Stibnite Gold Project

Fisheries and Aquatic Habitat (Including Threatened, Endangered, Proposed, and Sensitive Species) Report

Prepared by:
USDA Forest Service
Payette National Forest

for:
Payette and Boise National Forests

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Table of Contents

List of Tables

List of Figures

List of Acronyms

°C	degrees Celsius
µg/L	micrograms per liter
%	percent
ASAOC	Administrative Settlement Agreement and Order on Consent
BA	Biological Assessment
BF	bankfull
BMP	best management practices
BNF	Boise National Forest
Boise Forest Plan	Boise National Forest Land and Resource Management
CFR	Code of Federal Regulations
cfs	cubic feet per second
CR	County Road
DA	drainage area
dB	decibel

DEM	Digital Elevation Model
DPS	distinct population segment
East Fork SFSR	East Fork South Fork Salmon River
eDNA	environmental DNA
EFH	Essential fish habitat
EFMC	East Fork Meadow Creek
ESA	Endangered Species Act
ESS	Ecosystem Sciences
FA	Functioning Appropriately
FP	Forest Plan
FR	Functioning at Risk
FSH	Forest Service Handbook
ft	foot
FUR	Functioning at Unacceptable Risk
GIS	Geographic Information System
HUC	hydrologic unit code
ICTRT	Interior Columbia Technical Recovery Team
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
IP	intrinsic potential
ips	inches per second
IRA	inventoried roadless area
LiDAR	Light Detection and Ranging
km	kilometer
kV	kilovolt
m	meter
mg/L	milligrams per liter
MMP	Modified Mine Plan
MPG	major population group
MWMT	maximum weekly maximum temperature
N/A	not applicable
NFS	National Forest System
ng/l	nanograms per liter
NHD	National Hydrography Dataset
NMFS	National Marine Fisheries Service
NP	not present

NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity unit
OM	Occupancy Model
OP	occupancy potential
OSV	over-snow vehicle
RCA	Riparian Conservation Area
Payette Forest Plan	Payette National Forest Land and Resource Management Plan
Perpetua	Perpetua Resources Idaho Inc.
PHABSIM	Physical Habitat Simulation
PIBO	Pacific Anadromous Fish Strategy/Inland Fish Strategy Biological Opinion
PNF	Payette National Forest
PPV	peak particle velocity
RCA	Riparian Conservation Area
ROW	right-of-way
SFSR	South Fork Salmon River
SGLF	Stibnite Gold Logistics Facility
SGP	Stibnite Gold Project
SH	state highway
SODA	spent ore disposal area
SPCC	Spill Prevention, Control, and Countermeasure
SPLNT	Stream and Pit Lake Network Temperature
SWPPP	Stormwater Pollution Prevention Plan
TEPC	Threatened, Endangered, Proposed or Candidate
TSF	tailings storage facility
TSS	total suspended solids
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDOT	United States Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
VBET	valley bottom extraction tool
VBW	valley bottom width
VWR	valley width ratio
WCI	Watershed Condition Indicators
WSC	Westslope cutthroat trout
WUA	weighted usable area
WW	wetted width
YPP	Yellow Pine Pit

1.0 Introduction

The United States (U.S.) Department of Agriculture Forest Service (Forest Service) received the Stibnite Gold Project (SGP) Plan of Restoration and Operations, (Midas Gold Idaho, Inc. 2016) for review and approval in accordance with regulations at 36 Code of Federal Regulations (CFR) 228 Subpart A for the proposed SGP in central Idaho. A revised Plan, also known as ModPRO,[1] was submitted to the Forest Service in 2019 (Brown and Caldwell 2019a). A further modified Plan, also known as ModPRO2,[2] was then submitted in October of 2021 (Perpetua 2021a). Midas Gold changed their name to Perpetua Resources Idaho Inc. (Perpetua[3]) in February 2021.

The SGP would consist of mine operations, including an open pit hard rock mine and associated processing facilities, located within Valley County in central Idaho on federal, state, and private lands (**Figure 1-1**). The SGP would produce gold and silver doré, and antimony concentrate, for commercial sale by Perpetua. The SGP would have a life (construction, operation, closure, and reclamation), not including post-reclamation monitoring, of approximately 20 years, with active mining and ore processing occurring over approximately 15 years.

This specialist report describes the fish resources and fish habitats in the analysis area of the SGP under existing (baseline) physical, chemical, and environmental conditions. While all fish species are of management interest, four special status salmonids (i.e., fish in the family Salmonidae, which includes salmon, trout, and whitefish) are of particular resource management interest because of their status as federally listed fish or fish of management concern to the Forest Service or State of Idaho. Of the four fish species, three are federally listed as threatened species under the Endangered Species Act (ESA): summer Chinook salmon, Snake River Basin steelhead, and Columbia River bull trout. Also, the Payette National Forest Land and Resource Management Plan (Payette Forest Plan) (Forest Service 2003) has designated bull trout as a Management Indicator Species. The Forest Service defines Management Indicators as plant and animal species, communities, or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent (Forest Service Manual 2620.5-1 1991). In addition, the Forest Service (Intermountain Regional Forester) has identified the westslope cutthroat trout as a Forest Service sensitive species.

This report describes the existing (baseline) conditions (Affected Environment) relevant to fisheries and aquatic resources and supporting habitats that have the potential to be affected by the SGP and also evaluates the potential effects (Environmental Consequences) that the SGP could have on these species and their habitat.

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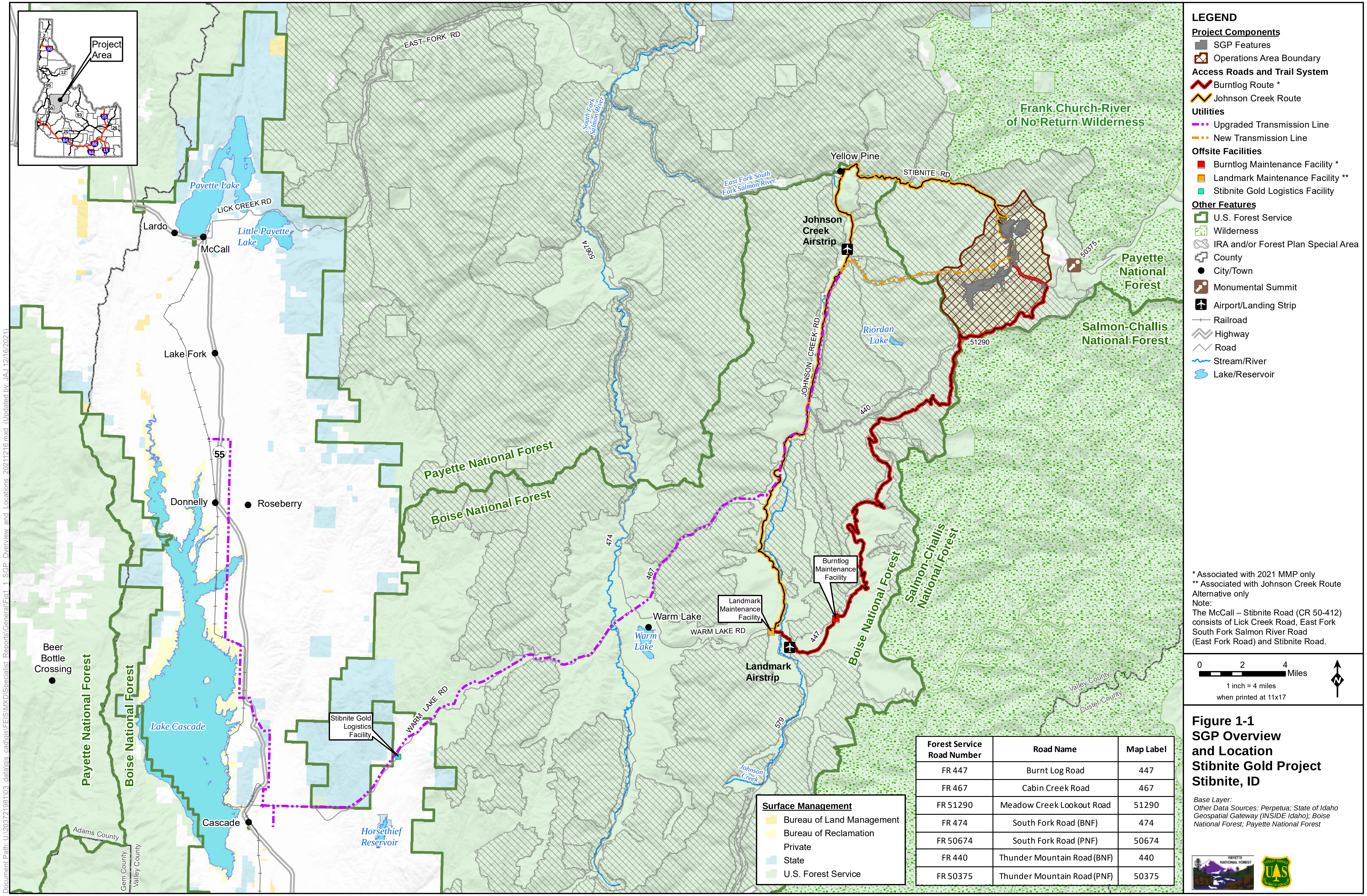
[1] Associated project documents may reference the Revised Plan as the ModPRO.

[2] Associated project documents may reference the Modified Plan as the ModPRO2.

[3] Documents provided by Perpetua prior to the February 2021 name change will still be cited and referenced as Midas Gold.



Forest Service Road Number	Road Name	Map Label
FR 447	Burnt Log Road	447
FR 467	Cabin Creek Road	467
FR 51290	Meadow Creek Lookout Road	51290
FR 474	South Fork Road (BNF)	474
FR 50674	South Fork Road (PNF)	50674
FR 440	Thunder Mountain Road (BNF)	440
FR 50375	Thunder Mountain Road (PNF)	50375

Figure 1-1
SGP Overview and Location
Stibnite Gold Project
Stibnite, ID

Base Layer:
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

2.0 Alternatives, Including the Proposed Action

The SGP 2021 Modified Mine Plan (MMP) Alternatives Report (Forest Service 2022a) contains the details of the alternatives that are being considered and fully analyzed in this report. For reader usability, the alternatives are briefly summarized here.

2.1 No Action Alternative

The No Action Alternative provides an environmental baseline for comparison of the action alternatives. Under the No Action Alternative, the mining, ore processing, and related activities under the 2021 MMP or the Johnson Creek Route Alternative would not take place. In addition, certain legacy and existing mining impacts would be addressed as directed in the 2021 Administrative Settlement Agreement and Order on Consent (ASAOC), including installation of stream diversion ditches designed to avoid contact of water with sources of contamination and removal of development rock and tailings currently impacting water quality. However, existing and approved activities (i.e., approved exploration activities and associated reclamation obligations) would continue and Perpetua would not be precluded from subsequently submitting another plan of operations pursuant to the General Mining Law of 1872.

2.2 2021 Modified Mine Plan

The 2021 MMP is based upon Perpetua's Revised Plan (ModPRO2) and is considered the Proposed Action. The description of this alternative has been updated per the Revised Plan submitted in 2021 (Perpetua 2021a). The SGP operations footprint has been modified but would still be within the previously identified Operations Area Boundary (**Figure 2-1**).

The following mine components would be common to the action alternatives:

- Mine pit locations, areal extents, and mining and backfilling methods
- Transportation management on existing and proposed roads
- Pit dewatering, surface water management, and water treatment
- Ore processing
- Lime generation
- Tailings Storage Facility (TSF) construction and operation
- TSF Buttress construction methods
- Water supply needs and uses
- Management of mine impacted water and stormwater runoff
- Electrical transmission lines
- Stibnite Gold Logistics Facility (SGLF)
- A road maintenance facility
- Surface and underground exploration
- Stibnite Gold Project worker housing facility

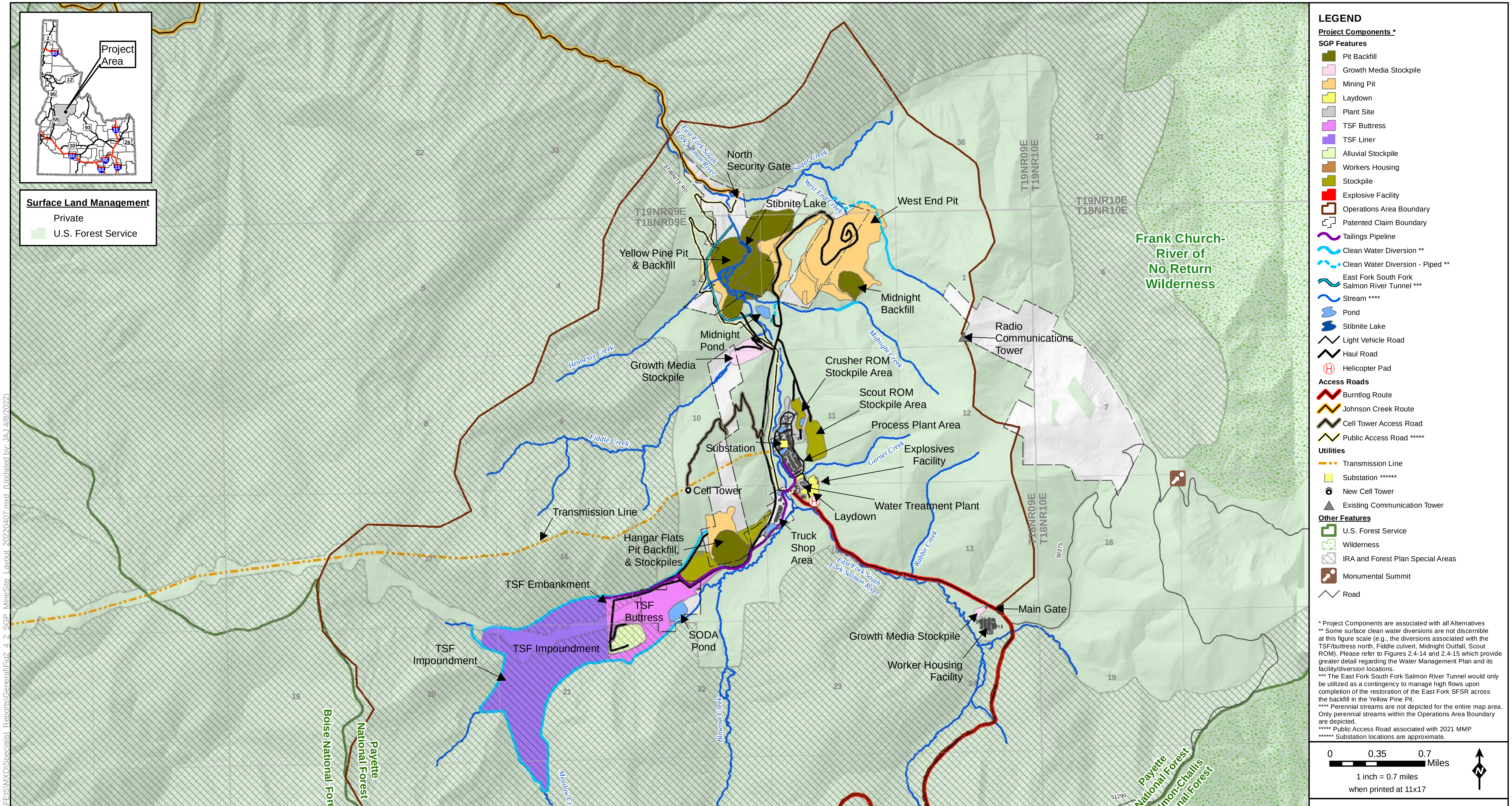


Figure 2-1
Mine Site Layout
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Midas Gold
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

