mercury at the proposed permit limits are not likely to adversely affect bull trout.

Zinc

The acute and chronic criteria values for zinc are 117 and 118 µg/L, respectively, as calculated from the following equations using a water hardness value of 100 mg/L:

$$\text{Acute zinc criterion } (\mu g/L) = e^{(0.8473[\ln(\text{hardness})]+0.884)} * 0.978$$

$$\text{Chronic zinc criterion } (\mu g/L) = e^{(0.8473[\ln(\text{hardness})]+0.884)} * 0.986$$

With zinc and several other hardness-dependent aquatic life criteria, the actual criteria are defined as an equation, and the table values merely illustrate comparable criteria concentrations all calculated at a water hardness value of 100 mg/L. For example, applying the above equation for the chronic zinc criterion at water hardness values of 10, 25, 50, and 250 mg/L, the corresponding chronic zinc criterion values are 17, 36, 66, and 257 µg/L, respectively. The only difference between the criteria equations is the constants at the end, which are conversion factors

to adjust the criteria from a "total zinc" basis to a "dissolved basis." While the conversion factors are close to 1.0, the acute conversion factor is slightly lower which results in calculated acute criterion values always being slightly higher than the chronic values. This relationship reflects the presumed reality of zinc being a fast- acting toxicant that is no more toxic in long-term exposures than in short-term exposures.

The hardness adjusted zinc criteria for outfalls 002 and 003 are shown in Tables 15 and 16, respectively.

The Service concluded (USFWS 2015i) that Idaho's acute and chronic zinc criteria are likely to adversely affect bull directly through mortality, and indirectly by reductions in available prey base through mortality of juveniles of other fish including salmonids. In NMFS' review of the Idaho zinc aquatic life criteria, NMFS (2014) reported that adverse effects to sensitive life stages (e.g., the first few months following hatching) could occur at concentrations below the criteria in low and moderate hardness waters.

The effluent limits for zinc in outfalls 002 (Table 3) and 003 (Table 4) exceed the applicable acute and chronic criteria in Jordan Creek and the Yankee Fork. The effluent limits account for the authorized mixing zones that vary in size from 8 to 25 percent (Table 2). The highest allowable total concentration that is authorized to be discharged is 304 µg/L from outfall 002 and 364 µg/L from outfall 003. Similar to other constituents, zinc concentrations are expected to drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume. The maximum concentrations of zinc measured in outfalls 002 and 003 since 2012 are 43 and 79 µg/L, respectively (NMFS 2018).

For Jordan Creek, the acute regulatory mixing zone is modeled to extend about 80 feet downstream under both flow tiers when discharging at the MDL. The furthest that the regulatory mixing zone is modeled to extend into the channel is about 3 feet. The travel time to reach the downstream edge of the regulatory acute mixing zone is 54 seconds when flows are less than 30 cfs and 28 seconds when flows are greater than or equal to 30 cfs. The chronic regulatory mixing zone in Jordan Creek, when discharging at the AML under the worst-case scenario, is modeled to be about 80-feet long by 4-feet wide. Under the worst-case scenario, the chronic regulatory mixing zone is modeled to encompass approximately 30 percent of the wetted width (NMFS 2018).

In the Yankee Fork, the acute and chronic regulatory mixing zones are modeled to extend no more than 3 feet downstream of the diffuser in the two lower flow tiers. The regulatory mixing zone is also modeled to be less than 11 feet wide, representing between 16 and 28 percent of the channel width. In the highest flow tier, the regulatory mixing zone is modeled to extend roughly 115 feet downstream. The regulatory mixing zone is also modeled to be less than 11 feet wide, with the majority of the plume being generally less than 4 feet in width (NMFS 2018).

The maximum and average zinc concentrations in Jordan Creek at sample location S-4 are 17 and 4.5 µg/L, respectively. Zinc concentrations in the Yankee Fork have been slightly lower than what was observed in Jordan Creek with maximum and average concentrations of 12 and 3.1 µg/L, respectively. In-stream zinc concentrations have not exceeded criteria, and in fact have typically been at least an order of magnitude below the applicable criteria. However, maximum zinc concentrations in soft water conditions have been nearing those that have been observed to result in lethality in toxicity tests.

The best available information indicates that sensitive bull trout life stages are not present in the action area and will not be affected by zinc discharges. Migrating adult and subadult and resident bull trout are present in the action area, but are not likely to be adversely affected by zinc discharges because they are not expected to occupy habitat in the mixing zones, they are less sensitive to toxics compared to early life stages, and they have a zone of passage as the permit requires a 25 percent mixing zone in compliance with USFWS (2015i) RPAs.

Metals without Effluent Limits: arsenic, aluminum, and silver

Arsenic

The acute criterion for arsenic is not to exceed 340 µg/L; the chronic criterion is not to exceed 150 µg/L. The EPA-approved (on July 7, 2010) human health/ recreational use criterion for arsenic is 10 µg/L.

EPA did not assign arsenic effluent limits to either outfall because there was no reasonable potential to exceed the criteria at the edge of the authorized 25 percent mixing zone. Monitoring of arsenic concentrations in the effluent is required to occur four times per year for the purposes of continued effluent characterization.

NMFS (2018) reports that arsenic concentrations in the effluent are far lower than concentrations found to cause mortality or other sublethal effects to anadromous fish or macroinvertebrates from waterborne exposure only (e.g., 100 µg/L for mayflies and about 40 µg/L for rainbow trout embryos). However, the dietary exposure route is of most concern because arsenic can bioaccumulate in the food chain to levels that could affect fish. This has been documented in streams with dissolved arsenic concentrations between 5 and 10 µg/L (NMFS 2014). NMFS (2018) reports that background concentrations in Jordan Creek and Yankee Fork are very low, and concentrations measured downstream of the outfalls also have remained very low.

NMFS (2018) determined that there is less than a 5 percent probability that the effluent concentration will exceed 10 µg/L. The arithmetic and geometric mean concentrations of arsenic since 2008 are 3.0 µg/L and 2.7 µg/L, respectively. It is unlikely that discharges of arsenic will be sustained for a sufficient period of time at high enough concentrations such that bioaccumulation to harmful levels will occur.

Based on NMFS' (2018) analysis, the Service concludes that arsenic discharges are not likely to adversely affect bull trout.

Aluminum

Idaho does not have water quality criteria for aluminum, and EPA did not assign aluminum effluent limits to either outfall 002or 003; however, monitoring of aluminum concentrations is required to occur four times per year at each outfall in order to better characterize the effluent in the future. Absent effluent limitations, NMFS evaluated the potential effects of the discharges using available effluent monitoring and toxicity data.

Aluminum toxicity is strongly influenced by the pH of the water. It is also influenced by hardness and dissolved organic carbon (DOC) concentrations. The pH of the effluent and of the receiving waters upstream for the outfalls is consistently higher than 6.6 and lower than 8. Hardness in the receiving streams is quite low, whereas it is very high in the effluent. Table 19 summarizes the 5th and 95th percentile of pH values in the effluent and receiving streams.

Table 19. Summary of pH and hardness characteristics of the effluent and in receiving streams (NMFS 2018, Table 14).

Sample Location	pH (S.U.)			Hardness (mg/L)		
	5th Percentile	Average	95th Percentile	5th Percentile	Average	95th Percentile
Outfall 002	6.7	7.2	7.9	204	349	543
Jordan Creek[1]	6.8	7.3	7.8	27	53	90
Outfall 003	6.9	7.5	7.9	210	338	494
Yankee Fork[1]	6.7	7.2	7.6	21	28	39

[1]pH values are for upstream conditions whereas the hardness values are for downstream.

No monitoring for DOC concentrations in the effluent or receiving streams has been conducted. Monitoring of DOC concentrations was performed between 2011 and 2014 in the nearby drainage of Thompson Creek (NMFS 2018). In Thompson Creek, measured DOC concentrations (2011 to 2014 data) ranged from less than 0.5 mg/L to a maximum of 2.7 mg/L (the average concentration at all four sample locations was about 1.1 mg/L). As expected, the highest DOC concentrations were measured during spring flows and the lowest concentrations were measured during late fall and early winter sample events. For purposes of this consultation, we have assumed that DOC concentrations in Thompson Creek are representative of those that may occur in the Yankee Fork and Jordan Creek (NMFS 2018).

The maximum measured aluminum concentration reported for the GCU effluent was 880 µg/L, with an average of 393 µg/L. Because these data were gathered between 2000 and 2010, it may not reflect effluent quality after the 2012 WTP upgrade. No data are available to evaluate more recent concentrations of aluminum in the effluent. Both the Yankee Fork and Jordan Creek are characterized by low levels of hardness, and it is likely that DOC concentrations are relatively low as well, decreasing the streams' ability to ameliorate aluminum toxicity. However, the pH of both creeks is close to circumneutral, which is influential in decreasing the toxicity of aluminum (NMFS 2018).

Historic discharge concentrations of aluminum do not suggest that acutely toxic conditions will occur. Assessing whether ongoing aluminum discharges would elicit sublethal effects after prolonged exposure is more difficult. Gundersen et al. (1994) observed significant differences in growth of juvenile rainbow trout exposed to aluminum concentrations of 890 µg/L for 16 days in water with similar pH as that of the Yankee Fork and Jordan Creek. The authors also documented a reduced growth rate in juvenile trout exposed to 550 µg/L; however, this reduction was not statistically different from the controls. Average historic discharge concentrations are almost 30 percent less than the lowest concentration tested by Gundersen et al. (1994). Furthermore, aluminum concentrations will likely be diluted relatively quickly in the receiving

streams, leaving only very small areas of the stream with concentrations near that characteristic of the effluent (NMFS 2018).

Given the above considerations, the Service does not expect aluminum concentrations in the discharge to result in adverse effects to bull trout.

Silver

The Idaho water quality standards (IWQS) include only an acute aquatic life criterion for silver that therefore limits both acute and chronic exposures. This necessitates a slightly different approach to the effects analyses than was done with substances that have both an acute and a chronic criterion value. For most substances, toxicity from short-term exposures is compared to the short-term (acute) criterion, and toxicity from long-term exposures is compared to long-term (chronic) criterion. However, since only a single criterion value is available for silver, regardless of the length or exposure or type of test, the results are compared against the sole silver criterion.

The aquatic life criterion for silver is defined as a function of water hardness. Using a water hardness value of 100 mg/L, the criterion value for silver is 3.5 µg/L, as calculated from the following equation:

$$\text{Silver criterion } (\mu g/L) = e^{(1.72[\ln(\text{hardness})]-6.52)} * (0.850)$$

At water hardness values of 10, 25, 50, and 250 mg/L, the acute silver criterion values are 0.07, 0.32, 1.05, 2.60, and 16.7 µg/L, respectively. The silver hardness-adjusted criteria for Jordan Creek and the Yankee Fork are shown in Tables 15 and 16, respectively.

EPA did not assign silver effluent limits to either outfall because there was no reasonable potential to exceed the criterion at the edge of the authorized 25 percent mixing zone. Monitoring of silver concentrations in the effluent is required to occur four times per year for the purposes of continued effluent characterization.

Silver is highly toxic. Concentrations of silver as low as 0.2 µg/L caused reductions in juvenile fish growth and 15 percent mortality when exposed for 28 days (Galvez et al. 1998). Birge et al. (1980) reported LC_{10} and LC_1 values of 0.7 and 0.1 µg/L for juvenile rainbow trout exposed to elevated silver nitrate for 28 days. Silver nitrate is highly soluble and laboratory tests using silver nitrate likely do not reflect toxicity concentrations that are environmentally relevant (NMFS 2018). In natural settings, silver will likely be much less toxic than what is published from laboratory experiments because of the strong modifying influence of naturally occurring ligands (Bianchini et al. 2002). Hogstrand et al. (1996) observed toxicities that varied by more than 4 orders of magnitude, depending on the silver anion tested (NMFS 2018).