For access, the 2021 MMP would utilize Warm Lake Road, Johnson Creek Road, and Stibnite Road during construction of the proposed Burntlog Route; then once constructed, the Burntlog Route would be utilized during operations and reclamation. The actions proposed under the 2021 MMP would take place over a period of approximately 20 years, not including the long-term, post-closure environmental monitoring or potential long-term water treatment.

2.3 Johnson Creek Route Alternative

The Johnson Creek Route Alternative was developed to evaluate potential reductions in impacts to various resources. The mining portion of this alternative would be the same as under the 2021 MMP. Therefore, the primary focus of the Johnson Creek Route Alternative would be using an existing road for mine access through operations and reclamation instead of the Burntlog Route that under the 2021 MMP requires new road construction in Inventoried Roadless Areas (IRAs). The Johnson Creek Route Alternative would require extensive upgrades to both Johnson Creek Road and Stibnite Road. The construction schedule for upgrading the roads and construction of the SGP would increase from 3 years to 5 years.

The action alternatives are summarized in **Table 2-1**.

Table 2-1 Action Alternatives Summary

SGP Phase	Component/ Subcomponent	2021 MMP	Johnson Creek Route Alternative
All Phases	SGP timeline	• Construction: Approximately3 years. • Operations: Approximately 15 years. • Exploration: Approximately 17 years (during construction and operations). • Reclamation: Approximately 5 years (except for the TSF which would require an additional 9 years for tailings dewatering and consolidation). • Closure/Post-Closure Water Treatment: Approximately through Mine Year 40. • Environmental Monitoring: As long as needed.	Same as 2021 MMP except: • Construction: Approximately 5 years (upgrading the existing Johnson Creek and Stibnite Roads to provide permanent mine access).
All Phases	Access Roads	Construction/Operations: • Warm lake road from State Highway (SH) 55 to Johnson Creek Route intersection (34 miles). • Johnson Creek Route for SGP access during early construction with minor improvements within the road prism. • Burntlog Route (38 miles) for SGP access during last year of construction, mining and ore processing operations, and closure and reclamation. Includes	Construction/Operations: • Warm lake road from SH 55 to Johnson Creek Route intersection (34 miles). • Johnson Creek Route (39 miles: Johnson Creek Road 25 miles, Stibnite Road 14 miles) upgraded and used for access throughout life of mine (LOM) instead of the Burntlog Route. • Access route around the Yellow Pine pit for public access, employee access, and deliveries

SGP Phase	Component/ Subcomponent	2021 MMP	Johnson Creek Route Alternative
		improvements of existing segments (23 miles) and road construction for new segments (15 miles). • Up to eight borrow areas developed along Burntlog Route for materials needed for road improvements and maintenance. • Access route around the Yellow Pine pit for public access. Closure and Reclamation: • New sections of Burntlog Route to be reclaimed after the closure and reclamation period.	of supplies and equipment to the processing, warehouse, worker housing facility, and administration areas. • No improvements or construction of new segments for Burntlog Route. • Up to seven borrow sources developed along the Johnson Creek Route for materials needed for road improvements and maintenance. Closure and Reclamation: • Improved Johnson Creek and Stibnite roads would not be reclaimed to pre-existing conditions.
All Phases	Public Access	Construction: • Temporary groomed over-snow vehicle (OSV) trail on the west side of Johnson Creek from Trout Creek to Landmark while Burntlog Route is constructed (8 miles). • OSV trail on west side of Johnson Creek from Wapiti Meadows to Trout Creek campground closed during construction (9 miles). • OSV trail from Warm Lake to Landmark closed during construction through operations (8.5 miles). • Cabin Creek Road Groomed OSV trail (11 miles). • Public roads remain open through the SGP with temporary closures as needed to accommodate construction. Operations: • Groomed OSV trail moves from west side of Johnson Creek Road to Johnson Creek Road from Landmark to Wapiti Meadows (16.7 miles). • Stibnite Road (County Road [CR] 50-412) / Thunder Mountain Road (FR 50375) closed through the SGP. • Seasonal public access through the Operations Area Boundary provided by constructing new road through Yellow Pine pit and below mine	Construction and Operations: Same as 2021 MMP except: • OSV trail on the west side of Johnson Creek from Wapiti Meadows to Trout Creek campground would be closed from construction through mine closure (9 miles). • Groomed OSV trail on the west side of Johnson Creek from Trout Creek to Landmark lasting from construction through mine closure. Closure and Reclamation: Same as 2021 MMP.

SGP Phase	Component/ Subcomponent	2021 MMP	Johnson Creek Route Alternative
		haul road to link Stibnite Road (FR 50412) to Thunder Mountain Road (FR 50375). • Public access allowed on Burntlog Route to Thunder Mountain Road (FR 50375). • Closure and Reclamation: • New road constructed over the Yellow Pine Backfill (backfilled Yellow Pine pit) connecting Stibnite Road (FR 50412) to Thunder Mountain Road (FR 50375).	
Operations	Utilities – Transmission Lines	• Upgrade approximately 63 miles of the existing 12.5 kilovolt (kV) and 69 kV transmission lines. • New approximate 9-mile, 138 kV line would be constructed from the Johnson Creek substation to a new substation at the mine site. • Upgrade the substations located at Oxbow Dam, Horse Flat, McCall, Lake Fork, and Warm Lake. • Reroute approximately 5.4 miles of transmission line to avoid the Thunder Mountain Estates subdivision. • Reroute approximately 0.9 miles of transmission line between Cascade and Donnelly to use an old railroad grade on private property. • Installation of approximately 3 miles of new underground distribution line along Johnson Creek Road from the Johnson Creek substation south to Wapiti Meadows.	Same as 2021 MMP.
Operations	Utilities - Communication Towers and Repeater Sites	• One cell tower located north of the Hangar Flats pit. • Locations along Burntlog Route for very high frequency (VHF) repeater sites. • Use existing access roads to repeater site locations along Burntlog Route. • Communication site at the SGLF. • Upgrades to existing communication site.	Same as 2021 MMP except: • Cell tower sites constructed and maintained using helicopter (instead of constructing access roads) for sites within IRAs managed for Backcountry/Restoration. • Locations along Johnson Creek route for repeater sites.

SGP Phase	Component/ Subcomponent	2021 MMP	Johnson Creek Route Alternative
Operations	Off-site Maintenance Facility	• SGLF located along Warm Lake Road. • Burntlog Maintenance Facility located at one of the borrow source locations 4.4 miles east of the junction of Johnson Creek Road and Warm Lake Road along the proposed Burntlog Route.	• SGLF same as 2021 MMP • Landmark Maintenance Facility located at junction of Warm Lake Road at Johnson Creek Road.
Closure and Reclamation	Access road segments	• Removal and reclamation of new road segments constructed for Burntlog Route. • Return of previously existing road segments to pre-construction width and condition.	• No removal or reclamation of pre-existing access routes.

2.4 Applicable Environmental Design Features

The SGP must comply with all laws and regulations that apply to the proposed activities (Forest Service 2022a). Standards and guidelines in the Payette and Boise National Forest Land and Resource Management Plans (Forest Service 2003, 2010a) that are designed to reduce or prevent undesirable impacts resulting from proposed management activities are incorporated into the action alternatives by reference. In addition, best management practices outlined in the Best Management Practices for Mining in Idaho (Idaho Department of Lands (IDL) 1992) would be implemented where appropriate and applicable for operations to minimize site disturbance from mining and drilling activities.

In the design of the 2021 MMP, Perpetua has already considered many of the potential environmental impacts that might be caused by the SGP. This has led to an internal evaluation of project design features and operational characteristics that may have the effect of reducing and/or eliminating potential environmental impacts of the SGP. Such project-specific measures intended by a proponent to inherently reduce and/or avoid potential environmental impacts of a proposed action are referred to as environmental "design features."

Based on the application of permits and regulatory compliance requirements (Forest Service 2022a) to the project, regulatory requirements, standards and guidelines, best management practices, and likely permit conditions are listed in **Table 2-2**. The environmental design features that have been proposed and committed to by the proponent are listed in **Table 2-3**. All of these environmental design measures have been assumed to be effective in conducting the environmental analysis presented in **Section 7.0**.

Table 2-2 Prominent Regulatory and Forest Service Requirements for Fisheries and Aquatic Habitat

Description	Type	Reference
Fish passage shall be provided at all proposed and reconstructed stream crossings of existing and potential fish-bearing streams.	FP Component	BNF and PNF: SWST08
When taking water from TEPC fish-bearing waters for road and facility construction and maintenance activities, intake hoses shall be screened with the most appropriate mesh size (generally 3/32 of an inch), or as determined through coordination with NMFS and/or USFWS.	FP Component	BNF and PNF: FRST01, TEST32

Description	Type	Reference
Employees and staff will receive training and direction to avoid spawning adult Chinook salmon, bull trout and steelhead.	Design Feature	
Surface water withdrawal intake hoses will be situated so as to prevent generation of turbidity in bottom sediments during pumping.	Design Feature	
The operator will immediately report any fuel, oil, or chemical discharges or spills greater than 25 gallons on land, or any spill directly in a stream to IDEQ, Forest Service, USFWS, and NMFS as required by applicable federal and state regulations by phone and/or fax (or as soon as possible after on-site containment efforts are implemented as per the SPCC plan), and initiate emergency consultation.	Regulatory Requirement	50 CFR 402.05
To reduce the potential of slope failure associated with saturated sump pits on steep slopes, a remote sump or portable recirculation tank would be used if stability considerations warrant it. On slopes greater than 35 percent, the selected locations would be reviewed fand approved by Forest Service specialists.	FP Component	BNF and PNF: SWGU03 Refer to the Implementation Guide for Management on Landslide and Landslide Prone Areas, located in Appendix B (Forest Service 2003, 2010a).
Prohibit solid and sanitary waste facilities in RCAs. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in RCAs exists, then: a) Analyze waste material using the best conventional methods and analytic techniques to determine its chemical and physical stability characteristics. b) Locate and design waste facilities using the best conventional geochemical and geotechnical predictive tools to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, and such releases or instability would result in exceedance of established water quality standards or would degrade surface resources, prohibit such facilities in RCAs. c) Monitor waste and waste facilities to confirm predictions of chemical and physical stability and make adjustments to operations as needed to avoid degrading effects to beneficial uses and native and desired non-native fish and their habitats. d) Reclaim and monitor waste facilities to ensure chemical and physical stability and revegetation to avoid degrading effects to beneficial uses and native and desired non-native fish and their habitats. e) Require reclamation bonds adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities.	FP Component	BNF and PNF: MIST09

Description	Type	Reference
An SPCC plan shall be prepared in accordance with 49 CFR parts 171 through 180, including packaging, transportation, incident reporting, and incident response. Include the following items within the SPCC plan: • During off-loading of fuel from fuel vehicles or during refueling operations have a standard marine-type fuel containment boom (which would be of sufficient length for a worst-case discharge), spill prevention kit, and fire kit readily available on site. • Store two or more spill containment/response caches along each of the fuel delivery routes. • Spill response team will carry sufficient containment equipment for one full fuel tanker. • Include the Forest Service as a party to be notified in the event of a hazardous materials spill. • Intake pumps, engines, fuel storage, fuel containment site, and other equipment with fuel or lubricants would be inspected at each refueling and periodically between refueling for leakage or spillage. • Pilot and emergency spill response vehicles would carry appropriate containment and first aid equipment. • All fuel containers would be marked with contents, owner's name and contact information. • Material Safety and Data Sheets for all products would be posted and available on site with the SPCC plan. • Intake pumps would not be situated within the active stream/ditch channel and would be placed within containment vessels capable of holding 120 percent of the pump engine's fuel, engine oil and hydraulic fluid. The smallest practical pump and intake hose would be used. • Following large storm events, the intake pumps would be inspected to determine if stream flow has encroached into the pump area and if the pump needs to be moved so it remains above flowing water. • A spill prevention and clean-up kit would be placed at the intake pump site and would consist of absorbent pads and/or boom (which would be sufficient length for a worst-case discharge), drip pan, a shovel, and a fire extinguisher. • Spare fuel for the water intake pump would be stored in approved [29 CFR 1926.152(a)(1)] fuel storage containers placed into a secondary containment vessel capable of holding at least 120 percent of the volume of the fuel in the fuel container. • A copy of the SPCC plan would be kept at an appropriate on-site facility.	Regulatory Requirement and Design Features	49 CFR 171
Unless otherwise authorized, all garbage or refuse should be removed from National Forest System lands. This includes, but is not limited to, empty fuel and lubricant containers. Food and garbage would be stored either indoors, in vehicles, or if outside, in wildlife-proof containers. No garbage would be burned.	FP Component and Design Features	Design Feature developed for compliance with BNF and PNF: MIGU04