EPA calculated the maximum projected concentrations of silver from outfalls 002 and 003 to be 0.18 and 0.2 µg/L, respectively. However, silver has not been detected above 0.05 µg/L in either outfall in more than 93 percent of the samples. Additionally, silver has not been detected at or above 0.05 µg/L in either of the receiving waterbodies. These concentrations are similar to the LC_1 values reported by Birge et al. (1980) for 28-day exposures to silver nitrate. In addition, silver is expected to be present in a complexed form resulting in reduced toxicity (NMFS 2018).

For these reasons, the Service concludes that discharges of silver at concentrations anticipated under this proposed action are not likely to adversely affect bull trout.

Non-Metals with Effluent Limits: WAD Cyanide, Total Suspended Solids, Whole Effluent Toxicity (WET), and pH

WAD Cyanide

The acute chronic aquatic life criteria for cyanide are 22 µg/L and 5.2 µg/L, respectively, as weak-acid-dissociable cyanide (USFWS 2015i).

Cyanide effluent limits were only developed for outfall 002 (Table 3). Outfall 003 did not have reasonable potential to exceed the water quality criteria at the edge of the authorized mixing zone; therefore, effluent limits were not developed. Both the effluent limit development and reasonable potential analysis relied upon an authorized 25 percent mixing zone. The MDL and AML for outfall 002 are 21.3 and 7.47 µg/L, respectively. The maximum projected effluent concentration for outfall 003 was 21.3 µg/L. In effect, there is no acute mixing zone for WAD cyanide because the MDL is less than the acute criterion of 22 µg/L. Since 2012, the maximum measured concentrations in the effluent from outfall 002 and 003 were 6 and 9 µg/L, respectively (NMFS 2018).

For Jordan Creek, the regulatory mixing zone is modeled to extend about 80 feet downstream under the worst-case scenario for both flow tiers. At this location, the regulatory mixing zone is modeled to extend approximately 4 feet into the channel, encompassing about 30 percent of the wetted width. Assuming the discharge from outfall 003 was equivalent to the maximum projected effluent concentration of 21.3 µg/L, the chronic criteria would be achieved in the Yankee Fork within 3 feet of the diffuser under all flow tiers. The maximum width of this mixing zone would be less than 10 feet wide (NMFS 2018).

NMFS (2018) reports that short-term LC_{50} values for rainbow trout were reported as low as 27 µg/L and 40 µg/L for exposures in water temperatures of around 40°F and 55°F, respectively (Kovacs and Leduc 1982a). The authors reported that the highest hydrogen cyanide concentration tested that did not result in any mortality within 96-hours also varied by temperature and ranged from 18 µg/L (at 6ºC) to 60 µg/L at 18ºC). Sublethal effects (e.g., reduced growth and reduced swimming abilities) were documented when juvenile rainbow trout were exposed to hydrogen cyanide concentrations as low as 5 µg/L for 20 days at these same temperatures. Kovacs and Leduc (1982b) reported marked reductions in fat synthesis and swimming performance of fish exposed to 5 µg/L cyanide around 43°F.

Although the maximum allowable discharge of WAD cyanide from outfall 002 is about 21 µg/L, the greatest concentration measured since 2012 was 6 µg/L. Concentrations of WAD cyanide are expected to drop precipitously with increasing distance from the outfalls and increasing entrainment of streamflow into the effluent plume. This expectation is supported by available data. The maximum WAD cyanide concentration detected in any of the Jordan Creek samples was 3 µg/L; however, the majority of samples (i.e., 94 percent) were not detected above 2 µg/L. None of the samples collected from the Yankee Fork had detectable levels of cyanide (NMFS 2018).

Considering the proposed effluent limitations and past effluent quality, it is unlikely that cyanide will be discharged at concentrations that will cause direct lethality. However, it is reasonable to conclude that authorized discharges of cyanide may occur at concentrations above those known to cause sublethal effects, especially during the months where water temperatures are 6ºC or less.

Within the Yankee Fork, this area is incredibly small (no more than 30 ft^2) relative to the stream, and overlaps habitat that is not ideal for rearing. Based on observations during a field visit, habitat near the diffuser is relatively shallow, stream velocities are fast, and there did not appear to be any suitable holding habitats such as pools (NMFS 2018).

Given NMFS' (2018) analysis, the Service concludes that the presence of a small area of potentially elevated cyanide concentrations in the Yankee Fork is not likely to adversely affect migrating adult and subadult bull trout. The mixing zone in Jordan Creek is modeled to be larger and has the potential to overlap more suitable rearing habitat. However, because resident bull trout in Jordan Creek are present at very low densities and there is a zone of passage, it is unlikely that an individual would be exposed to potentially elevated levels of cyanide; cyanide discharges in Jordan Creek are not likely to adversely affect bull trout.

Total Suspended Solids (TSS)

The permit limits TSS concentrations to a monthly average of 20 mg/L TSS and a daily maximum of 30 mg/L TSS applied at both outfalls. The information that is available suggests that sublethal effects are possible at exposure concentrations less than or equal to 20 mg/L but generally at exposure durations greater than or equal to 60 days for adults and less than or equal to 6 days for larvae (Newcombe and Jensen 1996, entire).

The TSS concentration at outfall 002 is typically below 10 mg/L. TSS has rarely exceeded 25 mg/L over the monitoring period and the maximum TSS value reported over all of the years is 88 mg/L (Figure 9). Spikes of over 20 mg/L are rare, occurring during the spring runoff period or during storm events. Outfall 003 TSS concentrations are typically 4 mg/L or lower (Figure 10) and the maximum value reported over all sample years is 180 mg/L (NMFS 2018).

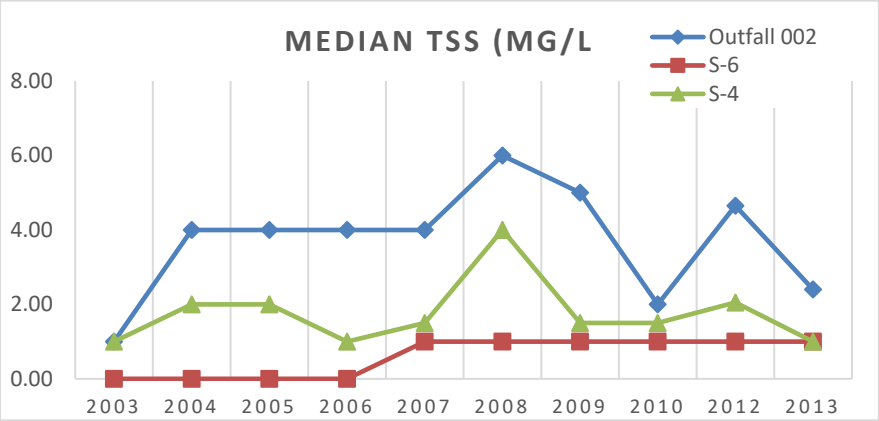

Figure 9. TSS median values for outfall 002 and Jordan Creek monitoring sites, 2003-2013 (BE Figure 12).

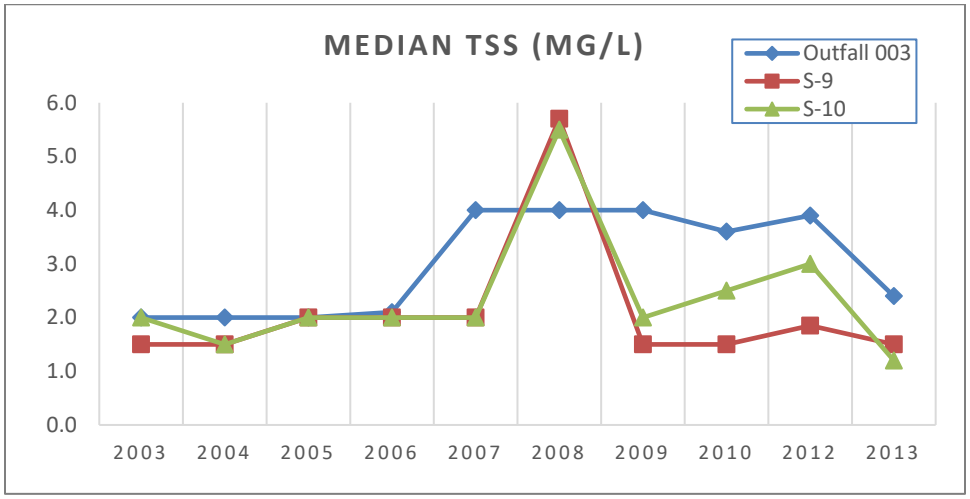

Figure 10. TSS median values for outfall 003 and Yankee Fork monitoring sites, 2003-2013 (BE Figure 13).

The TSS limit (less than 20 mg/L monthly and 30 mg/L daily maximum) prescribed would have a negligible effect bull trout as these are lower than the concentrations that may cause sublethal effects. TSS data collected at the outfalls has median and mean values less than or equal to 20 mg/L. Exceedances have occurred during storm and runoff events resulting in short term elevated TSS, but TSS discharge at the proposed permit limits is not likely to adversely affect bull trout.

Whole Effluent Toxicity (WET)

The following is from NMFS 2018, with minor modifications.

Testing the toxicity of the whole effluent provides insight into the toxicity of the mixture of all the contaminants in the effluent.

The proposed permit limits for WET are in Tables 3 and 4. The limits were calculated based upon the criteria of 1 TU_c (chronic toxic units) for the chronic criterion and 0.3 TU_a (acute toxic units) (or, equivalently, 3.0 TUc, based on an acute-to-chronic ratio of 10:1) for the acute criterion. The limits are greater than the criteria, because a mixing zone was factored into the calculation (EPA 2017).

The chronic WET effluent limits for the outfalls 002 and 003 were based on authorized mixing zones of 50 and 75 percent, respectively. The toxicity triggers were developed based upon a mixing zone size of 25 percent.

For outfall 002, the chronic regulatory mixing zone for WET (where WET exceeds 1.0 TU_c, if the facility is discharging at its average monthly limit) spans about 50 percent of the width of Jordan Creek and extends about 80 feet downstream. The acute regulatory mixing zone for WET (where WET exceeds 3.0 TUc, or equivalently, 0.3 TUa, if the facility is discharging at its maximum daily limit) is roughly the same size. These mixing zones are the same size under both flow tiers. Travel times to reach the end of the acute regulatory mixing zones are 28 seconds when the flow is greater than 30 cfs and 54 seconds when the flow is less than 30 cfs.

The downstream extent of the chronic WET mixing zones for outfall 003 are substantially longer than those for outfall 002. The CORMIX model predicts the mixing zone to extend between 650 and 2,130 feet downstream, depending on the flow tier. At most, the width of the mixing zone is about 20 feet, which is roughly one-third of the stream width. Assuming discharge is equivalent to the MDL, the acute mixing zone is modeled to extend between 80 and 850 feet downstream, depending on the flow tier. At its maximum width, the mixing zone is 16 feet wide, occupying about 26 percent of the stream width.

The mixture toxicity of an effluent is exclusive to a facility; therefore, data from literature are not available to evaluate the protection provided by WET permit limits in any particular permit. However, Hecla has conducted both chronic and acute WET testing for many years. Toxicity studies using whole effluent provide valuable information about potential synergistic or antagonistic toxicity of contaminants in the effluent. NMFS does not expect the effluent quality to diminish into the future as a result of the proposed action, and we expect mixture toxicity observed from previous monitoring provides reasonable insight into the potential toxicity of effluents the will be discharged in accordance with the proposed permit.

To support the static renewal WET tests, Hecla collected three 24-hour composite samples during the testing period. Reconstituted laboratory water has been used for the dilution series. Initially, short-term chronic toxicity testing was performed on two test species, a fathead minnow (*Pimephales promelas*) and a water flea (*Ceriodaphnia dubia*), to assess which species was most sensitive. The fathead minnow was determined to be the most sensitive and was subsequently used for all chronic WET tests. Juvenile rainbow trout were used for the acute WET tests.

Hecla has performed chronic WET testing (7-day toxicity tests on early life stage fathead minnows) multiple times per year for outfall 002 and at least once per year for outfall 003. Both survival and growth endpoints were tested and point estimates were calculated following EPA (2002) methodology. Table 20 summarizes the chronic WET test results for outfalls 002 and 003.

Table 20. Chronic WET tests results (TU_c and percent effluent) for outfalls 002 and 003 (from NMFS 2018, Table 17).

Sample Date[1]	Survival – NOEC[2]		Survival – LC_{10} [2]		Growth – IC_{25} [2]		Growth – IC_{10} [2]	
	TU_c	% Effluent	TU_c	% Effluent	TU_c	% Effluent	TU_c	% Effluent
Outfall 002								
4/25/2011	9.1	11	NA	NA	7.41	13.5	NA	NA
6/27/2011	1	100	NA	NA	12.4	8.1	NA	NA
8/8/2011	1	100	NA	NA	<1	>100	NA	NA
11/14/2011	1	100	NA	NA	<1	>100	NA	NA
4/23/2012	1	100	NA	NA	<1	>100	NA	NA
6/18/2012	1	100	<1	>100	<1	>100	<1	>100
8/6/2012	1	100	NA	NA	<1	>100	NA	NA
4/15/2013	1	100	NA	NA	<1	>100	NA	NA
4/22/2014	1	100	NA	NA	3.6	27.8	NA	NA
6/09/2014	15.9	6.3	NA	NA	13.8	7.2	NA	NA
7/8/2014	1	100	<1	>100	<1	>100	14.3	7
4/6/2015	1	100	NA	NA	<1	>100	NA	NA
8/22/2016	1	100	<1	>100	<1	>100	<1	>100
6/26/2017	1	100	9.4	10.7	<1	>100	14.4	6.9
8/9/2017	1	100	<1	>100	<1	>100	<1	>100
Outfall 003								
5/16/2011	18.5	5.4	14.1	7.1	14.4	6.9	80.6	1.2
11/14/2011	1	100	NA	NA	1.4	72.4	NA	NA
6/18/2012	1	100	<1	>100	<1	>100	24.4	4.1
5/6/2013	1	100	3.5	28.2	<1	>100	8	12.5
5/12/2014	18.5	5.4	NA	NA	19	5.3	NA	NA
5/4/2015	18.5	5.4	4.3	23.3	20.4	4.9	31.3	3.2
5/2/2016	1	100	8.3	12.1	6.5	15.3	17.5	5.7
5/8/2017	13.9	7.2	8.4	11.9	14	7.1	30	3.3

Cells shaded gray indicate values that exceed the corresponding proposed AML.
[1]The date of the initial sample collection. Samples for test renewals are typically collected on day 2 and day 4 following the initial sample date.
[2]Data sources: GEI 2011, 2012a, 2012b, 2013a, 2014b, 2015b, 2016a, 2016b, 2017a, 2017b, 2017c.

GEI WET testing reported 10 percent mortality rates in mixtures with as little as 11 percent effluent from outfall 002; however, the effluent toxicity was much lower in the vast majority of tests. Effluent samples collected in June 2017, appeared to have the greatest toxicity of all sample events since 2011. Even though permit limits were met, a 10 percent mortality rate was interpolated to occur in dilutions with 11 percent effluent and a 10 percent reduction in growth was estimated in dilutions with as little as 7 percent effluent. Assuming this level of effluent toxicity co-occurs with critical conditions (i.e., when there is a dilution ratio equivalent to 8 to 1 at the upper flow tier of 30 cfs), organisms could die or experience reduced growth if residing within approximately 500 feet downstream of the outfall for a sufficient period of time. At this

point, the stream is modeled to be comprised of less than 7 percent effluent. During this particular sample event, dilution ratios averaged approximately 57 to 1, which was about seven times greater than that required by the permit. Thus, the potential area where adverse impacts may have occurred during this sample event was actually much smaller than that modeled assuming critical conditions.

Effluent from outfall 003 exhibited toxicity more often than that of outfall 002. For example, interpolations for the majority of sample events estimated 25 percent mortality rates occurring at effluent concentrations far less than 100 percent. Results from the latest sample event indicate a 10 percent mortality rate in 12 percent effluent concentrations. A 10 percent reduction in growth was estimated to occur in mixtures with just 3 percent effluent. Assuming this level of effluent toxicity co-occurs with critical conditions (i.e., maximum effluent discharge coupled with an in-stream flow of 80 cfs), organisms could die if residing within approximately 5 feet downstream of the outfall for a sufficient period of time. Similarly, fish may experience reduced growth if rearing within 4,000 feet downstream of the outfall for a sufficient period of time. During the sample event, dilution ratios were approximately 59 to 1, which was about 1.5 times greater than that considered under critical conditions. Thus, the potential area where adverse impacts may have occurred during this sample event was likely smaller than that modeled assuming critical conditions.

Between 2010 and 2015, acute WET tests for outfall 002 were conducted eight times (Table 21). No acute WET testing has been performed for effluent discharged from outfall 003; however, since the sources of water for both outfalls are the same, acute WET for outfall 003 is expected to be similar to that of outfall 002. Acute WET tests were performed as 96-hour static renewal tests with juvenile rainbow trout. The acute toxic units (TU_a) were reported in terms of the NOEC[6], which is the highest concentration tested where observed mortality is not statistically significantly different from the controls. Significant reductions in survival were observed in effluent dilutions as low as 67 percent; however, this occurred in 2010, prior to the most recent WTP upgrades. Information in the latest two reports indicated that no test organisms died when exposed to 100 percent effluent.

Table 21. Acute WET test results for outfall 002 (NMFS 2018, Table 18).

Sample Date	TU_a	% Effluent
4/26/2010	1.5	67
5/26/2010	1.4	71
6/16/2010	1	100
4/25/2011	1	100
5/14/2012	1	100
4/15/2013	1	100
4/21/2014 [1]	1	100
4/6/2015	1	100

[1]The reference toxicant test results suggest that the juvenile rainbow trout used for this testing event may have been less sensitive than usual.

[6] No Observed Effect Concentration

Whether data from chronic WET testing provides accurate insight into the potential effects on bull trout is debatable. First, the test species (i.e., the fathead minnow or water flea in the case of the GCU) used to determine compliance with the WET effluent limits may not have the same sensitivity to the effluent as listed salmonids. NMFS (2014a) reported that toxicity tests using a water flea and fathead minnow were not as sensitive as 30- or 60-day chronic tests with rainbow trout and suggested that perhaps a sensitivity adjustment (e.g., limited dilution allowances) be made to account for these potential differences.

NMFS (2018) also identified the use of lab water versus use of stream receiving water (i.e., differences in hardness) and how well laboratory testing represents what is occurring in the natural stream system as issues to be considered when interpreting WET tests results. NMFS (2018) concluded that despite these limitations, WET testing is a practical and reasonable approach for assessing mixture toxicity of effluents. To address some of the uncertainties associated with WET testing and to gain some insights into effects of GCU discharges on the aquatic ecosystem, Hecla has conducted instream biomonitoring for a number of years at sample locations above and below the outfalls. Biomonitoring did not indicate that adverse effects to the aquatic ecosystem occurred as a result of the discharge. However, sample locations are located downstream of the regulatory mixing zones. NMFS is not aware of any information regarding the health of the macroinvertebrate community residing within the mixing zones.

Based on the WET testing, it is likely that some adverse effects are occurring as a result of chronic exposure (e.g., greater than 96-hours) mixture toxicity; however, those effects are likely limited to a small segment of the receiving streams, as indicated by the downstream biomonitoring. Adverse effects due to acute exposures of 96-hours or less are not expected based on the acute WET testing that has been performed to date using juvenile rainbow trout.

Based on NMFS (2018) analysis, the Service concludes that chronic WET has the potential to adversely affect early life stages of bull trout. However, as noted previously, these life stages are not expected to be present; only adult and subadult migratory bull trout are present seasonally below outfall 003 in the Yankee Fork. Similar to NMFS (2018), we are not expecting these life stages to be adversely affected by WET discharges from outfall 003. In addition, the mixing zone leaves a zone of passage for these fish to avoid exposure to WET while migrating up- or downstream.

Resident adult and subadult bull trout are present in Jordan Creek, but present in such low numbers (a mean of less than one fish per year in 18 years of sampling), that the risk of adverse effects is discountable.

pH

The proposed permit requires pH to be within the range of 6.5 to 9.0 standard units for all outfalls. The lower limit (6.5) is based on Idaho water quality standards with no mixing zone applied. The higher limit (9.0) is based on both technology-based effluent guidelines and the Idaho water quality standards.

Although most studies looked at the effects of pH on adults, the life stages most sensitive to effects of pH are egg incubation and alevin/fry development. Data regarding the effects of pH on the aquatic biota are limited and dated. Studies on the effects of pH on salmonids are usually ancillary to other objectives of the research.

In the development of EPA's criteria, (EPA 1986) two bioassay references on freshwater fish showed a lower pH limit of about 6.5 for normal development (EIFAC 1969, Mount 1973). Vulnerable life stages of Chinook salmon are sensitive to pH values below 6.5 and possibly at pH values greater than 9.0 (Marshall et al. 1992). For Chinook, Rombough (1983) reported that low pH decreases egg and alevin survival, but specific values are lacking. Adult salmonids seem to be at least as sensitive as most other fish to low pH including rainbow, brook, and brown trout and Chinook salmon (ODEQ 1995). In studies of biological changes with surface water acidification, Baker et al. (1990) found that decreased reproductive success may occur for highly acid-sensitive fish species (e.g., fathead minnow, striped bass) at pH values of 6.5 to 6.0. At pH values between 6.0 and 5.5, Baker et al. (1990) found decreased reproductive success in lake trout. The lower critical pH value for rainbow trout is approximately 5.5 (Baker et al. 1990). Based on the EPA criteria documents and Baker et al. (1990), the low-end of Idaho's pH standard of 6.5 is considered protective for salmonids.

At the higher end of the pH scale, even less is known regarding effects on fish. In EPA's review for water quality criteria development, the upper limit of 9.0 was obtained from only one reference (EIFAC 1969). Though no recent data have been generated, studies conducted earlier in the 20th century show salmonids, including both trout and salmon species, to be sensitive to pH values in the range of 9.2 to 9.7 (ODEQ 1995). Non-salmonid fish are, with some exceptions, more tolerant of high pH, with sensitivity appearing at or over pH 10 for most species tested (EIFAC 1969). Levels of pH greater than 9.0 may adversely affect benthic invertebrate populations, thereby altering the food base for salmonids (ODEQ 1995).

Monitoring data collected at the outfalls indicate that pH is within the acceptable range for salmonids. Monitoring data from both outfalls show the effluents generally slightly elevated from the neutral value of 7.0 pH. Outfall 002 annual median pH values range from 7.0-7.3 and minimum and maximum values overall years range from 6.6-8.8 (Figure 11).