Description	Type	Reference
Fuel will be stored in sealed 55-gallon steel drums, approved double-walled fuel tanks, or in approved single-walled tanks within secondary containment. Fuel will be managed, tanks would be inspected, and any oil release would be responded to in accordance with the SPCC plan.	FP Component	BNF and PNF: SWGU11 49 CFR 171
Should any oil or chemical discharges or spills occur, the release would be reported to IDEQ, and other appropriate agencies as required by applicable federal and state regulations immediately (or as soon as possible after on-site containment efforts are implemented as per the SPCC plan). Spill response would be in accordance with the SPCC plan, which includes a trained on-site emergency response team. Spills or discharges would be documented in writing.	Design Feature	
Transport hazardous materials on the Forest in accordance with 49 CFR 171 in order to reduce the risk of spills of toxic materials and fuels during transport through RCAs.	FP Component	BNF and PNF: SWGU11
Annual spill awareness/response training will be required for on-site personnel and suppliers/providers.	Design Feature	
Fuel containment sites, engines and other equipment with fuel or lubricants will be periodically checked for leakage or spillage and in accordance with the SPCC plan.	Design Feature	
A copy of the SPCC plan will be kept at an appropriate onsite facility. Staff handling fuel or petroleum products will be trained to successfully implement the SPCC plan. Inspections of fuel storage and handling areas will be conducted as specified in the SPCC plan. Appropriate warning signs will be placed around fuel storage facilities.	Design Feature	
Measures such as, but not limited to, segregating and stockpiling topsoil, implementing stormwater and sediment BMPs, backfilling, revegetation and concurrent reclamation would be conducted, where possible and practical, for areas where the soil has been exposed by ground-disturbing activities. These areas/sites include, but are not limited, to burrow sites, utility corridors, skid trails, firebreaks, temporary roads, cut and fill slopes, and areas where construction activities have occurred.	Design Feature	Design Feature developed for compliance with BNF and PNF: SWST03, SWGU05
Handling of road waste material (e.g., slough, rocks) will avoid or minimize delivery of waste material to streams that would result in degradation of soil, water, riparian and aquatic resources.	FP Component	Design Feature developed for compliance with BNF and PNF: FRST05
To minimize the degradation of watershed resource conditions, prior to expected water runoff, water management features would be constructed, installed, and/or maintained. Activities and features include, but are not limited to, water bars, rolling dips, seeding, grading, slump removal, barriers/berms, distribution of slash, and culvert/ditch cleaning in all applicable areas.	Design Feature	Design Feature developed for compliance with BNF and PNF: SWST01 and SWST04

Description	Type	Reference
To accommodate floods, including associated bedload and debris, new culverts, replacement culverts, and other stream crossings will be designed to accommodate a 100-year flood recurrence interval unless site-specific analysis using calculated risk tools or another method, determines a more appropriate recurrence interval.	FP Component	BNF and PNF: FRST02
To minimize sediment runoff from the temporary roads and roadbeds, water management features would be constructed, installed, and/or maintained on authorized temporary roads and roadbeds, on completion of use, before expected water runoff, or before seasonal shutdown. Activities and features could include, but would not be limited to, water bars, silt fencing, certified weed-free wattles, and/or weed-free straw bales, rolling dips, seeding, grading, slump removal, barriers/berms, distribution of slash, and culvert/ditch cleaning. These features would be installed in strategic downslope areas and in RCAs, where and when appropriate.	Design Feature	Design Feature developed for compliance with BNF and PNF: SWGU06
Snow removal will be accomplished in accordance with the following standards of performance: • All debris, except snow and ice, which is removed from the road surface and ditches will be deposited away from stream channels at approved locations. • During snow removal operations, banks will not be undercut, and gravel or other surfacing material will not be bladed off the roadway surface. • Ditches and culverts will be kept functioning during and following plowing. Berms left on the shoulder of the road will be removed and/or drainage openings will be created and maintained. Drainage openings will be spaced to maintain satisfactory surface drainage without discharge on erodible fills. • Dozers will be used on an as-needed basis for plowing snow. The dozer operator will maintain an adequate snow floor over the gravel road surface. • Snow will not be totally removed to the gravel road surface. Appropriate snow floor depth will be maintained to protect the roadway. • Damage of roads from, or as a result of, snow removal will be repaired in a timely manner. • Culverts and stream crossings will be clearly marked before snow removal begins to avoid placing berm openings in locations that will allow runoff to enter drainages directly at the culverts or stream crossings. Excessive snow will not be plowed into locations that will impact operation of the culverts or prevent positive drainage from drainage areas. Some snow is necessary around culvert openings and in the bar ditches as this will insulate the ditch and culvert and will prevent the water in the ditch and culvert from freezing. • No ice and snow removal chemicals will be used on roads. • Traction material will be 3/8-inch diameter gravel or greater.	Design Feature	
Road rutting from operations, outside the mine site, would be minimized by construction and maintenance of surface drainage structures, application of surfacing material, and by restricting road use when conditions are unacceptable due to moisture that is leading to the onset of rutting and concentrated turbid flow. (Note	Design Feature	Design Feature developed for compliance with BNF and PNF: SWST02

Description	Type	Reference
typical guidance is 'no use' if ruts deeper than 4" are created.) This design feature does not apply to the mine site.		SWST03
Perpetua would implement surface water quality baseline turbidity monitoring, as defined in the IDEQ permit clauses.	Design Feature	
Do not authorize storage of fuels and other toxicants or refueling within RCAs unless there are no other alternatives. Storage of fuels and other toxicants or refueling sites within RCAs shall be approved by the responsible official and have an approved spill containment plan commensurate with the amount of fuel.	FP Component	BNF and PNF: SWST11
New facilities for storage of fuels and other toxicants would be located outside of occupied TEPC plant habitat.	FP Component	BNF and PNF: TEST11
Dust abatement chemicals would be used in accordance with the applicable road maintenance Biological Assessment. Apply dust-abatement additives and stabilization chemicals (typically MgCl2, CaCl2, or lignin sulphonates) to avoid run-off of applied dust abatement solutions to streams. Spill containment equipment would be available during chemical dust abatement application. Where the road surface is within 25 feet (slope distance) of surface water, dust abatement would only be applied to a 10-foot swath down the centerline of the road. The rate and quantity of application would be regulated to insure all of the chemical is absorbed before leaving the road surface.	Design Feature	
Trees or snags that are felled in RCAs will be left unless determined not to be necessary for achieving soil, water, riparian, and aquatic desired conditions. Felled trees or snags left in RCAs will be left intact unless resource protection (e.g., the risk of insect infestation is unacceptable) or public safety requires bucking them into smaller pieces.	FP Component	BNF and PNF: SWST10
Perpetua would monitor stormwater runoff and stormwater BMPs as per the SWPPP. Stormwater monitoring, inspections, and reporting would be conducted in accordance with the NPDES Multi-Sector General Permit and the SWPPP.	Permitting Requirement	NPDES Multi-Sector General Permit and the SWPPP
Pumps will be turned off when not in use and water conservation practices will be implemented.	Design Feature	Design Feature developed for compliance with BNF and PNF: WIST03, WIST04 TEST29
All activities will be conducted in accordance with Idaho environmental anti-degradation policies, including IDEQ water quality regulations at IDAPA 58.01.02 and applicable federal regulations.	IDAPA 58.01.02	

BMP = Best Management Practice; BNF = Boise National Forest; CFR = Code of Federal Regulations; FP = Forest Plan; IDAPA = Idaho Administrative Procedures Act; IDEQ = Idaho Department of Environmental Quality; NDPES = National Pollutant Discharge Elimination System; NMFS = National Marine Fisheries Service; PNF = Payette National Forest; RCA = Riparian Conservation Area; SPCC = Spill Prevention, Control and Countermeasure; SWPPP = Stormwater Pollution Prevention Plan; TEPC = Threatened, Endangered, Proposed or Candidate; USFWS = U.S. Fish and Wildlife Service

Table 2-3 Proponent Proposed Environmental Design Features for Fisheries and Aquatic Habitat

Description
Proper dust control would be employed along transportation corridors and active mining areas using aquatic safe dust suppression chemicals and methods.
To protect fish residing in, using, or potentially using the Yellow Pine pit (YPP) lake (Chinook salmon, steelhead trout, bull trout, westslope cutthroat trout, mountain whitefish), Perpetua has developed a Fish Salvage and Release Plan to isolate the lake from upstream movement into the lake and salvage and release fish. The Fish Salvage and Release Plan would be refined in coordination with federal, state, and tribal agencies. Perpetua would, in consultation with the USFWS and the NMFS, design, install, and operate a fish trap and one or two weirs designed to allow fish to leave the YPP lake but not allow fish to migrate upstream past the trap to ensure that the fewest number of individual ESA-listed fish species are present in the pit lake when the draining process begins. The timing for providing the upstream barrier to fish movement would be designed to minimize the number of fish in the YPP lake, particularly larger bull trout that dominate the fish assemblage in the lake. Fish captured in the YPP lake would be immediately released downstream from the upstream fish movement barrier or in another location determined by the appropriate regulatory agencies. The YPP lake would be partially drained to recover the remaining fish and relocate them prior to final draining of the pit lake.
A fishway has been designed and would be operated within the East Fork South Fork Salmon River (East Fork SFSR) tunnel to provide upstream and downstream connectivity fish passage throughout mine operations. The East Fork SFSR diversion tunnel would be approximately 0.9 miles long and 15 feet high by 15 feet wide. The tunnel would include a parallel accessway to allow equipment and personnel access for monitoring, inspection, and maintenance. The accessway would function as a floodway for high flows, limiting the operating flow range within the fishway while river and thus total tunnel flows vary more widely.
As an alternative to the fishway in the East Fork SFSR tunnel Perpetua would provide adult passage by trap and haul if needed. Criteria may be put in place so that if any unusual or unexpected events occur that result in adverse impacts to fish during operations, fish passage through the fishway would be switched to trap and haul operations.
Low-energy lighting would be provided in the fishway to determine if it aids in fish passage and to provide light for tunnel and fishway inspections. The system would be configured so that it mimics the photoperiod of the region, run manually on a dimming system, or be completely turned off at the option of the operator.
Fish salvage and relocation operations would be conducted any time the facility needs repair within the fishway, potentially during sediment removal, and potentially when stream flows recede from the accessway.
Post mining, the East Fork SFSR stream channel would be reestablished across the backfilled YPP with a channel design that would provide for upstream and downstream fish passage.
Perpetua would reestablish fish passage through the existing box culvert on the East Fork SFSR just downstream from the confluence with Meadow Creek at the McCall-Stibnite Road (County Road [CR] CR 50-412) crossing.
Perpetua would improve fish passage conditions in the steep and woody debris-clogged portion of the East Fork SFSR stream channel just upstream from the confluence with Meadow Creek.
Perpetua would improve fish passage along the Burntlog Route within the SGP area by identifying and replacing existing collapsed, undersized, or otherwise degraded or poorly designed culverts at road crossings and committing appropriate resources to fix and improve these structures.
Perpetua would install side-ditching, culverts, guardrails, and bridges, where necessary along the Burntlog Route, with design features to provide fish passage and limit potential sediment delivery to streams.
Perpetua would employ blasting setback distances and other controlled blasting techniques following industry best management practices (modifying blasting variables including charge size, and vibration and overpressure monitoring) to minimize impacts to fish from blasting. Perpetua would follow up with monitoring in early stages of operation to evaluate effectiveness and refine blasting protocols in coordination with federal, state, and tribal agencies, if needed.