At outfall 003, annual median pH values range from 7.2-7.6 and minimum and maximum values overall years range from 6.3-8.9 (Figure 12). Also, data from upstream and downstream monitoring sites are comparable.

Given these considerations, the Service concludes that discharge within the 6.5-9.0 pH permit limit in outfalls 002 and 003 is not likely to adversely affect bull trout.

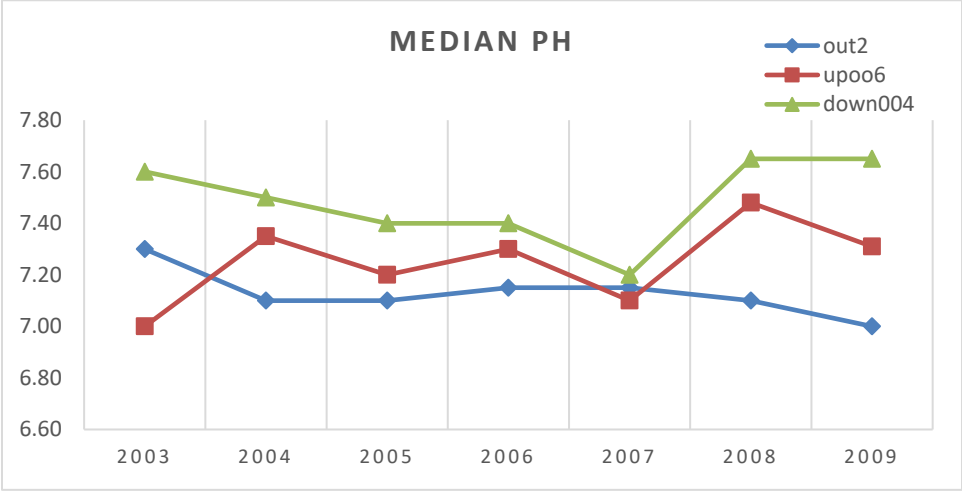

Figure 11. PH median values for outfall 002 and Jordan Creek monitoring sites, 2003-2013 (BE Figure 14).

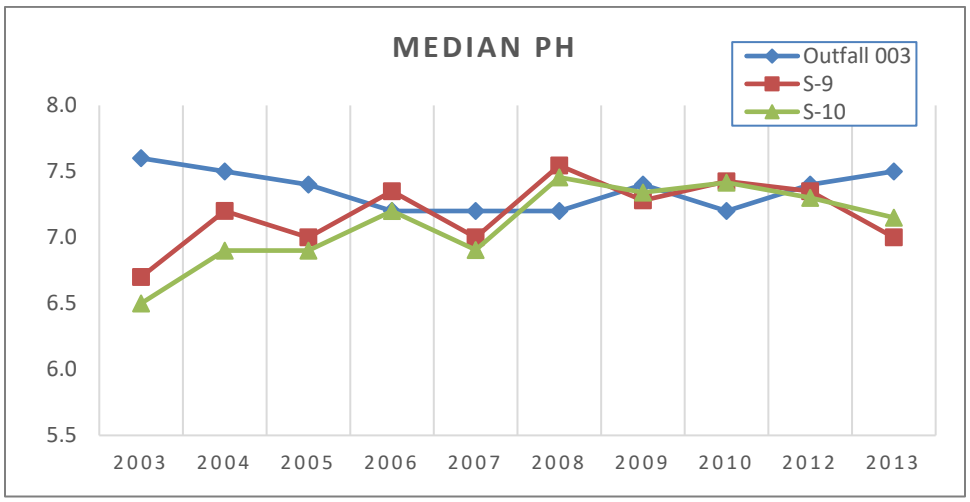

Figure 12. PH median values for outfall 003 and Yankee Fork monitoring sites, 2003-2013(BE Figure 15).

Non-Metals without Effluent Limits: Ammonia, Nitrate plus Nitrite, Selenium

Ammonia

EPA did not assign ammonia effluent limits to either outfalls 002 or 003 because there was no reasonable potential to exceed the criteria at the edge of the authorized 25 percent mixing zone. Monitoring of ammonia concentrations in the effluent is required to occur four times per year in order to better characterize the effluent in the future. In reviewing data provided by EPA, it

appears that ammonia concentrations meet the applicable instream criteria at the end of the pipe, so it is unlikely that any mixing is necessary to achieve the existing quality criteria.

Since 2008, the highest concentration of total available nitrogen (TAN) discharged from outfall 003 was 0.51 mg/L and the effluent pH associated with this sample was 7.2. To compare this to the toxicity information discussed in NMFS 2018 (Appendix B), NMFS normalized the datum to a pH of 7, giving a TAN concentration of 0.62 mg/L. Similarly, the highest observed ammonia concentration from outfall 002 was 0.41 mg/L and the pH was 7.6. Normalizing this to a pH of 7 produces a TAN concentration of 0.87 mg/L. These normalized concentrations are well below the lowest reported chronic EC_{20}[7] value (i.e., 3.246 mg/L) and are orders of magnitude below reported LC_{50} values. Similarly, ammonia concentrations discharged are at levels far below that which would be expected to cause a change in the macroinvertebrate community (NMFS 2018).

Given NMFS' (2018) analysis and because effluent concentrations will be even further diluted in the receiving streams, the Service concludes that ammonia concentrations in the effluent are not likely to adversely affect bull trout.

Nitrate plus Nitrite

EPA is not proposing effluent limitations for nitrate plus nitrite (NO_3 + NO_2). The maximum concentration of NO_3 + NO_2 recorded in outfall 002 since 2012 was 0.66 mg/L (NMFS 2018). No samples were collected from outfall 003 for NO_3 + NO_2 analysis; however, discharges from outfall 003 are expected to be similar to that of outfall 002. Aquatic organisms are relatively tolerant of elevated nitrate concentrations. Observed effluent concentrations are many orders of magnitude below concentrations known to cause lethal or sublethal effects to fish. However, while NO_3 is not very toxic to aquatic life, it can cause excessive plant and algal growth that could lead to depletion of oxygen levels in the stream as well as alteration of pH regimes. Continuous effluent discharge of nitrate for extended periods, while generally not toxic, can result in habitat alteration and changes in abundance and composition of riverine plants and animals depending upon the resulting nutrient concentrations (Chambers et al. 2001). Stimulation of excess algal productivity occurs at a much lower concentration than for potential toxicity. Ferreira et al. (2006) suggested that minor increases in dissolved nitrogen in streams can cause eutrophication, which can lead to significant shifts in microbial dynamics and ecosystem function. Typically, primary production in streams is limited by phosphorus; however, in freshwater environments with low nitrogen to phosphorus loading ratios, nitrogen can play a significant role in net primary production (Carmago et al. 2005).

Periphyton biomass is not monitored in the receiving streams, although macroinvertebrate communities are. GEI has monitored benthic macroinvertebrate communities above and below the outfalls for more than 10 years. Based upon examination of the upstream and downstream condition of various macroinvertebrate metrics (i.e., density; mean number of taxa; mean number of ephemeroptera, plecoptera, and tricoptera taxa; and the Shannon-Weaver diversity index), discharges of NO_3 + NO_2 from outfalls 002 and 003 do not appear to be causing shifts in macroinvertebrate communities (NMFS 2018).

[7] The effect concentration (ECx) is the estimated concentration at which a specified proportion of test organisms exhibit the endpoint (e.g., reduced growth, immobility, etc.).

Given NMFS' (2018) analysis, and the expectation that effluent quality will not change in the future, the Service concludes that discharges of $NO_3 + NO_2$ are not likely to adversely affect bull trout.

Selenium

The aquatic life criteria for selenium are an acute criterion of 20 µg/L and a chronic criterion of 5 µg/L, both expressed as "total recoverable" selenium (USFWS 2015i).

Selenium occurs naturally in the environment and is an essential micronutrient for all animals that have a nervous system, yet it is toxic at not much higher concentrations (Eisler 1985). Selenium accumulation is modified by water temperature, age of the organism, route of exposure, and other factors (Eisler 1985). Selenium toxicity is primarily manifested as reproductive impairment due to maternal transfer, resulting in embryotoxicity and teratogenicity[8] in egg-laying vertebrates such as birds and fish (Janz et al. 2010, pp. 149-152). The most sensitive toxicity endpoints in fish larvae are teratogenic deformities such as skeletal, craniofacial, and fin deformities, and various forms of edema (Janz et al. 2010, p. 152). Embryo mortality and severe development abnormalities can result in impaired recruitment of individuals into populations (Janz et al. 2010, pp. 209-210).

Rather than through waterborne exposure, diet is the primary pathway of selenium exposure for both invertebrates and vertebrates (Chapman et al. 2009, p. 5). Selenium readily bioaccumulates in aquatic food webs, and biomagnifies (increases with increasing trophic level) (Presser and Luoma 2010, fig. 6). The single largest step in the bioaccumulation of selenium occurs at the base of food webs, characterized by an "enrichment function," with much lower increases at higher trophic levels (Chapman et al 2009, pp. 5-7). However, lower trophic level organisms are less sensitive to selenium toxicity than higher tropic level organisms (Lemly 1993, p. 83). Piscivorous fish accumulate the highest levels of selenium and are generally one of the first organisms affected by selenium exposure, followed by planktivores and omnivores (Lemly 1985).

Neither outfall 002 nor outfall 003 have reasonable potential to exceed the selenium water quality criteria; therefore, effluent limits were not developed. The maximum projected effluent concentration of selenium from outfall 003 is 3.1 µg/L, which is below both the acute and chronic water quality criteria. The maximum projected effluent concentration for outfall 002 is 5.5. µg/L, which is greater than the chronic aquatic life criterion. However, the concentration at the edge of the authorized 25 percent mixing zone is below the aquatic life criterion (NMFS 2018).

NMFS (2014) noted that selenium concentrations in the water around 2 µg/L may present a low risk of selenium accumulation to levels that cause adverse effects in fish. Concentrations of selenium in the water column downstream of outfalls 002 and 003 have consistently been below 1 µg/L and discharges of selenium from outfalls 002 and 003 have been greater than or equal to 2 µg/L less than 10 percent of the time.

[8] Having the capability to cause malformations, abnormalities, or other physical defects in the developing embryo.

Given NMFS' (2018) analysis, and the expectation that effluent quality will not change in the future, the Service concludes that discharges of selenium are not likely to adversely affect bull trout.

Temperature

EPA (2017) notes that an issue that has been raised in the past is the possibility of a temperature differential between the receiving water and the effluent resulting in thermal refuge for bull trout. This would result in bull trout being attracted to the chronic mixing zone and possibly spending an inordinate amount of time exposed to the chemicals in the effluent. Monitoring data do not indicate that outflow 002 is consistently colder than the receiving water; thus, we cannot reasonably speculate that the outfall will create a cold water refuge that would act as an attractant to fish during warm periods (Figures 13 and 14). A similar situation exists in the Yankee Fork where effluent temperatures are cold in the winter and summer maximums range from 16.7°C to 20.4°C through the sample years (Figures 15 and 16).

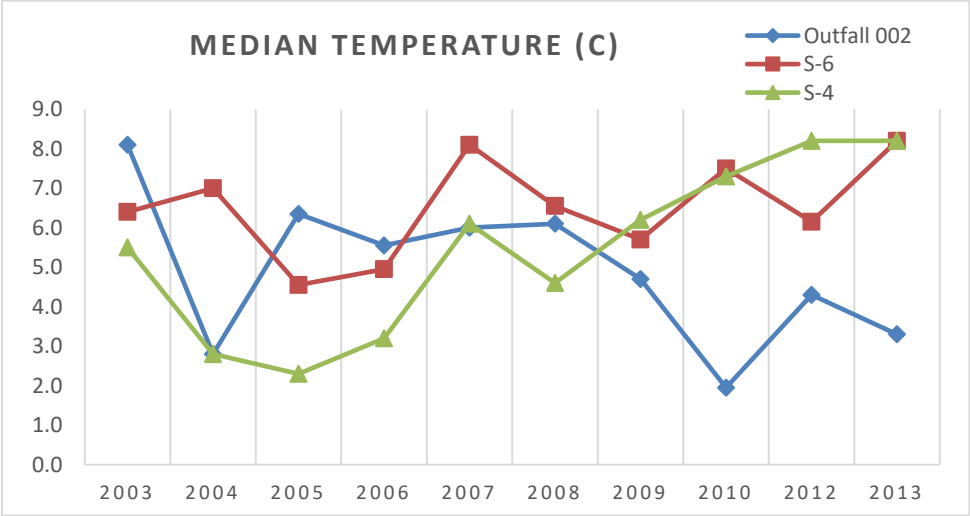

Figure 13. Temperature median values for outfall 002 and Jordan Creek monitoring sites, 2003-2013 (BE Figure 29).

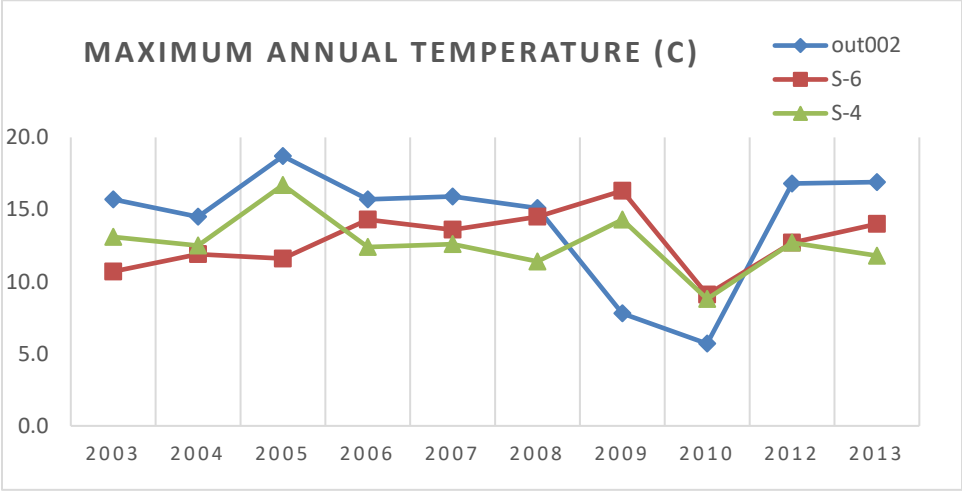

Figure 14. Temperature maximum values for outfall 002 and Jordan Creek monitoring sites, 2003-2013 (BE Table 30).

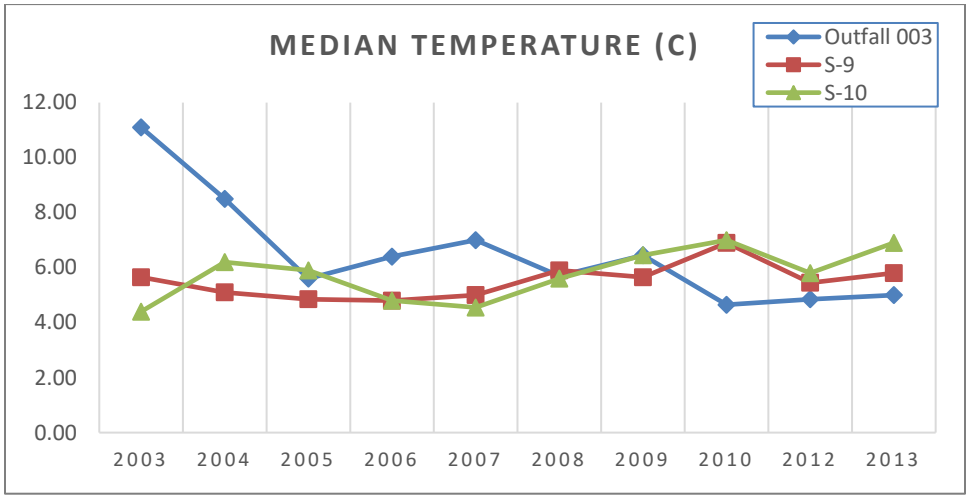

Figure 15. Temperature median values for outfall 003 and Yankee Fork monitoring sites, 2003-2013 (BE Figure 31).

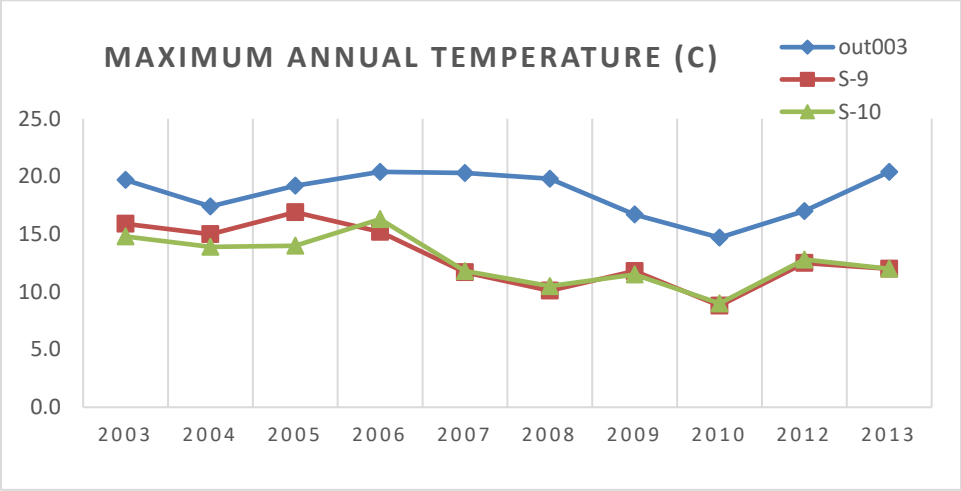

Figure 16. **Temperature maximum values for outfall 003 and Yankee Fork monitoring sites, 2003-2013 (BE Figure 32).**

Although effluent discharges may not be a cold water attractant, they are a warm water source to the receiving streams. The water treatment process involves retention of water in a pond prior to discharge, which could lead to elevated temperatures in the discharge. EPA is not proposing effluent limitations for temperature for either outfall; rather, hourly monitoring will be required and Hecla will be required to report the monthly instantaneous maximum temperature, maximum daily average, and 7-day running average of the daily maximums.

Fish are ectothermic; their ability to survive and reproduce is dependent on water temperatures. Elevated water temperatures could cause direct lethality; sublethal effects (e.g., increased susceptibility to disease, reduced growth, decreased ability to compete and avoid predation); and impede or delay passage to spawning grounds.

NMFS (2018) reports that Hecla has collected over 2,000 daily temperature readings from each of the outfalls since 2008. Although instantaneous temperature data have limited utility, it provides some insight into the potential effects of the discharge. With one exception, average monthly temperatures calculated for daily data collected at the downstream monitoring locations in Jordan Creek and the Yankee Fork were less than or equal to 0.7ºF (0.4ºC) warmer than upstream locations. The maximum temperatures recorded in outfalls 002 and 003 were 67ºF (19.4ºC) and 70ºF (21.1ºC), respectively. Because the proposed action requires more rigorous temperature monitoring, a more thorough evaluation of the potential impacts of the discharge on instream temperatures will be performed during the next permit renewal cycle.

Watershed Sciences, Inc. conducted thermal infrared remote sensing of water temperatures of Jordan Creek and the Yankee Fork in August 2010 (USBR 2012). They reported Jordan Creek water temperatures at its mouth were 6.7ºF (3.8ºC) warmer than temperatures of the Yankee Fork. Similarly, temperatures measured at the mouth of the Pinyon Creek channel (i.e., outfall 002) were about 4.3ºF (2.4ºC) warmer than Jordan Creek. Mine discharges were identified as a significant contributor to warming of Jordan Creek waters. Jordan Creek was also identified as one of the warmer tributaries to the Yankee Fork (USBR 2012).

While the discharge of treated water is not the only contributing factor to warming of Jordan Creek waters, it plays a significant role. Discharge from outfall 002 may comprise up to 11 percent of the flow in Jordan Creek and influences of elevated temperature are expected to be carried downstream to its mouth due to a lack of other cooler water inflows. Conversely, discharge from outfall 003 comprises much less of the overall Yankee Fork flows. Temperatures are expected to decrease quickly with increasing distance from the diffusers. Heated discharge from outfalls 002 and 003 are anticipated to adversely affect the water temperature in Jordan Creek and the Yankee Fork. These impacts are expected to occur during the warmer months of the year when water in the pond has the greatest heating potential.

However, instream temperatures do not appear to approach temperatures thought to cause lethality or impede fish movements. Furthermore, the effluent plume encompasses only a fraction of the wetted width near the discharge points, leaving room for adult and juvenile fish to avoid unfavorable temperatures (NMFS 2018).

For the purposes of this Opinion, and lacking additional information, we have assumed that adverse effects to bull trout from the discharge of heated water to Jordan Creek extend from outfall 002 to the mouth of Jordan Creek because the effluent comprises a significant portion of the streamflow and there does not appear to be other significant sources of cooler tributary water. For the Yankee Fork, because the effluent comprises a much smaller percentage of the stream flow, the extent of adverse effects are estimated to extend downstream to monitoring location S-10.

Biomonitoring including Fish Sampling

Important fish population data and fish tissue data have been collected from the action area over the years of operation to monitor for possible effects from the discharge. This data collection can affect bull trout. The primary fish sampling method has been electrofishing. Harmful effects of electrofishing are detailed by Snyder (2003) and include internal and external hemorrhaging, fractured spines, and death. The primary contributing factors to stress and death from handling are differences in water temperatures (between the river and the holding tank), dissolved oxygen concentrations, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 64ºF (17.8ºC) or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in tanks if the tanks are not emptied on a regular basis. When electrofishing long-term index reaches, McMichael et al. (1998) found that up to 5 percent of sampled fish can be injured and or die, including delayed mortality. Although some bull trout may die from electroshocking, the majority of captured fish will only be exposed to the stress caused by biological sampling/handling once. In addition, less than a couple of hours of disturbance will occur at each site, once every five years.

Benthic macroinvertebrate sampling is not expected to significantly disrupt the normal behavior of migrating bull trout in the Yankee Fork, or resident bull trout in Jordan Creek. Bull trout spawning has not been documented, and is not expected, in either stream within the action area, therefore, sampling will have no effect on spawning bull trout or redds.

2.5.1.2 Effects of Interrelated or Interdependent Actions

The Service has not identified actions that are interrelated or interdependent with the proposed action.

2.5.2 Bull Trout Critical Habitat

2.5.2.1 Direct and Indirect Effects of the Proposed Action

For more detailed information on the effects of the effluent discharges see the bull trout effects section (Section 2.5.1), above.

Effects to critical habitat are analyzed by effects to each of the PBFs below.

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 have no effect on PBF 1.

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.

   Because the mixing zone for parameters of concern incorporate a zone of passage for bull trout migration and movement, effluent discharges are not likely to adversely affect PBF 2. However, because electrofishing will delay the migration of any bull trout captured, electrofishing is likely to adversely affect PBF 2.