Description
Dewatering would generally be conducted during low-flow periods to facilitate stream segment isolation and fish salvage. When practicable, dewatering also would be timed to avoid or minimize impacts during known spawning periods for Chinook salmon, steelhead, and bull trout.
To protect fish, Perpetua would develop a standard procedure for channel segment isolation, dewatering, fish salvage, and fish relocation to appropriate receiving streams during dewatering or maintenance of natural stream and diversion channels, based on the USFWS Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards (USFWS 2012) and refined in coordination with federal, state, and tribal agencies.
The fishway operations and management plan (FOMP) defines the monitoring and evaluation plan elements and describes how the hydraulic conditions, fish use, and performance of the tunnel fishway would be measured and evaluated, and the design of the adaptive management component of the plan including the option of using trap and haul.
Access and mine site haul road crossings of fish bearing streams would be designed such that structures installed or constructed allow fish passage.
Perpetua would implement measures to limit stream baseflow effects during active operations, including a combination of lining key reaches of streams potentially impacted by pit dewatering, and infiltrating groundwater that is extracted for pit dewatering into infiltration basins. Maintain instream flows for fish species and other aquatic resources: flows within natural stream channels affected by SGP operations would be maintained to meet seasonally appropriate and stream-specific low-flow needs to the maximum extent practicable. Perpetua would continue to evaluate options and measures to further avoid and minimize the magnitude and duration of effects of the SGP through other measures in consultation with federal, state, and tribal agencies.
Following permanent cessation of mining activities at the YPP, Perpetua would backfill the pit and route the East Fork SFSR over the backfilled pit with a longer, lower-gradient channel with higher intrinsic potential for Chinook salmon and steelhead spawning and rearing than the channel that exists presently. The floodplain area along the constructed channel would include side-channels and other off-channel features and would be revegetated to restore wetland and riparian habitat providing long-term shade/cover favorable to fish.
The Meadow Creek channel would be routed over the final tailings storage facility (TSF) and the TSF Buttress, resulting in a long, relatively flat surface and a short, steep face. On top of the TSF/TSF Buttress surface, Meadow Creek would be contained within a broad floodplain corridor bound laterally by erosion-resistant terraces and vertically by a subsurface armor layer over an impermeable stream liner.
Perpetua would stabilize and restore East Fork Meadow Creek. East Fork Meadow Creek wetland restoration would consist of restoring and enhancing palustrine aquatic bed , palustrine emergent , palustrine scrub-scrub wetlands that were impacted when a historical dam failed on East Fork Meadow Creek. Headcutting and shallow aquifer dewatering have impaired and reduced functions of the wetland vegetation classes. A grade control and groundwater cutoff structure is proposed to raise the water level in East Fork Meadow Creek as well as recharge the shallow groundwater system and reduce stream headcutting. A coarse rock drain would be constructed within the chute downstream from the failed dam to isolate the flow of East Fork Meadow Creek from the actively eroding chute side slopes and to prevent further erosion of the gully bottom, facilitating subsequent restoration of a surface channel on top of the drain. Perpetua would stabilize the steep, confined, erosive middle reach to address the significant fine sediment load currently produced from this reach and restore the downstream, relatively low-gradient reach.
Perpetua would lead annual site visits for U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (EPA), Idaho Department of Fish and Game (IDFG), and other interested agency personnel as needed to facilitate agency review of mitigation areas if desired. Final reporting and data archival requirements would be subject to permit conditions; however, at a minimum, it is anticipated that monitoring reports would be prepared by Perpetua annually and submitted to USACE Walla Walla District, EPA, IDFG, Idaho Department of Lands (IDL), NMFS, USFWS, the Forest Service, and other interested agencies, SGP partners, and stakeholders.
Perpetua would repair and rehabilitate habitats adversely affected by historical mining impacts in the SGP area.

Description
Minor surface improvements (e.g., ditch and culvert repair, adding gravel, winter snow removal, and summer dust suppression) would occur on the Johnson Creek Route to reduce sediment runoff and dust generation.
Personnel transporting, handling, or using any hazardous chemicals (including sodium cyanide) would be trained to ensure the safe use of such materials. Perpetua would design, construct, and manage facilities to conform to International Cyanide Management Institute code.
Fuel and other petroleum products at the site would be stored in above ground containment structures, with appropriate secondary containment measures.
Perpetua would use aquatic safe herbicides during vegetation management activities and noxious weed control. Adhere to chemical label restrictions, federal/state rules on usage. Use proper equipment for chemical application by trained personnel.
Crushed rock would be placed on SGP access roads as needed to provide a durable surface and limit sediment transport.
Road surfaces throughout the SGP would be stabilized and managed to minimize transport of sediment, dust, and other materials, especially near watercourses through appropriate road engineering, surface drainage, watering, and application of dust control binding agents (magnesium chloride, lignin sulfonate, etc.), roadside ditching, road-cut stabilization, road surface maintenance, appropriate speed limits, and by limiting traffic.
Runoff generated from direct precipitation on the TSF would be retained in the TSF water pool for reclaim to the ore processing circuit.
During the Burntlog Route and mine site haul road construction and use, Perpetua would install and maintain sediment control measures and devices, such as culverts, culvert inlet protection devices, ditching, silt fencing, straw wattles, straw bales, and sediment catch basins.
Placing sub-base material and surfacing with gravel and localized sections of road with binders to provide a stable long-term roadway and reduce sediment runoff
During winter road maintenance, Perpetua would remove snow from the Burntlog Route and haul roads at the mine site and the temporary construction access Johnson Creek Route. Perpetua would avoid disposal of snow in riparian areas, wetlands, or areas where snowmelt might cause road damage or erosion during spring melt. Care would also be taken to dispose of collected snow, which may contain sand or gravel, in a manner that avoids impacts to nearby streams and rivers.
Perpetua would use coarse sand for winter sanding of the main access road and mine site haul roads in combination with gravel as needed.

In addition to the design features listed in **Table 2-3**, Perpetua has proposed additional environmental measures for the SGP as described in the following documents:

- Fisheries and Aquatic Resources Mitigation Plan (Brown and Caldwell, Rio Applied Science and Engineering, and BioAnalysts, Inc. 2021);
- Fishway Operations and Management Plan (Brown and Caldwell, McMillen Jacobs Associates, and BioAnalysts 2021a); and
- Conceptual Stream and Wetland Mitigation Plan (Tetra Tech 2021).

3.0 Relevant Laws, Regulations, and Policy

The following section provides descriptions of the relevant laws, regulations and policies that may affect fisheries and aquatic resources.

3.1 Land and Resource Management Plan

Physical, social, and biological resources on National Forest System (NFS) lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. National Forest Land and Resource Management Plans embody the provisions of the National Forest Management Act and guide natural resource management activities on NFS land. In the SGP area, the Payette National Forest Land and Resource Management Plan (Payette Forest Plan; Forest Service 2003), and the Boise National Forest Land and Resource Management Plan (Boise Forest Plan; Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired conditions for wildlife and wildlife habitat and include various objectives, guidelines, and standards for this purpose.

Portions of the BNF are administratively managed by the PNF due to location. Forest Service regulations and the Forest Plans (Forest Service 2003, 2010a) provide guidance on resource management on NFS lands. The SGP is located in PNF Management Area 13 (Big Creek/Stibnite) and in BNF Management Areas 17 (North Fork Payette River), 19 (Warm Lake), 20 (Upper Johnson Creek), and 21 (Lower Johnson Creek), which are described in the respective Forest Plans. In addition, Appendix B of both the Payette and Boise Forest Plans provides National Environmental Policy Act guidance with respect to evaluating the ecological functionality of aquatic resources in the analysis area using Watershed Condition Indicators (WCI) under existing baseline conditions because they may be affected by the SGP.

3.2 Federal Laws, Regulations, and Policy

3.2.1 U.S. Army Corps of Engineers 404 Permit

Under Section 404 of the Clean Water Act (33 United States Code [USC] 1344), a Department of the Army, U.S. Army Corps of Engineers (USACE) permit is required for the discharge of dredged and/or fill material into "waters of the United States". This would include discharges of dredge and/or fill material associated with activities, such as the construction of road crossings, water diversions, waste rock disposal in a stream, and other facilities associated with the SGP's construction, operation, and closure and reclamation. See the SGP Wetlands and Riparian Resources Specialist Report (Forest Service 2022b) for additional detail regarding the Clean Water Act.

3.2.2 Endangered Species Act Section 7 Consultation

The ESA (16 USC 35 1531 et seq. 1988) provides for the protection and conservation of threatened and endangered species and their Critical Habitats.

Section 7 of the ESA (16 USC 1531 et seq.) requires all federal agencies to consult with the USFWS and/or the NMFS, collectively known as "the Services", which share regulatory authority for implementing the ESA. Federal agencies must submit a consultation package for proposed actions that may affect ESA-listed species, species proposed for listing, or designated Critical Habitat for such species. The USFWS generally manages ESA-listed terrestrial and freshwater plant and animal species, while NMFS is responsible for marine species, including anadromous fish.

"Critical habitat" is defined by the ESA as specific areas within the geographical area occupied by listed species at the time of listing that contains the physical or biological features essential to conservation of the species and that may require special management considerations or protection (50 CFR 424). Critical habitat also may include specific areas outside the geographical area occupied by the species, if the agency determines that the outside area itself is essential for conservation of the species.

The first step in the consultation process is an "informal" consultation with one or both of the Services to initially determine if the proposed action is likely to affect any listed species, species proposed for listing, or designated Critical Habitat in the analysis area. The federal agency taking the action or the "action agency" (i.e., the Forest Service and the USACE in the case of the SGP) may prepare a Biological Assessment (BA) (or designate a non-federal representative to prepare the BA acceptable to the agency under federal regulation) to aid in determining a project's effects on listed or proposed species or designated Critical Habitat. If the action agency determines that the action is likely to adversely affect ESA-listed or proposed species or designated Critical Habitat, then the action agency enters into "formal" consultation (or "conference" for species proposed for listing). The USFWS and/or NMFS then prepare(s) a Biological Opinion and determines whether the action is likely to jeopardize the continued existence of the species or adversely modify designated Critical Habitat. If there is any anticipated "incidental take" (see 50 CFR 402.02 [defining "take"]) of a species, one or both of the Services must issue an Incidental Take Statement that includes terms and conditions and reasonable and prudent measures that must be followed to eliminate or minimize impacts to the species or its designated Critical Habitat.

3.2.3 Sustainable Fisheries Act (Essential Fish Habitat)

In response to growing concern about the status of fisheries in the U.S., Congress passed the Sustainable Fisheries Act of 1996 (Public Law 104 297) to amend the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), the primary law governing marine fisheries management in the federal waters of the U.S. NMFS is responsible for protecting habitats important to federally managed marine species, which include anadromous Pacific salmon that occur in the SGP analysis area. Federal agencies must consult with NMFS concerning any action that may adversely affect "Essential Fish Habitat" (EFH) pursuant to the amended Magnuson-Stevens Fishery Conservation and Management Act and its regulations (50 CFR 600). The Act defines EFH as habitats necessary to a species for spawning, breeding, feeding, or growth to maturity, which includes marine and riverine migratory corridors, spawning grounds, and rearing areas of Pacific salmon species. Given the SGP's geographic location, Chinook salmon (Oncorhynchus tshawytscha) is the only species that has designated EFH within the SGP analysis area. As defined by the regulations, EFH includes "all streams, estuaries, marine waters, and other waterbodies occupied or historically accessible to Chinook salmon in Washington, Oregon, Idaho, and California" (50 CFR 660.412(a)). EFH is coincident with designated critical habit for Chinook salmon within the analysis area.

3.2.4 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act generally requires that federal agencies consult with the USFWS, the NMFS, and State wildlife agencies for activities that control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with National Environmental Policy Act, Section 404 of the Clean Water Act, or other federal permit, license, or review requirements. The Fish and Wildlife Coordination Act provides that wildlife conservation shall receive equal consideration and be coordinated with other features of a project.

The term "wildlife resources" is explicitly defined to include "birds, fishes, mammals, and all other classes of wild animals and types of aquatic and land vegetation upon which wildlife is dependent" (16 USC 666 (b)). Further, the Fish and Wildlife Coordination Act states that reports determining the possible damage to wildlife resources and an estimation of wildlife loss shall be made an integral part of any report prepared or submitted by the action agency with permitting authority (16 USC 662 (b), (f)).

3.3 State and Local Policy

3.3.1 Idaho Department of Water Resources – Stream Channel Protection Program

The Idaho Stream Channel Protection Act (Idaho Code Title 42, Chapter 38) requires that the stream channels of the state and their environments be protected against alteration for the protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, and water quality. The Idaho Stream Channel Protection Act applies to any type of alteration work done inside the ordinary high-water mark of a continuously flowing stream and requires a stream channel alteration permit from Idaho Department of Water Resources (IDWR) before commencing any work that would alter the stream channel. This means that the IDWR must approve, in advance, any work that is conducted within the beds and banks of continuously flowing streams (i.e., perennial streams). Stream channel alteration permitting requires a joint-permit application process with IDWR, the IDL, and the USACE.

3.3.2 Idaho Department of Fish and Game – Scientific Collection Permit and Fish Transport Permit

The IDFG requires a Scientific Collection Permit for any handling of fish that is not related to sportfishing with a state fishing license. The salvage and transport of fish by vehicle between capture and release sites for the proposed SGP is expected to require a fish transport permit.

4.0 Issues and Resource Indicators

4.1 Significant Issues

Construction and operation of mine infrastructure may impact the quality and quantity of water, and habitat for steelhead, salmon, and bull trout. Project activities may also affect fish behavior and reproductive success and may result in injury or mortality of steelhead, salmon, and bull trout in the analysis area.

4.2 Resource Issues and Indicators

The analysis of effects on fish resources and fish habitat includes the following identified issues and indicators:

Issue: The SGP may cause changes in fish habitat in the analysis area that may affect aquatic species, including federally listed fish species and aquatic habitat (e.g., designated Critical Habitat) and Management Indicator Species within and downstream from the SGP area.

Indicators:

- Changes in water chemistry.
- Change in stream flow.
- Change in length of stream and lake habitat directly impacted by channel removal.
- Changes in water temperature (degrees Celsius [°C]).
- Change in amount of total useable Chinook salmon Intrinsic Potential (IP) habitat.

- Loss of Chinook salmon Critical Habitat.
- Change in total useable steelhead IP habitat.
- Change in length of bull trout habitat.
- Change in bull trout occupancy probability.
- Change in access to bull trout lake habitat.
- Loss of bull trout Critical Habitat.
- Change in length of westslope cutthroat trout habitat (km)
- Change in westslope cutthroat trout occupancy probability
- Changes in stream peak and baseflow (cubic feet per second [cfs]).

5.0 Methodology

5.1 Analysis Area

The analysis area for fish and fish habitat includes the area where effects (direct / indirect and cumulative) may be caused by the proposed activities (Forest Service Handbook [FSH] 1909.15, 15.2a). The analysis area encompasses all areas in which fish resources and fish habitat may be affected directly or indirectly by the SGP, and not merely the immediate area involved. The analysis area is located in the South Fork Salmon River hydrological subbasin and the North Fork Payette River hydrological subbasin (**Figure 5-1**).

Hydrologic unit codes (HUC) are used to identify all of the drainage basins in the United States in a nested (hierarchical) arrangement from the largest to smallest drainage basins. In the SGP analysis area the hydrologic units of relevance are, from largest to smallest:

- Salmon River “Basin” (HUC 170602) and Middle Snake-Boise “Basin” (HUC 170501);
- South Fork Salmon River “Subbasin” (HUC 17060208) and North Fork Payette River “Subbasin” (HUC 17050123);
- Numerous “Watersheds” within each subbasin (i.e., Upper East Fork Salmon River Watershed (HUC 1706020804); and
- Numerous “Subwatersheds” within each watershed (i.e., Headwaters East Fork South Fork Salmon River Subwatershed (HUC 170602080201). Subwatersheds are sometimes referenced as “6th field” or “HUC 12” due to the 12-digit numerical code assigned to each.

The physical footprint of the SGP where mining is proposed (i.e., the proposed “mine site” footprint) occurs within two subwatersheds: Sugar Creek and Headwaters East Fork South Fork Salmon River (**Figure 5-2**), labeled numbers 5 and 6 on **Figure 5-1**. SGP-related facilities potentially located within these two subbasins would include buildings, tailings and waste rock storage facilities, access roads, electrical substations, transmission lines, and mining operational areas. Immediately downstream from these two subwatersheds is the adjacent No Mans Creek-East Fork SFSR subwatershed that also is discussed in this section (hydrologic unit code [HUC] 170602080206), which is labeled number 4 on **Figure 5-1**. This latter subwatershed is within the analysis area, but not within the proposed mine site.

The analysis area for fish resources also includes all of the watercourses (i.e., streams and rivers) and waterbodies (i.e., lakes, reservoirs) in the 12-digit HUC subwatersheds that overlap the SGP area. Because the majority of the activities and disturbance would occur at the mine site, which is located in the South Fork Salmon River (SFSR) subbasin, greater emphasis is placed on describing the affected environment within this subbasin. However, relevant habitat conditions in other subbasins, watersheds, and subwatersheds that may be impacted by SGP activities also are described, as appropriate.

The SGP affects watersheds within the analysis area differently depending on the activities proposed for each area. The majority of the mining activity occurs within the headwaters of the East Fork SFSR subwatershed (HUC 170602080201). In this subwatershed, surface water conditions are affected by ground disturbance, development of mine facilities, and water abstraction for mine dewatering, contact water management, and consumptive use. As a result, stream flows in the subwatershed would be reduced by up to 30 percent during operations. While project design features and regulatory requirements maintain water chemistry conditions, removal of riparian shading increases predicted stream temperatures by up to 6.6°C until a time that restoration efforts would effectively shade stream flows and reduce temperatures toward baseline conditions. When the tools utilized to evaluate fish habitat (e.g., intrinsic potential, occupancy, and flow productivity modeling) are applied to the forecasted flow and temperature conditions in the headwaters of the East Fork SFSR watershed, they indicate a change from existing conditions.

Under the SGP, there would be limited mining activity in the Sugar Creek watershed (HUC 170602080202) with most of the effects associated with diverting the West End Creek around the West End pit. West End Creek is not fish bearing and contributes relatively minor flow volumes to Sugar Creek. Predicted flow reductions in Sugar Creek attributable to the SGP would be typically less than 1 percent with a maximum monthly difference of 3 percent. Predicted stream temperature changes would be between 0.1 and 0.3°C, with maximum summer temperatures ranging from 15.5°C to 15.7°C compared to a baseline temperature condition of 15.4°C. Application of fish habitat evaluation tools to these conditions in Sugar Creek would not indicate an observable change from existing conditions. For the other watersheds in the analysis area, SGP-related effects are associated with site access and transportation which are not expected to affect streamflow and temperature conditions to the degree that fish habitat evaluation tools would indicate change from existing conditions.

Because of the minimal SGP effects anticipated to Sugar Creek, the focus of the environmental consequences analyses is on the headwaters of the East Fork SFSR. Where appropriate, the impact analysis does discuss effects to other areas of the analysis area, particularly with respect to road construction and traffic effects. Effects of direct mining activities are discussed in the context of the mine site area. Mining effects generally do not affect conditions outside the mine site area where effects are primarily associated with road usage.

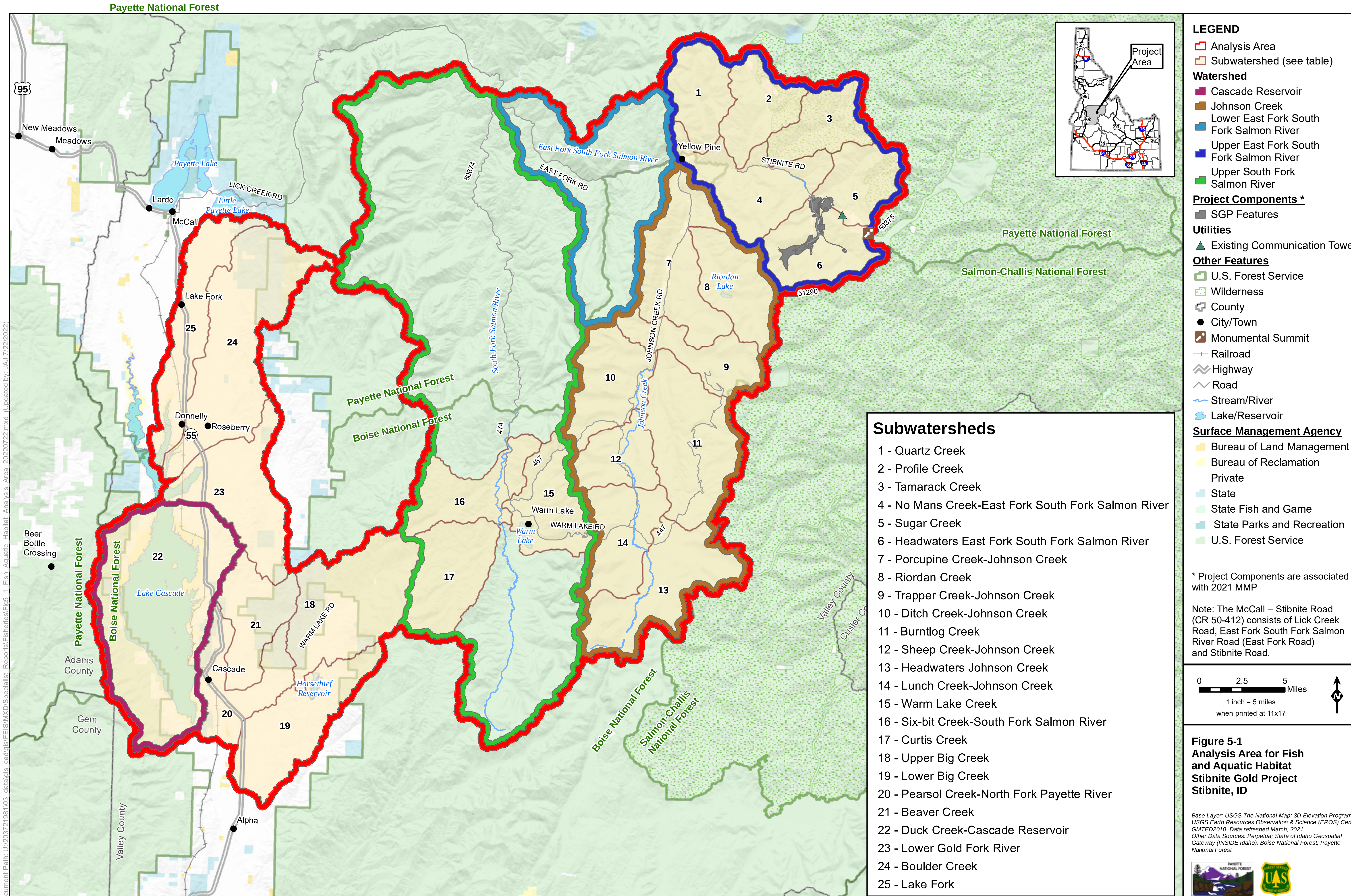
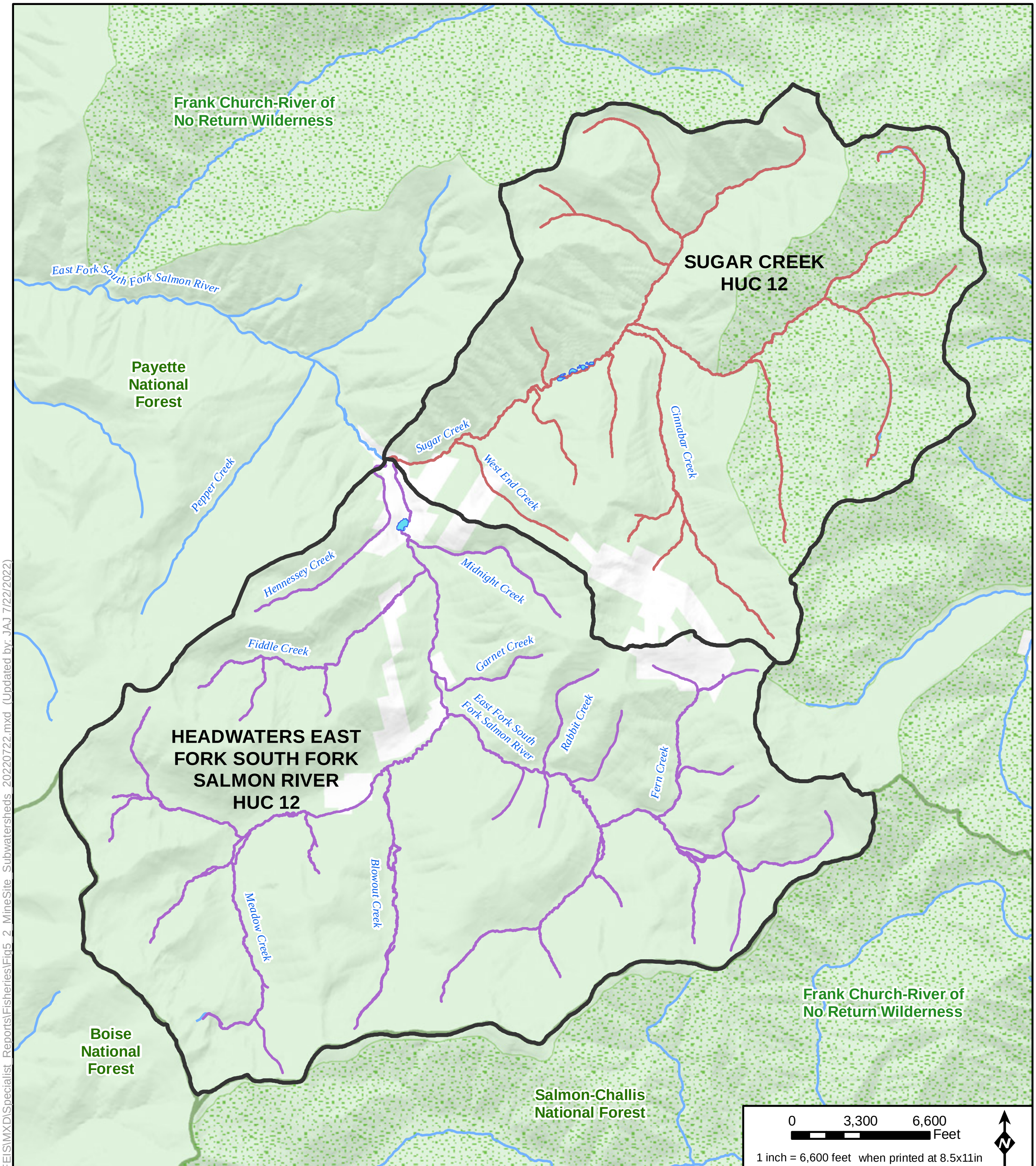
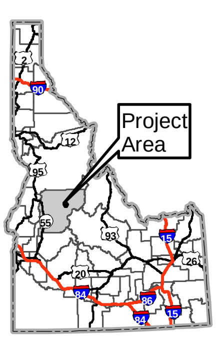


Figure 5-1
Analysis Area for Fish and Aquatic Habitat
Stibnite Gold Project
Stibnite, ID





LEGEND

Subwatershed (HUC 12)
Headwaters East Fork South Fork Salmon River Drainages
Sugar Creek Drainages

Other Features
U.S. Forest Service
Wilderness
County
Stream/River
Lake/Reservoir

Surface Management
Private
U.S. Forest Service

Figure 5-2
Mine Site Subwatersheds
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Document Path: U:\2037219\81\03 data\gis cad\gis\FEIS\MXD\Specialist Reports\Fisheries\Fig5 2 MineSite Subwatersheds 20220722.mxd (Updated by: JAJ 7/22/2022)

5.2 Methodology

The analysis area for fish and aquatic habitat includes the area where effects (direct/indirect and cumulative) may be caused by the proposed activities (FSH.1909.15, 15.2a). Alternative components include the mine site, all associated mine support infrastructure, all access and haul roads (proposed and existing), all utility infrastructure (proposed and upgraded), and off-site facilities.

5.2.1 Information Sources

A summary of the available data was compiled for specific watersheds/subwatersheds and individual species (Chinook salmon, steelhead, bull trout, and westslope cutthroat trout). Data was obtained and modeled using various sources and consisted of different metrics, such WCIs. The information used to describe the existing condition of fish and fish habitat in the analysis area was gathered from numerous sources, including federal and state resource agencies, the Nez Perce Tribe, and Perpetua. AECOM (2020a) provides a list of fish and stream habitat data collected in the analysis area between 1991 and 2019 (**Table 5-1**).

To further describe the existing condition of habitat in the analysis area for special status fish species, additional modeling was performed and the studies and outcomes are described in technical memoranda (Ecoysystem Sciences (ESS) 2019a, 2019b, 2019c, 2019d, 2019e, 2019f, 2019g, 2019h, AECOM 2020a, 2020b).

In addition, various other data sources were used to describe the existing conditions. For instance, fisheries distribution and environmental DNA (eDNA) data were obtained from the Forest Service; stream gage data were obtained from the U.S. Geological Survey (USGS); water quality information was provided by the IDEQ; and the IDFG provided fisheries technical reports, management plans, and historical supplementation (i.e., fish translocation) records.