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

   As described in Appendix B, long-term biomonitoring in Jordan Creek and the Yankee Fork shows that discharges are not significantly impacting bull trout forage species, including macroinvertebrates and forage fish. The proposed action is not likely to adversely affect PBF 3.

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.

   The proposed action will have no effect on PBF 4.

5. Water temperatures ranging from 2 to 15 °C (36 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.

   As discussed in the Temperature subsection of Section 2.5.1.1.3 above, discharges from the water treatment pond are warmer than Jordan Creek and the Yankee Fork, and

contribute to elevated stream temperatures. Therefore, the proposed action is likely to adversely affect PBF 5.

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.

Bull trout spawning has not been documented, and is not expected to be present, in the action area; therefore, the proposed action will have no effect on PBF 6.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departures from a natural hydrograph.

The flow of effluent through outfalls 002 and 003 is variable since the quantity of storm water, waste rock run-off, and mine drainage are highly dependent upon precipitation and snowmelt. The discharge pattern is therefore similar to the basin flow discharge characteristic of higher discharges from April through June (see Figures 5 and 6). For these reasons, the proposed action will have no effect on the natural hydrographs of Jordan Creek and the Yankee Fork; there will be no effect to PBF 7.

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

Although effluent discharges permitted under the proposed action have the potential to adversely affect water quality, as described previously, the mixing zones for the discharges are relatively small and do not span the entire stream channel. In addition long-term biomonitoring shows that macroinvertebrate and fish assemblages are not being significantly impacted by the discharges. Therefore, the Service concludes that the proposed action is not likely to adversely affect PBF 8.

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.

The proposed action will have no effect on PBF 9.

In summary, the proposed action is likely to adversely affect migration habitat (PBF 2) and water temperatures (PBF 5); is not likely to adversely an abundant food base (PBF 3) or sufficient water quality and quantity (PBF 8); and will have no effect on springs, seeps, and groundwater sources (PBF 1), complex aquatic habitats (PBF 4), spawning and rearing areas (PBF 6), a natural hydrograph (PBF 7), or the presence of nonnative predatory, interbreeding, or competing fish species (PBF 9).

2.5.2.2 Effects of Interrelated or Interdependent Actions

The Service has not identified actions that are interrelated or interdependent with the proposed action.

2.6 Cumulative Effects

The implementing regulations for section 7 define cumulative effects to include the effects of future State, tribal, local or private actions 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.

2.6.1 Bull Trout

Greater than 99 percent of the project area is Federally managed; however, there are small pieces of land that are privately owned. Most private land in the Yankee Fork area is associated with mining, which is expected to continue to degrade surface and groundwater at or slightly below current levels. Maintenance and repair of roads in the drainage is expected, which will continue to prevent or delay channel and floodplain restoration. The SBT and other partners are continuing to plan and implement restoration projects in the Yankee Fork drainage; however, these will have a Federal nexus and will undergo separate section 7 consultation (NMFS 2018).

NMFS (2018) conducted an online search for real estate listings, development plans, mining, and mines for sale in the Yankee Fork drainage and did not find any new activities being considered on private property. The Service therefore finds, like NMFS, that new developments or mines are unlikely to occur. In addition, any future mining development will likely require a special use permit or other authorization from the Forest Service, and would require section 7 consultations.

Future impacts from State or private actions are likely to be similar to what they currently are, These impacts have been described in the Environmental Baseline and are not expected to change appreciably. No additional cumulative effects are reasonably certain to occur.

2.6.2 Bull Trout Critical Habitat

The cumulative effects described above for bull trout also apply to bull trout critical habitat.

2.7 Conclusion

2.7.1 Bull Trout

The Service has reviewed the current status of the bull trout, the environmental baseline in the action area, effects of the proposed action, and cumulative effects, and it is our conclusion that the proposed action is not likely to jeopardize the continued existence of the bull trout. Increases in water temperature resulting from outfall discharges and fish collection using electrofishing (resulting in injury and death) are likely to adversely affect bull trout. However, these effects will only occur in FMO habitat, not SR habitat. Because adverse effects are limited to individual

feeding, migrating, or overwintering bull trout, we are not expecting adverse effects at the larger population, core area, recovery unit, or rangewide levels.

2.7.2 Bull Trout Critical Habitat

The Service has reviewed the current status of bull trout critical habitat, the environmental baseline in the action area, effects of the proposed action, and cumulative effects, and it is our conclusion that the proposed action is not likely to destroy or adversely modify designated critical habitat for bull trout. Electrofishing is likely to adversely affect PBF 2 (migration) and increases in water temperature resulting from outfall discharges are likely to adversely affect PBF 5 (temperature) of bull trout critical habitat; however, these actions will only impact FMO habitat, not SR habitat. Because adverse effects are limited to discrete reaches of FMO habitat, we are not expecting adverse effects at the larger CHSU, CHU, or rangewide designation levels.

2.8 Incidental Take Statement

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species, respectively, without specific 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 in the definition of take in the Act means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

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

EPA has a continuing duty to regulate the activity covered by this incidental take statement. If EPA fails to assume and implement the terms and conditions the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, EPA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

This Incidental Take Statement remains valid for 5 years from the issuance of the renewed permit or until a new permit is issued.

2.8.1 Form and Amount or Extent of Take Anticipated

The Service has determined that electrofishing will result in the incidental take of adult and subadult bull trout in the form of harassment, harm, and mortality. The Service has also determined that warmer stream temperatures in FMO habitat in Jordan Creek and the Yankee Forks from warm water discharges from outfalls 002 and 003 will result in the incidental take of bull trout in form of harassment. These two pathways for incidental take are discussed in the

following sections. Also discussed below is the need to confirm the assumed absence of bull trout redds below the outfalls.

Electrofishing

As discussed in section 2.5.1.1, electrofishing has the potential to result in sublethal and lethal take of bull trout. Electrofishing is conducted every 5 years. The anticipated numbers of bull trout subject to take by electrofishing shown in Table 22 are based on the numbers that have been sampled in the past in Jordan Creek and the numbers trapped or detected by the SBT in the Yankee Fork (see Section 2.4.1.1).

Table 22. Incidental take limits for electrofishing conducted every 5 years in Jordan Creek and the Yankee Fork. A 5 percent injury/mortality rate was applied to calculate the lethal take limit (NMFS 2018).

Location	Incidental Take Limits	
	Sublethal	Lethal
Jordan Creek	10	2
Yankee Fork	200	10

Authorized take will be exceeded if the limits shown in Table 22 are exceeded or if electrofishing occurs more frequently than once every 5 years.

Water Temperature

Temperature impacts associated with the discharge of heated effluent are expected to occur during the warmer months of the year (e.g., July through September). Based on maximum recorded effluent temperatures and mixing zone modeling, resultant in-stream temperatures are not expected to cause lethality or impede fish movements. However, the discharges contribute to in-stream warming to levels outside of those optimal for growth and disease resistance.

For the purposes of this Opinion and lacking additional information, incidental take of bull trout from the discharge of heated water to Jordan Creek is confined to the stretch of stream from outfall 002 to the mouth of Jordan Creek because the effluent comprises a significant portion of the streamflow in this reach, and there does not appear to be other significant sources of cooler tributary water. For the Yankee Fork, because the effluent comprises a much smaller percentage of the stream flow, the extent of incidental take is estimated to extend downstream from outfall 003 to monitoring location S-10 (or S-14 once established).

We are not able to identify the number of bull trout that may be subject to incidental take resulting from exposure to elevated stream temperatures. Therefore, we will use the 7-day average of the daily maximum water temperatures at S-4 and S-10/S-14 as a surrogate for take. Authorized take will be exceeded if the 7-day average of the daily maximum water temperatures is greater than 16ºC (60.8°F) from July through September.

Bull Trout Redds

An important assumption for the effects analysis and conclusions presented in this Opinion is that bull trout do not spawn near or downstream of the outfalls and therefore sensitive life stages (eggs, alevins, and fry) are not present in the most impacted stream reaches. Although the absence of spawning is based on the best available information, it is important to validate this assumption, as the authorized take will be exceeded if bull trout redds are present.

2.8.2 Effect of the Take

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the bull trout across its range.

Only adult and subadult bull trout in FMO habitat in Jordan Creek and the Yankee Fork will be subject to incidental take from electrofishing and elevated stream temperatures. Because adverse effects are limited to individual feeding, migrating, or overwintering bull trout, we are not expecting adverse effects at the larger population, core area, recovery unit, or rangewide levels.

2.8.3 Reasonable and Prudent Measures

The Service concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the take of bull trout caused by the proposed action.

1. Minimize the potential for harassment, harm, and mortality to bull trout from electrofishing.
2. Minimize the potential for harassment to bull trout from elevated water temperatures in Jordan Creek and the Yankee Fork.
3. Minimize the potential for the proposed action to result in harm and mortality of sensitive bull trout life stages (i.e., eggs, alevins, and fry).

2.8.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the EPA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary. Required reporting and monitoring requirements are described in Section 2.8.5.

To implement reasonable and prudent measure 1:

a. When performing fish sampling with electrofishing equipment the operation will be led by an experienced fisheries biologist and will follow the most current NMFS electrofishing guidelines (2000).
b. Only direct current (DC) or pulsed direct current (PDC) will be used.
    i. If conductivity is less than 100 µS/cm, voltage up to 1100 v. will be used. For conductivity ranges between 100 to 300 µS/cm, voltage up to 800 v

will be used. For conductivity greater than 300 µS/cm, voltage will be less than 400 v.

c. Electrofishing will begin with a minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized.

d. The anode will not intentionally contact fish while the current is being emitted.

e. Electrofishing will not occur when water temperature is warmer, or is expected to be warmer, than 64ºF (17.8ºC) during the sample interval.

f. Fish shall be held in containers that are adequately aerated and not overcrowded.

g. If held for extended periods of time, water shall be exchanged as necessary to maintain temperatures that mimic the stream.

h. If mortality or obvious injury (defined as dark bands on the body, spinal deformations, de-scaling of 25 percent or more of body, and torpidity or inability to maintain upright attitude after sufficient recovery time) occurs during electrofishing, operations will be immediately discontinued, machine settings, water temperature and conductivity checked, and procedures adjusted or postponed to reduce mortality.

To implement reasonable and prudent measure 2:

a. Continue to monitor temperatures at S-4 and S-10/S-14, and provide the Service the seven day average of the daily maximum water temperatures for data collected between July and September.

To implement reasonable and prudent measure 3:

a. As soon as practicable, conduct bull trout redd surveys at and downstream of both outfall 002 and outfall 003. Use standard protocols and experienced personnel. If experts in the field determine that any areas to be surveyed are unsuitable for bull trout spawning (i.e., lack suitable substrate, stream temperatures are above 10 degrees C during the spawning season, etc.), redd surveys in these areas would not be required. Report the results to the Service as described in Section 2.8.5.

2.8.5 Reporting and Monitoring Requirement

In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [(50 CFR 402.14 (i)(3)]. EPA shall ensure through the agency's binding permit language that Hecla annually report on compliance with this Opinion's terms and conditions. Submit all reports, including Hecla's annual surface water and biomonitoring reports to: Consultation Supervisor, U.S. Fish and Wildlife Service, Idaho Fish and Wildlife Office, 1387 S. Vinnell Way, Suite 368, Boise, Idaho 83709.

1. By April 15 in the year following electrofishing, EPA shall provide a report to the Service documenting the number of bull trout captured and handled. The report shall include the date captured/released, as well as general information on life history stage and condition of captured bull trout (e.g., presence of injuries or mortalities).