5.2.2 Aquatic Resources Baseline Data Collection

Perpetua funded aquatic resources baseline studies from 2012 to 2020 specifically for the SGP within the mine site area and along the Burntlog Route area (AECOM 2020a). Fish data was collected through snorkel surveys, electrofishing, videography, and eDNA sampling (MWH 2017; Stantec 2018, 2019). **Figures 5-3a** and **5-3b** show the location of these surveys. In 2015, fish tissue was collected to check for metal concentrations and DNA analysis.

Field investigations to characterize existing aquatic physical habitat in the mine site area and along the Burntlog Route area were performed between 2012 and 2020 (Great Ecology 2018; HDR 2016; Rio ASE 2019, 2020; MWH 2017; Stantec 2018, 2019, 2020; Watershed Solutions Inc. 2021) (**Figure 5-4**). These investigations collected information on aquatic habitat parameters, such as water temperature, substrate size, substrate embeddedness, surface fines, channel geometry and physical attributes, large woody debris, and pool frequency. Stream habitat condition surveys, following the Pacific Anadromous Fish Strategy/Inland Fish Strategy Biological Opinion (PIBO) protocols, collected information on bankfull width, wetted width, bank stability, sediment size, stream gradient, pool dimensions, and large woody debris.

Table 5-1 Fisheries and Stream Habitat Data Collected Within and Near the Analysis Area, 1991-2019

Data Source	Project/ Study	Location	Data Years	Available Data	Data Collection Methods	Species Information	Reference
Boise National Forest	Boise National Forest Aquatic Database	Analysis area and vicinity	1991-2016	Habitat, fish community	Electrofishing, snorkel, eDNA, PIBO and other stream habitat surveys	Chinook salmon, bull trout, westslope cutthroat trout, *Oncorhynchus mykiss*	BNF 2017
Brown and Caldwell	Yellow Pine Pit Fish Monitoring Summary	Yellow Pine Pit	2018-2019	Fish community	Seining and hook-and-line angling.	Chinook salmon, bull trout, westslope cutthroat trout, rainbow trout, whitefish	Brown and Caldwell 2019b, 2020
GeoEngineers	Aquatic Resources 2016 Baseline Study Addendum Report	Mine site Study Area	2015	Fish community, population estimates	Electrofishing/mark-recapture surveys	Chinook salmon, bull trout, westslope cutthroat trout, *Oncorhynchus mykiss*	GeoEngineers 2017
Great Ecology	Supplemental Stream and Wetland Baseline Data Report for the Stibnite Gold Project	Mine site Study Area, as well as access roads	2018	Habitat	Stream habitat surveys	Habitat data only	Great Ecology 2018
HDR	Stream Functional Assessment	Mine site Study Area	2015-2016	Habitat	Stream habitat surveys	N/A	HDR 2016
MWH	Aquatic Resources 2016 Baseline Study	Mine site Study Area	2012-2016	Habitat, fish community, macroinvertebrates, fish tissue	Electrofishing, snorkel, eDNA, PIBO and substrate surveys, water temperature monitoring	Chinook salmon, bull trout, westslope cutthroat trout, *Oncorhynchus mykiss*	MWH 2017

Data Source	Project/ Study	Location	Data Years	Available Data	Data Collection Methods	Species Information	Reference
Nez Perce Tribe	Status and Monitoring of Natural and Supplemented Chinook Salmon	Johnson Creek, Burntlog Creek, East Fork SFSR (tributaries, including Meadow Creek)	2005-2017	Adult and smolt data; redd counts	Weir counts and spawning ground survey	Chinook salmon	Rabe and Nelson 2007, 2008, 2009, 2010, 2013, 2014 Rabe et al. 2016a, 2016b, 2017, 2018
Nez Perce Tribe	Chinook and Bull Trout Redd Count Data	Johnson Creek, Burntlog Creek, East Fork SFSR, and tributaries, including Meadow Creek	1998-2018	GIS data on redd counts	Spawning ground survey	Chinook salmon and bull trout	Nez Perce Tribe 2018
Stantec	Aquatic Resources Baseline Study Tech Memos	Mine site Study Area, as well as access roads and control sites	2017-2019	Habitat and fish community	Substrate, PIBO, floodplain monitoring, and eDNA surveys, water temperature monitoring	Chinook salmon, bull trout, westslope cutthroat trout, *Oncorhynchus mykiss*	Stantec 2018, 2019, 2020
Watershed Solutions	Aquatic Resources Baseline Study	Mine site Study Area, as well as access roads and control sites	2020	Habitat	Substrate and PIBO surveys, water temperature monitoring	N/A	Watershed Solutions 2021

[1] Available data: stream habitat (e.g., habitat unit, riparian habitat, PIBO methodology, substrate type, water temperature, water velocity), fish community (e.g., eDNA, presence/absence, redd counts, juvenile density), tissue residues (metals), population estimates, etc.
[2] Data collection methods applied (e.g., fish surveys, weir counts, spawning ground surveys, stream habitat surveys (e.g., PIBO).

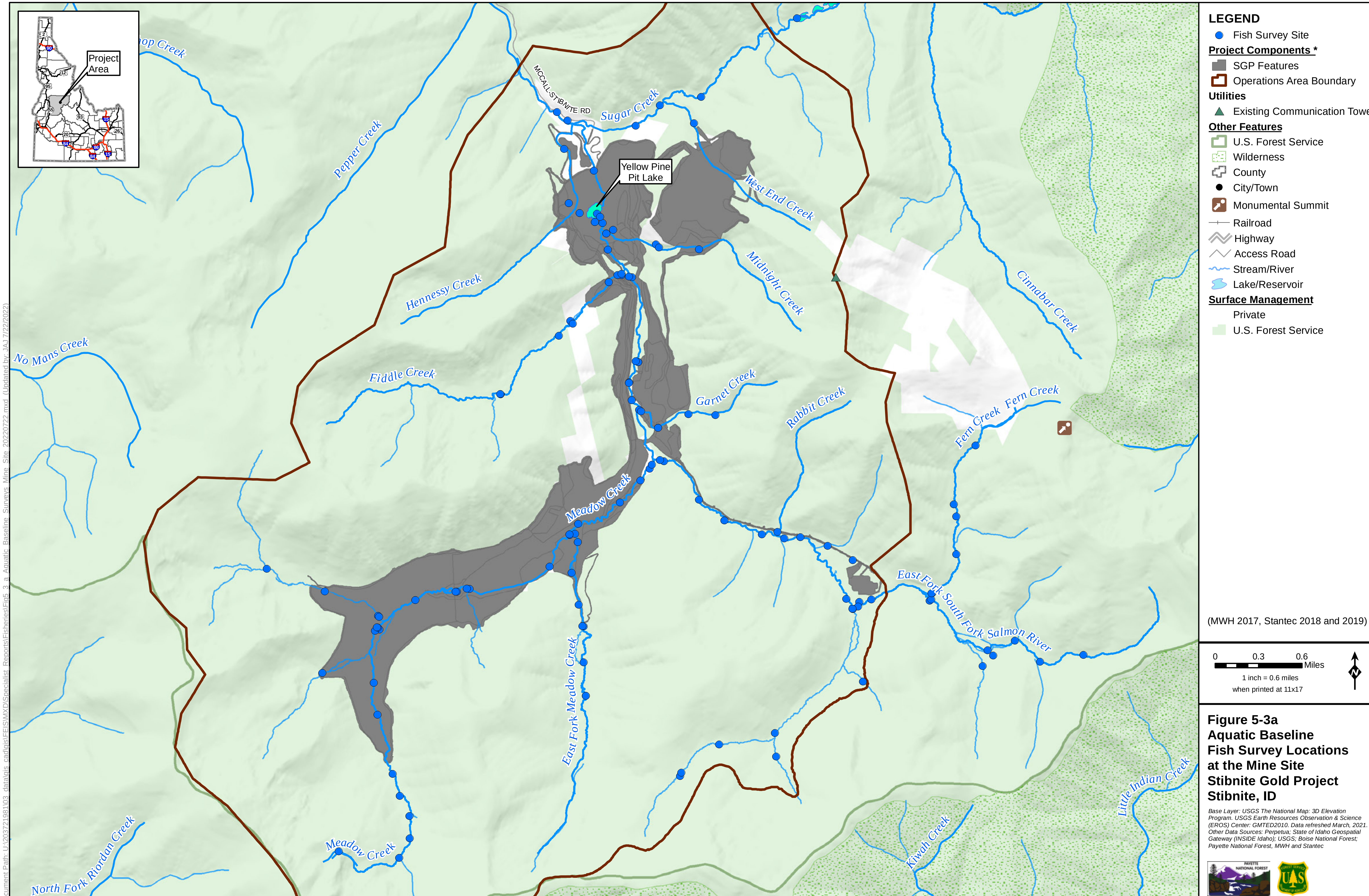
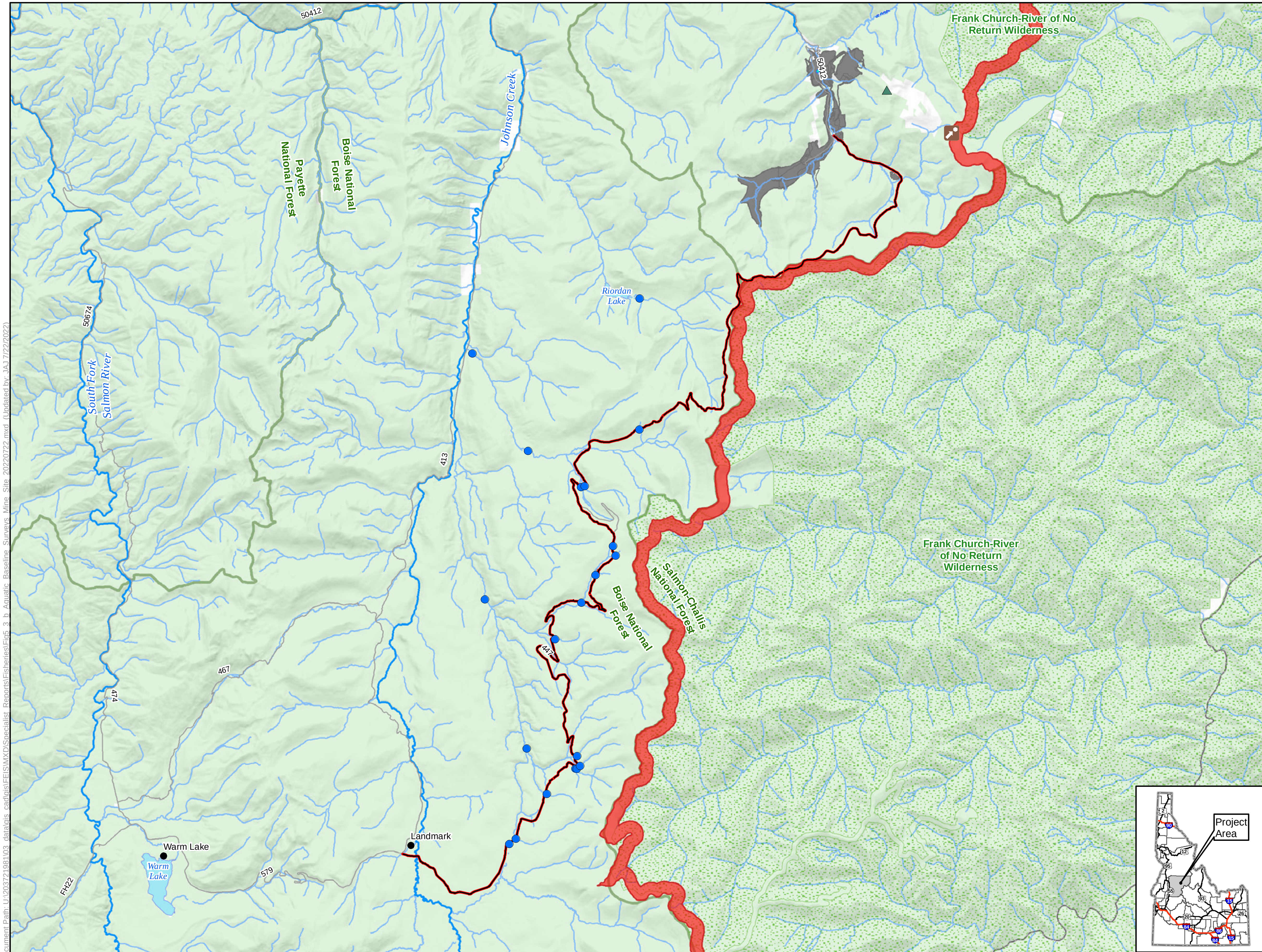


Figure 5-3a
Aquatic Baseline
Fish Survey Locations
at the Mine Site
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest, MWH and Stantec

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Fisheries\Fig5_3_a_Aquatic_Baseline_Surveys_Mine_Site_20220722.mxd (Updated by: JAJ 7/22/2022)



LEGEND

- Fish Survey Sites
- Analysis Area

Project Components *

- SGP Features
- Burntlog Route

Utilities

- Existing Communication Tower

Other Features

- U.S. Forest Service
- Wilderness
- County
- City/Town
- Monumental Summit
- Railroad
- Highway
- Road
- Lake/Reservoir

Surface Management

- Private
- U.S. Forest Service

(Stantec 2018 and 2019)

0 1.125 2.25 Miles

1 inch = 2.25 miles when printed at 11x17

Figure 5-3b Aquatic Baseline Fish Survey Locations Along Burntlog Route Stibnite Gold Project Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

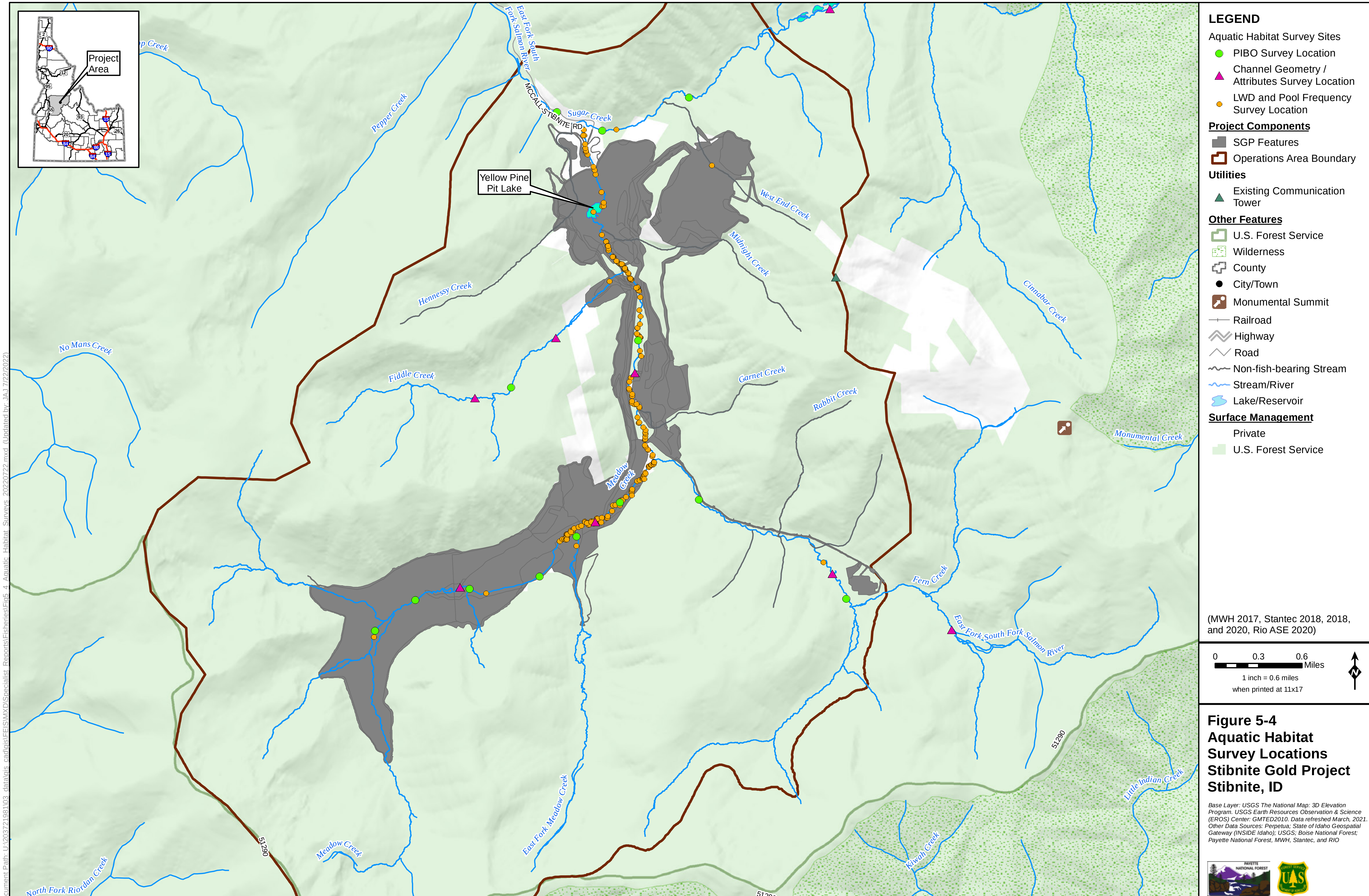


Figure 5-4
Aquatic Habitat Survey Locations
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest, MWH, Stantec, and RIO

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Fisheries\Fig5_4_Aquatic_Habitat_Surveys_20220722.mxd (Updated by: JAJ 7/22/2022)

6.0 Affected Environment

General descriptions of fish and aquatic habitat in the analysis area, including descriptions are presented in **Section 6.1**. The following subsections describe the existing conditions of fish species, particularly Chinook salmon, steelhead, bull trout, and westslope cutthroat trout, and their habitat, as well as an overview of fish densities. A summary of the streams within the mine site area and the WCIs under baseline conditions is provided in **Section 6.3**.

6.1 Watershed Condition Indicators

This section summarizes the existing data describing the baseline aquatic habitat conditions that may be affected by the SGP within the analysis area. It includes brief descriptions of the streams that may be affected by the SGP both outside and within the mine site. The WCIs are used as a metric to compare baseline conditions to estimated changes that might be caused by projects or other events. Over the past 20 years, various fish and aquatic habitat studies have been conducted in the SFSR subbasin which have provided a better understanding of aquatic resource baseline conditions within the analysis area. Studies have been conducted by federal, state, local, and tribal agencies (e.g., PNF, BNF, IDFG, and the Nez Perce Tribe), as well as private entities (e.g., Perpetua).

Table 6-1 and **Table 6-2** summarize the WCI data currently available along with fish species occurrence information for each watershed and subwatershed (shown in **Figure 5-1**). Only one subwatershed (Upper Big Creek) in the Cascade Reservoir Watershed had any WCI data available for the local fish community. More WCI data are available for most of the subwatersheds in the Upper SFSR, Johnson Creek, Lower East Fork SFSR, and Upper East Fork SFSR watersheds.

The Southwest Idaho Ecogroup Matrix of Pathways and Watershed Condition Indicators (WCIs or "The Matrix") (Forest Service 2003, 2010a) have been applied to describe and evaluate the baseline environment for fish and aquatic resources in the analysis area. The WCI matrix was developed specifically for application in the PNF and BNF (Forest Service 2003, 2010a) to assist in project design and analysis during National Environmental Policy Act (NEPA) assessments of proposed projects. The WCI matrix evaluates watershed ecological functions by measuring elements that reflect water quality, habitat access, channel conditions and dynamics, flow and hydrology, and other watershed conditions. Furthermore, the WCI matrix comprises a series of "pathways" by which mining, reclamation, or restoration activities can have potential effects on native and desired non-native fish species, their habitats, and associated ecological functions. This ecological functionality is broken down into three separate categories: "functioning appropriately," "functioning at risk," and "functioning at unacceptable risk." Where possible, quantitative values are applied to determine the functionality. The same description of the pathways and WCIs can be found in Table B-1, Appendix B of each Forest Plan (Forest Service 2003, 2010a).

6.1.1 North Fork Payette River Subbasin Baseline

The Cascade Reservoir Watershed is the only HUC 5th Field watershed in this subbasin (**Figure 5-1**; **Table 6-1**). Eight subwatersheds occur in this watershed that could be impacted by the SGP. Only one subwatershed, Upper Big Creek, has had a WCI analysis completed. Many of the other subwatersheds are on private land and do not have WCIs completed.

Table 6-1 Baseline Watershed Condition Indicators for Potentially Impacted Subwatersheds in the Analysis Area for the Cascade Reservoir and Upper South Fork Salmon River Watersheds

Watershed Condition Indicator	Cascade Reservoir Watershed (HUC 5th Field)								Upper South Fork Salmon River Watershed (HUC 5th Field)		
	Subwatersheds (HUC 6th Field)										
	Lake Fork	Boulder Creek	Lower Gold Fork River	Duck Creek	Beaver Creek	Pearsol Creek	Lower Big Creek	Upper Big Creek	Curtis Creek	Six-bit Creek	Warm Lake Creek
Bull Trout Local Population Characteristics within Core Area											
Local Population Size	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	FR	No Data	FR
Growth and Survival	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Life History Diversity and Isolation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Persistence and Genetic Integrity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Water Quality											
Temperature – Steelhead, Chinook salmon	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	FR	Steelhead Present. No Data	FUR
Temperature – Bull trout	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FUR
Temperature – Other fish species	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present. FA for other species	WSC Present. No Data	WSC Present. No Data	WSC Present. No Data
Sediment/Turbidity – Steelhead, Chinook salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Sediment/Turbidity – Bull trout	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Sediment/Turbidity – Other fish species, i.e., westslope cutthroat trout	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present. FUR for other species	No Data	No Data	No Data
Chemical Contamination / Nutrients	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FR
Habitat Access											
Physical Barriers	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FA	No Data	FR
Habitat Elements											
Substrate Embeddedness (Bull trout rearing areas)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FUR
Large Woody Debris	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FA
Pool Frequency and Quality	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FA	No Data	FR
Large Pools/Pool Quality (all fish species in adult holding, juvenile rearing, and over wintering reaches)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FA	No Data	FR
Off-Channel Habitat	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FR
Refugia (Steelhead, Chinook salmon)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Channel Conditions and Dynamics											
Average Wetted Width/Maximum Depth Ratio	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FA	No Data	FR
Streambank Condition	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FR
Floodplain Connectivity	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FUR	No Data	FUR
Flow/Hydrology											
Change in Peak/Base Flows	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FUR
Change in Drainage Network	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FUR	No Data	FUR

Watershed Condition Indicator	Cascade Reservoir Watershed (HUC 5th Field)								Upper South Fork Salmon River Watershed (HUC 5th Field)		
	Subwatersheds (HUC 6th Field)										
	Lake Fork	Boulder Creek	Lower Gold Fork River	Duck Creek	Beaver Creek	Pearsol Creek	Lower Big Creek	Upper Big Creek	Curtis Creek	Six-bit Creek	Warm Lake Creek
Watershed Conditions											
Road Density/Location	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FUR	No Data	FR
Disturbance History	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FUR	No Data	FUR
Riparian Conservation Areas	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FUR
Disturbance Regime	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FR
Integration of Pathways											
Integration of Pathways (Steelhead, Chinook salmon)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FUR	FR	No Data	FUR
Integration of Pathways (Bull trout)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FUR	FR	No Data	FUR
Integration of Pathways (Other fish species, i.e., westslope cutthroat trout)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	WSC not Present. FUR for other species	FR	No Data	FUR

Source: Forest Service 2003; Forest Service 2012; Foust and Nalder 2010; Rio ASE 2019; StreamNet 2020
Subwatersheds are at the HUC 6th Field.
FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; HUC = hydrologic unit code; N/A = Not Applicable; WSC = westslope cutthroat trout

Table 6-2 Baseline Watershed Condition Indicators for Potentially Impacted Subwatersheds in the Analysis Area for the Johnson Creek, Lower East Fork South Fork Salmon River, and Upper East Fork South Fork Salmon River Watersheds

Watershed Condition Indicator	South Fork Salmon River Subbasins															
	Johnson Creek Watershed (HUC 5th Field)									East Fork SFSR Watershed (HUC 5th Field)	Upper East Fork SFSR Watershed (HUC 5th Field)					
	Subwatersheds (HUC 6th Field															
	Lunch Creek	Headwaters Johnson Creek	Sheep Creek	Burnt Log Creek	Dutch/Ditch Creek	Trapper Creek	Upper Indian Creek	Riordan Creek	Porcupine Creek	Lower East Fork SFSR	Quartz Creek[1]	Profile Creek[1]	Tamarack Creek[1]	No Mans Creek[1]	Sugar Creek[2]	Headwaters East Fork SFSR[2]
Bull Trout Local Population Characteristics within Core Area																
Local Population Size	FUR	FUR	FUR	FA	Bull Trout Present No Data	FA	Bull Trout Present No Data	FR	FR	FR	Bull Trout Present No Data	Bull Trout Present No Data	Bull Trout Present No Data	Bull Trout Present. No Data	FR	FR
Growth and Survival	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Life History Diversity and Isolation	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Persistence and Genetic Integrity	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Water Quality																
Temperature (Steelhead, Chinook salmon)	FUR	FUR	FUR	FR	Steelhead Present. No Data	FA	Steelhead and Chinook Present No Data	FUR	Species Not Present	FR	Steelhead Present. No Data	Chinook Present. No Data	FR	Species Not Present	FR	FR
Temperature (Bull trout)	FUR	FUR	FUR	FR	No Data	FA	No Data	FUR	FUR	FR	No Data	FR	FR	No Data	FR	FR
Temperature (Other fish species, i.e., westslope cutthroat trout)	No WSC. No Data for other species	WSC Present. No Data	No WSC. No Data for other species	WSC Present. No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data
Sediment/Turbidity (Steelhead, Chinook salmon)	FUR	FUR	FA	FA	Steelhead Present. No Data	FUR	No Data	FUR	N/A	No Data	No Data	No Data	No Data	N/A	FUR	FUR
Sediment/Turbidity (Bull trout)	FUR	FUR	FA	FA	No Data	FUR	No Data	FUR	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Chemical Contaminants/ Nutrients	No Data	No Data	No Data	FA	No Data	FA	No Data	FA	No Data	FUR	No Data	No Data	No Data	No Data	FUR	FUR
Habitat Access																
Physical Barriers	FUR	FA	FUR	FA	No Data	FUR	No Data	FA	FUR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Habitat Elements																
Substrate Embeddedness (Bull trout rearing areas)	FUR	FUR	FA	FA	No Data	FA	No Data	FUR	FR	FR	No Data	FA	FUR	No Data	FA	FA
Large Woody Debris	FA	FA	FA	FA	No Data	FA	No Data	FA	FUR	FUR	No Data	No Data	No Data	No Data	FA	FA