2. Annually by April 15 of the following year, EPA shall provide a report documenting the seven day average maximum of temperatures recorded between July and September at S-4 and S-10 (or the new station S-14 once established).
3. As soon as possible after completing redd surveys, EPA shall provide a report detailing the presence or absence of bull trout redds. If habitat below the outfalls is determined to be unsuitable for bull trout spawning, the report shall explain how the determination was made and provide maps showing the unsuitable reaches. If redds are found, reinitiation of consultation will be required.
4. Upon locating dead, injured, or sick bull trout, or upon observing destruction of redds as a result electrofishing, such activity shall be terminated and notification must be made within 24 hours to the Services Division of Law Enforcement at (208) 378-5333.

2.9 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 programs, or to develop new information on listed species.

1. Assess the feasibility and effectiveness of riparian planting along Jordan Creek and the Yankee Fork in order to lower stream temperatures and make the streams more resilient to influxes of warm water from outfalls 002 and 003.
2. Work with cooperators to study the bull trout population in Jordan Creek. Particular goals for such a study would be to determine the location of spawning areas and movement patterns.

2.10 Reinitiation Notice

This concludes formal consultation on the EPA reissuance of an NPDES permit for Hecla's Grouse Creek Unit. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if:

1. The amount or extent of incidental take is exceeded.
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion.
3. The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion.
4. A new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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3.2 *In Litteris* References

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4. APPENDICES

4.1 Appendix A. Matrix of Pathways and Indicators for the Yankee Fork

The following table has been excerpted from this source:

Shoshone Bannock Tribes 2012. Biological Assessment for ESA Listed/Proposed/Candidate Fish Species. Yankee Fork Chinook Salmon PIT Tag Array Project

Table A-1. Status of Baseline Conditions for Yankee Fork Watershed

Agency: USDA Forest Service, Salmon-Challis National Forest	5'" Field HUC and Name: 1706020105, Yankee Fork
Unit: Challis-Yankee Fork Ranger District	Spatial Scale of Matrix: One 5th HUG
Fish Species Present: Chinook Salmon, Steelhead, Bull Trout	Designated Critical Habitat Present: Chinook Salmon, Steelhead, Bull Trout
Anadromous Species Major Population Group: Upper Salmon River Chinook Salmon MPG, Salmon River Steelhead MPG	Anadromous Species Subpopulation: Yankee Fork Chinook Salmon Population, Upper Salmon River Mainstem Steelhead Population.
Bull Trout Core Area: Upper Salmon River	Local Population: West Fork Yankee Fork, Yankee Fork
Management Actions: Ongoing	Last Updated: 12-12-2011 (C. Wood)

Pathway	Indicators	Functionality Of Baseline	Description
Subpopulation Characteristics	Subpopulation Size	Functioning Appropriately	Bull trout are known to occur in the upper portion of the Yankee Fork Watershed and in tributaries to the Yankee Fork, such as McKay Creek, Elevenmile Creek, Eightmile Creek, Fivemile Creek, Adair Creek, the West Fork Yankee Fork, Lightning Creek, Cabin Creek, and Ramey Creek (Garnett & Bartel 2008). Bull trout densities are known for McKay Creek and are moderate to high (Bartel & Garnett 2010).
	Growth and Survival	Functioning Appropriately	Growth and survival of bull trout within the watershed appear to be good; all age classes are present (sampling data on file at Lost River Ranger District). Multiple years of data from McKay Creek show a stable trend for the bull trout subpopulation in that stream (Bartel & Garnett

Pathway	Indicators	Functionality Of Baseline	Description
			2010). The abundance and wide distribution of subpopulations within the Yankee Fork watershed ensure resilience of bull trout in the event that a short-term disturbance or population decline should affect one subpopulation.
	Life History Diversity and Isolation	Functioning Appropriately	A radio telemetry study showed the migratory form of bull trout making consistent movements between the Yankee Fork watershed and the upper mainstem Salmon River (Schoby & Curet 2007). The connectivity of the Yankee Fork bull trout populations with other populations as far away as Redfish Lake was documented as part of that study. The migratory corridors for bull trout within the Lower Yankee Fork subwatershed are degraded, but the Middle, Upper, and West Fork Yankee Fork subwatersheds contain good migratory corridors and rearing habitat. There are no built barriers that impede migration within the mainstem Yankee Fork.
	Persistence and Genetic Integrity	Functioning Appropriately	Neighboring subpopulations of bull trout within the Yankee Fork watershed are relatively close in proximity to each other. The probability of hybridization is nonexistent given the absence of brook trout in the Yankee Fork. The probability of displacement by competitive species is low.
Water Quality	Temperature	Functioning at Risk	Factors influencing water temperatures within the Yankee Fork watershed such as stream shading, width:depth ratios, and flows are believed to be functioning at risk in the dredged reaches of the Lower Yankee Fork and Jordan Creek subwatersheds. Water temperature data collected in 2002 showed water temperatures exceeding 17 degrees Celsius in those areas. Water temperatures in the West Fork Yankee Fork also exceeded 17 degrees Celsius, however, and it is a relatively undisturbed subwatershed. Additionally, 2002 water temperature data collected in tributaries to the Yankee Fork, such as Tenmile Creek, showed that temperatures did not exceed 9.2 degrees Celsius (data on file at Lost River Ranger District).
	Sediment	Functioning at Risk	Depth fine data within the Yankee Fork watershed in year 2010 showed that depth fines ranged between 24–37%. The average trend for a range of sampling locations within the Yankee Fork from years 1995 through 2010 appears to be widely variable, but with some of the higher depth fines percentages occurring in recent years (data on file at Lost River Ranger District). Local natural disturbances within the steep topography of the Yankee Fork watershed contribute large amounts of sediment to streams on an almost annual basis. Presumably, this fine sediment accumulation occurs in both spawning and rearing areas.
	Chemical Characteristics	Functioning Appropriately	There are no CWA 303d designated reaches (in regards to chemical contaminants) with the Yankee Fork watershed. Presently, there are no chemical contaminants which affect water quality that are not within Idaho Department of Environmental Quality standards. However,

Pathway	Indicators	Functionality Of Baseline	Description
			some chemical contaminant sources related to past and present mining activities pose a risk that contaminants may become available to the channel network.
Habitat Access	Physical Barriers	Functioning at Risk	Upstream and downstream passage to most anadromous and resident fish habitat is at natural levels. Some tributaries to the Yankee Fork that were historically accessible by fish are now inaccessible due to past dredge mining (Jerry's Creek and Silver Creek). A built structure on Jordan Creek near its confluence with the Yankee Fork may prevent upstream passage for juvenile salmonids during certain flows. Some tributaries to the Yankee Fork have culverts in them, and according to 2004 data, a culvert in 4th of July Creek is likely a fish passage barrier and a culvert in Slaughterhouse gulch was possibly a fish barrier (data on file at Lost River Ranger District).
Habitat Elements	Substrate Embeddedness	Functioning at Risk	There were variable and sometimes moderate levels of sediment that existed at a range of sampling locations in the Yankee Fork watershed from years 1995 through 2010 (data on file at Lost River Ranger District). Recent data for substrate embeddedness is not available.
	LWD	Functioning at Risk	Results of the 2010 USFS Level II stream habitat survey for the Yankee Fork and Jordan Creek showed that Riparian Management Objectives derived from PACFISH (>20 pieces of medium or large wood/mile) were not met for large woody debris in any of the survey reaches (USFS 2010). Annual inputs of LWD are generally not retained in the dredged reaches of the Yankee Fork and Jordan Creek due to high water velocities and lack of floodplain, though these areas likely functioned similarly in natural conditions (Reclamation 2011). The upper portions of the Yankee Fork watershed retain more LWD than the Lower Yankee Fork subwatershed, however. Potential sources of LWD in the Yankee Fork watershed are being recruited and maintained.
	Pool Frequency and Quality	Functioning at Risk	Pool frequency per mile criteria listed in the RMO is probably not suitable for the bedrock channel system that alternates between bedrock and alluvial channel segments within the Yankee Fork watershed (Reclamation 2011). Results of the 2010 USFS Level II stream habitat survey for the Yankee Fork and Jordan Creek showed that pool frequencies within a reach did not always meet standards.
	Off-channel Habitat	Functioning at Risk	Off-channel habitat within the dredged reaches of the Yankee Fork and Jordan Creek is likely reduced from natural levels. Other areas within the watershed appear to contain appropriate levels of this habitat feature, or are functioning at near-natural conditions.
	Refugia	Functioning at Risk	May be limited within the dredged reaches of the Yankee Fork and Jordan Creek where the floodplain may have been reduced in size and where water velocities are high during the

Pathway	Indicators	Functionality Of Baseline	Description
			spring. Refugia are good in upper reaches of the Yankee Fork Watershed. Some tributaries to the Yankee Fork that may have historically functioned as refugia for fish are now inaccessible due to past dredge mining (Jerry's Creek and Silver Creek).
Channel Condition and Dynamics	Width:Depth Ratio	Functioning At Risk	Results of the 2010 USFS Level II stream habitat survey for the Yankee Fork and Jordan Creek showed that Riparian Management Objectives derived from PACFISH were not met for width:depth ratios within any of the dredged reaches of the Yankee Fork. All but one of the survey reaches upstream of the dredged area met the RMO for width:depth ratio (USFS 2010).
	Streambank Condition	Functioning Appropriately	Results of the 2010 USFS Level II stream habitat survey for the Yankee Fork and Jordan Creek showed that Riparian Management Objectives derived from PACFISH (90% stable) were met for streambank stability for all but one of the survey reaches. In that reach, the RMO standard was exceeded by less than 2% (USFS 2010).
	Floodplain Connectivity	Functioning at Risk	Overbank flows have been eliminated relative to historic frequency within the dredged reaches of the Yankee Fork. While there is an apparent lack of water velocity dissipation that occurs in these reaches due to the unnatural confinement of the stream by dredge piles, it is likely that river was naturally confined by the steep and narrow topography during natural conditions (Reclamation 2011). Floodplain connectivity is good in upper reaches of the Yankee Fork Watershed.
Flow/ Hydrology	Change in Peak/Base Flows	Functioning Appropriately	Data processed by Bureau of Reclamation as part of the Yankee Fork Tributary Assessment effort indicates that changes over time in the annual watershed hydrograph are related to climate change and are not unique to the Yankee Fork watershed (Reclamation 2011). There are no major agricultural or municipal uses for existing diversions on Forest Service lands, therefore flows have not been affected by them.
	Increase in Drainage Networks	Functioning Appropriately	There does not appear to have been any significant change to the drainage network within the Yankee Fork watershed.

Pathway	Indicators	Functionality Of Baseline	Description
Watershed Conditions	Road Density and Location	Functioning at Risk	The Yankee Fork watershed road density, excluding mining access roads, is about 0.85 miles/square miles and many of these roads are generally located along stream corridors.
	Disturbance History	Functioning Appropriately	Relative values associated with an Equivalent Clear-cut Acres (ECA) are not known for the Yankee Fork Watershed. EGA's that are known for all other watersheds in the Upper Salmon River Basin are less than 15%, however (data on file at Lost River Ranger District). Timber harvest within the Yankee Fork watershed was extensive during the late 1800s/early 1900s and was associated with the fast growth of the mining industry at that time. Timber harvest in the Yankee Fork within the last few decades has been limited, however.
	Riparian Conservation Areas	Functioning at Risk	Within the dredged portions of the Lower Yankee and Jordan Creek subwatersheds there have been severe alterations within riparian zones. Vegetation in these areas is scattered at low levels and riparian zones are considered non-functional. Riparian vegetation within the non-dredged portions of the Yankee Fork watershed is considered to be at middle or high seral status and at Proper Functioning Condition (USFS 2001). Mitigation measures have been developed for all activities to help protect RHCA's.
	Disturbance Regime	Functioning at Risk	Environmental disturbance events are localized and occur in minor parts of the Yankee Fork watershed in variable years. Such disturbance events include wildfires and high intensity rain events that tend to cause debris torrents in steep topographical areas. The habitat appears to have moderate resiliency in recovering from these environmental disturbances. Disruptions in natural fire regimes have decreased fire frequency, but increased fire intensity and size, as exhibited by the 2000 Rankin Creek Fire and 2006 Potato Fire (Reclamation 2011).
Integration of Species and Habitat Conditions	Habitat Quality and Connectivity	Functioning at Risk	Fine sediments inputs, stream temperatures, and the connectivity of suitable habitat within the Yankee Fork watershed have been altered by anthropogenic activities. The connectivity and size of subpopulations within the watershed have been reduced from historic conditions, but now exhibit stable trends and persistence into the long- term.

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4.1.1 References

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4.2 Appendix B. Biomonitoring Results

Another line of evidence on the overall effect of the discharge to the ecological condition of the stream reaches is the measure of biotic integrity. According to the USFWS 2003 Biological Opinion (USFWS 2003), the Service considers this assemblage useable to detect affects to the bull trout population. Macro-invertebrates are an important food source for bull trout, thus effects (declines or alterations in relative abundance) to the benthic macro-invertebrate community would be indicative of adverse impacts to the bull trout population and that it can be used to infer take. They state that statistically significant decreases in invertebrate abundance, diversity or composition between upstream and downstream sample locations are indicative of adverse effects. Monitoring data on macro-invertebrates was collected from both streams to monitor possible effects to the benthic population. Data were compared to the State of Idaho screening criteria for assessment of ecological integrity. The following is a summary of conclusions from these reports. Additional, the fish assemblage was monitored in Jordan Creek with the same objectives to compare the biological integrity between sites upstream and downstream of outfall 002 to determine if the effluent is having an adverse effect.

4.2.1 IDEQ aquatic monitoring result in the action area

IDEQ's Beneficial Use Reconnaissance Project (BURP) collects benthic invertebrate, fish assemblage, water chemistry and habitat data to determine the quality of Idaho's waters (Grafe et al. 2002). Stream field data are evaluated using multi-metric indices for fish assemblage (SFI), habitat (SHI), and benthic macroinvertebrates (SMI) which are specific to the bioregions. Data results are compared to established bioregion specific reference condition and then assigned a rating of 3, 2, or 1 corresponding to high, medium, low relation to the reference condition. The results are used by IDEQ to evaluate the support of cold water aquatic life. Details on methodology are in Grafe (2002a and 2002b). The IDEQ BURP database was searched for monitoring data available from the action area for describing stream quality in the action area and for validation of biological monitoring data collected by the mine. Data for two relevant areas were found: BURP Yankee Fork assessment area (ID17060201SL032_04) and BURP Jordan Creek assessment area (9ID17060201SL041_03) (Table 23). All data were obtained from http://www2.deq.idaho.gov/water/BurpViewer/Menu.

Table 23. Available IDEQ BURP monitoring data (1995-2011) from action area (BE Table 28).

Burp ID	SMI score	SMI rating	SFI Score	SFI Rating	SHI Score	SHI Rating	Ave. rating	Location
Jordan Creek BURP data								
1995SIDFA039	78.9	3	80.2	2	34	1	2.0	Below 002
2002SIDFA079	78.3	3	77.7	2	69	3	2.7	Below 002
2008SIDFA144	63.5	3	—	—	43	1	2.0	Below 002
2008SIDFA152	66.4	3	78.1	2	48	1	2.0	Below 002
Yankee Fork Creek BURP data								
1995SIDFA093	83.2	3	61.9	1	30	1	1.7	Below 003
1995SIDFA091	72.7	3	51.2	1	52	1	1.7	Above 003
2008SIDFA068	No data	—	—	—	—	—	—	Below 003
2011SIDFA029	83.6	3	60.7	1	88	3	2.3	Above 003
2011SIDFA030	81.2	3	80.6	2	81	3	2.7	Above 003

Jordan Creek results collected at various locations downstream of outfall 002 give an overall 'medium' rating. Benthic invertebrate and fish assemblage scores were consistently high and medium respectively. Habitat scores were all 'low' except in 2002 (high). Overall, conditions were consistent over between these 4 sample events (1995 – 2008).

Yankee Fork BURP data are less informative. Only one downstream site available from 1995 indicated high scores for benthic macroinvertebrate assemblage and low for fish assemblage and habitat. More recent data were collected far upstream of outfall 003. These sites have a 'high' rating due to better habitat condition.

4.2.2 Biomonitoring data –Hecla Limited

Biomonitoring data collected by GEI for Hecla Limited are available from sites upstream and downstream of both outfalls. Benthic macroinvertebrate data were collected from both Jordan Creek and Yankee Fork and fish assemblage data were collected from Jordan. Annual data collection began pre-discharge to establish a baseline condition for comparison and continued, in most years, post discharge (2003 – 2013).

Yankee Fork biomonitoring

Two monitoring sites, one above (S-9, which is 1 km above outfall 003) and one below (S-10, 1 km below outfall 003) are compared to evaluate possible effects of the discharge. Hecla Inc. used the classification and rating methods developed and used by IDEQ BURP for rivers (Grafe

2002a). These are similar to those used for the BURP data presented above but are adjusted for non-wadeable streams. Both the upstream and downstream monitoring sites were rated as high ('good') for benthic macroinvertebrate condition in the past three years (GEI 2012, 2013, 2014a) (Table 24). These results are comparable to those collected by IDEQ in Yankee Fork (Table 23).

Table 24. Results of multimetric analysis of benthic macroinvertebrates in Yankee Fork (BE Table 29).

	S-9 upstream site		S-10 downstream site	
Year	**RMI score**	**Rating**	**RMI score**	**Rating**
2011	21	Good	23	Good
2012	21	Good	21	Good
2013	21	Good	21	Good

Three benthic invertebrate metrics, density, total taxa, and EPT taxa, were used to evaluate trends over the entire monitoring period in Yankee Fork in the vicinity of outfall 003. Data were collected pre-discharge (1999 and 2000) and post discharge 2003 – 2013 GEI (2014a). This information shows the benthic macroinvertebrate assemblage in the Yankee Fork is stable with no decreasing trends in any of these metrics. These results indicate that instream water quality and habitat conditions are not degrading and specifically do not indicate degradation associated with discharge from outfall 003. The following are a summary of findings over this monitoring period.

Benthic invertebrate density (#/m^2) has been variable at both the upstream and downstream sites. The two sites are compatible in terms of year to year variability. There is evidence that stream flow may be the driver for this variability in density (GEI 2014a). There is no statistically significant increasing or decreasing trend in density for the upstream or downstream site over the monitoring years of sampling (1999 – 2013).

Total mean number of taxa has been generally higher since 2003 compared to the 1999 – 2000 pre-discharge baseline. There is no statistically significant increasing or decreasing trend in density for the downstream site. The upstream site has a significant upward trend over the monitoring years of sampling (1999 – 2013). A possible explanation for the positive trend for the upstream site is that this area has better riffle habitat that would be likely to support a more diverse macro-invertebrate assemblage.

EPT mean number of taxa has been similar or higher at both Yankee Fork monitoring sites compared to the pre-discharge baseline data (1999 – 2000). There is no statistically significant increasing or decreasing trend in EPT taxa abundance for the upstream or downstream site over the monitoring years of sampling (1999 – 2013).

Jordan Creek biomonitoring

Two monitoring sites, one above (S-6, which is 2.4 km above outfall 002) and one below (S-4, which is 0.3 km below outfall 002) are compared to evaluate possible effects of the discharge. Data were available for both benthic macroinvertebrate and fish assemblage from Hecla Inc. reports. Their analysis use the multimetric classification and rating methods developed and used

by IDEQ BURP for streams (Grafe 2002b). Scoring for both assemblages over the past three years does not indicate a degraded condition for biota in this area (Table 25). These results are comparable to those collected by IDEQ in Jordan Creek (Table 23).

Table 25. Results of multimetric index analyses for benthic macroinvertebrate (SMI) and fish (SFI) assemblages in Jordan Creek (BE Table 30).

	S-6 upstream site		S-4 downstream site	
Year	**score**	**Rating**	**score**	**Rating**
	Benthic macroinvertebrate assemblage			
2011	87	Very good	88	Very good
2012	82	Very good	77	Good
2013	79	Good	78	Good
	Fish assemblage (SFI)[1]			
2011	76	Medium	93	High
2012	81	High	94	High
2013	85	High	89	High

Source: GEI 2012b, 2013b, 2014b.
1. GEI did not apply rating convention described in Grafe 2002b. The table is populated with fish assemblage condition ratings based on cut-offs from the Grafe 2002b methodology for the Forested Bioregion. This is consistent with the procedure used in the IDEQ results presented in the previous table.

Four benthic invertebrate metrics were used to evaluate trends over the entire monitoring period 1999-2013 GEI (2014a). This information shows the benthic macroinvertebrate assemblage in Jordan Creek has stable or increasing trends. These results indicate that instream water quality and habitat conditions are not degrading and specifically do not indicate degradation associated with discharge from outfall 002. The following are a summary of findings over this monitoring period.

Benthic invertebrate density (#/m^2): There is a statistically significant increasing trend in density for both the upstream (S-6) and downstream site (S-4) over the monitoring years of sampling (1999 – 2013). Site S-4 had a significantly higher trend in density than S-6 over the same period.

Total mean number of taxa: There is a statistically significant increasing trend in mean number of taxa for both the upstream (S-6) and downstream site (S-4) over the monitoring years of sampling (1999 – 2013). Site S-6 had a significantly higher trend in number of taxa than S-4 over the same period.

EPT mean number of taxa: There is no statistically significant increasing or decreasing trend in EPT taxa abundance for the upstream or downstream site over the monitoring years of sampling (1999 – 2013). The long-term mean number of EPT taxa was significantly higher at site S-6 than at site S-4.

Shannon –Weaver diversity index: There is no statistically significant trend in the diversity index over the monitoring years of sampling. The long-term mean diversity index value at site S-6 is significantly higher than S-4.

Trends in Jordan Creek fish assemblage in the vicinity of outfall 002 are described using metrics of trout biomass, trout density, sculpins biomass, and sculpins density over the entire monitoring period 1999 – 2013 GEI (2014b). This information shows the fish assemblage in Jordan Creek is

variable over time yet stable. Differences in physical habitat and elevation between the upstream and downstream sites likely influence differences in sculpin abundance. These fish assemblage metrics do not indicate degradation associated with the discharge from outfall 002. The following are a summary of fish assemblage monitoring results.

Trout biomass: Biomass has been variable at both the upstream (S-6) and downstream(S-4) sites over the monitoring period (refer to the fish abundance section III.A.). There are no significant trends in trout biomass for either site over the sample period. The biomass trend is significantly higher at site S-4 compared to S-6.

Trout density: There is a significant increasing trend in trout density at the upstream site but no significant trend at the downstream site. Mean trout density at Site S-6 is significantly higher than at S-4 over the study period.

Sculpin biomass and density: Sculpin biomass and density over the monitoring period are both significantly higher at the downstream site (S-4) than the upstream site (S-6). No significant trends in sculpins biomass or density over the period were found.

Based on review of biomonitoring data from above and below the two outfalls, there does not appear to be adverse effects to the aquatic habitat from the effluent that would result in a detectable change in the presence, abundance, and diversity of the benthic assemblage.

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