Watershed Condition Indicator	**South Fork Salmon River Subbasins**															
	Johnson Creek Watershed (HUC 5th Field)									**East Fork SFSR Watershed (HUC 5th Field)**	**Upper East Fork SFSR Watershed (HUC 5th Field)**					
	Subwatersheds (HUC 6th Field															
	Lunch Creek	**Headwaters Johnson Creek**	**Sheep Creek**	**Burnt Log Creek**	**Dutch/Ditch Creek**	**Trapper Creek**	**Upper Indian Creek**	**Riordan Creek**	**Porcupine Creek**	**Lower East Fork SFSR**	**Quartz Creek[1]**	**Profile Creek[1]**	**Tamarack Creek[1]**	**No Mans Creek[1]**	**Sugar Creek[2]**	**Headwaters East Fork SFSR[2]**
Pool Frequency and Quality	FA	FA	FA	FA	No Data	FA	No Data	FA	FUR	FR	No Data	No Data	No Data	No Data	FR	FR
Large Pools/Pool Quality (all fish species in adult holding, juvenile rearing, and over wintering reaches)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Off-Channel Habitat	FA	FA	FA	FA	No Data	FA	No Data	FA	FA	FR	No Data	No Data	No Data	No Data	FR	FR
Refugia (Steelhead, Chinook salmon)	FR	FR	FR	FR	No Data	FR	No Data	FR	No Data	FR	No Data	No Data	No Data	N/A	FR	FR
Refugia (Bull trout)	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	FA	No Data	FR	FR
Channel Conditions and Dynamics																
Average Wetted Width/Maximum Depth Ratio	FA	FR	FA	FA	No Data	FA	No Data	FA	FR	FR	FA	No Data	No Data	FA	FA	FA
Streambank Condition	FUR	FR	FA	FA	No Data	FA	No Data	FA	FR	FR	No Data	No Data	No Data	No Data	FA	FA
Floodplain Connectivity	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FR	FR	FR	No WCI	No WCI	FR	FR
Flow/Hydrology																
Change in Peak/Base Flows	FR	FUR	FA	FUR	No Data	FUR	No Data	FUR	FUR	FR	No Data	FR	No Data	No Data	FA	FA
Change in Drainage Network	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FUR	No Data	No Data	No Data	No Data	FA	FA
Watershed Conditions																
Road Density/Location	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Disturbance History	FUR	FUR	FA	FUR	No Data	FUR	No Data	FUR	FUR	FUR	No Data	No Data	No Data	No Data	FR	FR
Riparian Conservation Areas	FR	FA	FR	FR	No Data	FR	No Data	FR	FR	FUR	FUR	FUR	No Data	No Data	FA	FUR
Disturbance Regime	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	FUR	FUR	No WCI	No WCI	FR	FR
Integration of Pathways																
Integration of Pathways (Steelhead, Chinook salmon)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	NA	FR	No Data	No Data	No Data	N/A	FR	FR
Integration of Pathways (Bull trout)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Integration of Pathways (other fish species, i.e., westslope cutthroat trout)	No WSC	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Source: Forest Service 2010b: Johnson Creek Watershed Improvement Project-Boise NF: Attachment B, Subwatersheds Baselines; Forest Service 2012; Foust and Nalder 2010; Rio ASE 2019; StreamNet 2020

[1] Outside of the Mine Site

[2] Within the Mine Site

WCI thresholds used are from Rio ASE 2019.

FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; HUC = hydrologic unit code; WCT = westslope cutthroat trout

6.1.2 South Fork Salmon River Subbasin Baseline

Baseline conditions for WCIs were developed per the guidance in Appendix B of the Forest Plans (Forest Service 2003, 2010a) to describe the existing conditions in the SFSR subbasin. **Table 6-2** summarizes the baseline WCI information for the SFSR subbasin for those watersheds and subwatersheds that may be directly impacted by SGP activities.

6.1.2.1 East Fork South Fork Salmon River Watershed Baseline

The East Fork SFSR watershed covers approximately 250,000 acres and enters the mainstem SFSR near the confluence of the Secesh River. Most of the watershed is administered by the Forest Service and managed by the PNF and BNF. Private land in the watershed includes small parcels of land along Johnson Creek, large legacy mines in the headwater drainages (e.g., Stibnite and Cinnabar mines), and the village of Yellow Pine. Predominant historical land uses occurring in this watershed include timber harvest and large-scale mining (Wagoner and Burns 2001). Extensive cattle grazing also historically occurred in the Johnson Creek watershed, but federal grazing allotments have now been retired and grazing has been reduced to private lands.

Large-scale historical mining altered stream channel conditions in the Upper East Fork SFSR watershed. The Forest Service and mine operators have since undertaken restoration work. However, habitat for migratory salmonids in the East Fork SFSR upstream from the YPP lake is inaccessible because historical mining excavation of the stream channel has created a gradient barrier (YPP lake cascade). Although there has been a reduction in human influences since about 1950, there are still significant legacy effects that continue to impact channel conditions and fish populations. Kuzis (1997) describes the Upper East Fork SFSR watershed as follows:

> *"The most significant geophysical processes affecting channels in the East Fork SFSR are mass wasting and erosion. The most obvious impacts to stream channels are located at the Yellow Pine pit lake, Meadow Creek, East Fork Meadow Creek, and the Cinnabar Mine area."*

The East Fork SFSR drainage has the lowest quality habitat for sensitive and protected fish in the SFSR subbasin (Northwest Power Conservation Council 2004). Primary habitat limitations in the East Fork SFSR drainage are reduced riparian habitat and decreased streambank stability due both to road design and the extent of the existing road system; secondary limitations include reduced instream large woody debris, water quality degradation, and fish passage barriers resulting from legacy mining in the area (Northwest Power Conservation Council 2004).

All IDEQ-inventoried waterbodies at the proposed mine site (except for West End Creek) are listed under Section 303(d) of the federal Clean Water Act as "impaired" due to water quality. The causes for listing of these waters are associated with elevated concentrations of arsenic, antimony, and mercury. Each of the 303(d)-listed waterbodies has designated beneficial uses of "cold water communities," "salmonid spawning," and "primary contact recreation," and all (except Sugar Creek) have designated beneficial uses of "drinking water supply."

Wildfires have eliminated much of the tree canopy at the SGP mine site and vicinity. Although much of the understory vegetation in burned areas has started to regenerate, substantial erosion still occurs (HDR 2013). In addition, the failure of a dam on the East Fork Meadow Creek (also referred to as Blowout Creek) in 1965 resulted in extensive erosion, both upstream and downstream from the former dam and reservoir site, which in turn has led to extensive and ongoing deposition of sediment in the lower reaches of Meadow Creek and downstream in the East Fork SFSR. Currently, while concentrations of total suspended solids and turbidity are low during some months, there is seasonal variation in these concentrations associated with high flow periods when concentrations can reach moderate to high levels.

East Fork South Fork Salmon River

The East Fork SFSR is a tributary to the SFSR. The East Fork SFSR between its confluence with Sugar Creek upstream to the YPP lake is 1.2 km, upstream to the confluence with Meadow Creek is 6.1 km. This stream reach includes the YPP lake, immediately upstream from which is a long cascade (22 percent gradient) that presents a complete upstream passage barrier for all fish species including migrating Chinook salmon and steelhead. Despite the migratory barrier at the YPP lake, bull trout and westslope cutthroat trout are known to occur upstream from the YPP lake. Chinook salmon also spawn and rear in the stream reach upstream from the lake because they have been introduced there by the IDFG. Downstream from the YPP lake, this stream reach is accessible to all four special status salmonid species.

Between Meadow Creek and the YPP lake, the East Fork SFSR widens and has larger streambed material (including abundant cobble and boulders), relative to the upper East Fork SFSR. This stream reach has moderate to high stream gradients (approximately 2 to 8 percent) (HDR 2016). Moving downstream to the confluence with Sugar Creek, the East Fork SFSR is similar in width, gradient, and substrate material as upstream, but many of the larger boulders and cobble are sharp and more angular. Based on field surveys conducted by Rio ASE (2019), there are more and deeper pools upstream from the YPP lake. The East Fork SFSR generally supports a healthy riparian corridor, with the exception of areas near the YPP lake and areas of legacy mine waste dumps along the banks upstream and downstream from the YPP lake.

The East Fork SFSR in this reach has been heavily impacted by legacy mining activities. In addition to the YPP lake, a remnant of legacy mining activities, these impacts include waste rock dumps in and adjacent to the stream channel, tailings washed down from Meadow Creek valley, roads and infrastructure within and adjacent to the East Fork SFSR channel, dam construction across the East Fork SFSR main channel, and other legacy impacts (Midas Gold 2016).

Hennessy Creek

Hennessy Creek historically flowed into the East Fork SFSR downstream from the YPP lake, but it has been diverted to flow into the East Fork SFSR downstream from Sugar Creek. It is a narrow, low-flow stream that flows in a constructed ditch alongside McCall-Stibnite Road (CR 50-412), and then through a subterranean section under an adjacent waste rock dump before passing through a very high-gradient reach into the East Fork SFSR. The creek is not expected to support upstream fish passage because of an average channel gradient of 37 percent at its mouth (HDR 2016). Hennessy Creek is densely vegetated and shallow. The lower portion of Hennessy Creek has been significantly impacted by legacy mine-related activities, including stream diversion, road construction that buried the stream channel, and mining infrastructure (Midas Gold 2016).

Yellow Pine Pit Lake

During mining activities during the 1930s through the 1950s, the nearly 5-acre YPP lake was created by open pit mining while the East Fork SFSR was diverted through the Bradley Tunnel to Sugar Creek (Hogen 2002). After mining ceased in 1952, the East Fork SFSR was allowed to flow through the abandoned mine pit. The pit currently has a maximum depth of approximately 11 meters. Diverting the East Fork SFSR back into the stream channel and pit created a long cascade with a high (22 percent) gradient that precluded fish passage upstream into the upper watershed. Therefore, all streams upstream from the YPP lake are inaccessible to anadromous Chinook salmon and steelhead without human intervention. The YPP lake is used by both fish and mammals, including Chinook salmon, bull trout, and river otters. Mountain whitefish are abundant in the lake (Brown and Caldwell 2019b and 2020a) and it supports a healthy benthic macroinvertebrate community (IDEQ 2002). Bull trout found in the YPP lake may be either resident (Brown and Caldwell 2020a) and/or an adfluvial life history population that use the YPP lake for overwintering, with downstream migration to tributaries for spawning (Hogen and Scarnecchia 2006).

The YPP lake is the largest feature that affects flow rates in the East Fork SFSR; however, because of its small area, it affects low flows only slightly and does not affect high flows at all (Kuzis 1997). The lake also displays thermal stratification (i.e., order), but resuspension of sediments due to turnover is not expected. The bottom velocities necessary for turnover would not be high enough for resuspension (IDEQ 2002). Fish sampling in the YPP lake was not included in the habitat-related aquatic baseline studies conducted by HDR (2016) or MWH (2017).

Midnight Creek

Midnight Creek is a small tributary of the East Fork SFSR. The lower portion of the creek is characterized as a narrow channel with extremely high gradient (approximately 90 percent) and dense overhanging vegetation. The high gradient presents a complete fish passage barrier to fish (HDR 2016). Midnight Creek has been impacted by legacy mining activities, including open-pit mining, waste rock dumps, and road construction (Midas Gold 2016).

Midnight Creek was not included in the preliminary baseline study due to restricted access, but it was surveyed by Great Ecology (2018) in the supplemental assessment. There is no baseline fish use noted for Midnight Creek (MWH 2017).

Fiddle Creek

Fiddle Creek is a small tributary of the East Fork SFSR just upstream from Midnight Creek. Habitat conditions in the creek have been adversely impacted from legacy mine operations, road construction, and culvert installation (Midas Gold 2016). The lower portion of Fiddle Creek also was the site of a former water storage reservoir, the construction and operation of which degraded portions of the stream.

The lower reach of Fiddle Creek has an approximate 37 percent gradient where it flows into the East Fork SFSR, creating a complete barrier to upstream fish passage (HDR 2016). Upstream from this barrier, Fiddle Creek retains a relatively high gradient in a relatively narrow channel, with side channels (HDR 2016). The lower portion of the creek has a thick tall-shrub overstory dominated by gray alder (*Alnus incana*) (HDR 2016). The uppermost section of Fiddle Creek is natural glacial topography, flattens in gradient, and is a slower meandering stream . Large amounts of large woody debris occur throughout the creek, and the dominant streambed substrate consists of boulders, large cobble, and gravel (HDR 2016). Westslope cutthroat trout were the only salmonids observed in Fiddle Creek or detected in eDNA surveys (MWH 2017).

Garnet Creek

Garnet Creek is a narrow, shallow, moderate-gradient tributary to East Fork SFSR approximately 0.5 km downstream from the Meadow Creek confluence. The creek has been severely modified over the past 100 years to accommodate mining-related activities. It is still influenced by legacy mining infrastructure that was located across and adjacent to the stream channel, including portions of a town site; and is currently routed through several man-made ditches (Midas Gold 2016). Garnet Creek flows through a 26-m-long corrugated metal pipe culvert near its confluence with the East Fork SFSR that presents a partial barrier to fish (HDR 2016).

Garnet Creek was surveyed by Great Ecology (2018) in a supplemental assessment. Garnet Creek cuts through a formerly burned hillside. Most of the vegetative cover along the creek is composed of grasses; however, shrubs and trees grow alongside its banks, and woody vegetation is found in the channel (MWH 2017). There is no baseline fish use noted for Garnet Creek (MWH 2017).

Lower and Middle Meadow Creek

Meadow Creek is a major tributary to the East Fork SFSR that flows through a flat-bottomed valley surrounded by steep mountains. Elevations range from 1.9 km above sea level in the lower reach to over 2.3 km in the headwaters. Meadow Creek has been heavily impacted by legacy mining-related activities, including deposition of tailings and spent heap leach ore, ore processing facilities, heap leach pads, and other infrastructure, stream relocation into a straightened riprap channel, and construction of an airstrip (Midas Gold 2016). The downstream end of the valley shows remnant effects from early mining activities, along with a large outwash feature created by a dam failure in the East Fork Meadow Creek drainage south of the site of the Meadow Creek Mine. Portions of the creek have been modified over the years to improve conditions caused by past mine operations, including the regrading and revegetation of the 2 percent gradient lower reach of the creek in 2004 and 2005.

The middle reach of Meadow Creek is an engineered channel that was constructed to bypass the spent ore disposal area (SODA). The channel was lined with riprap over geotextile fabric and is confined between reinforced/engineered slopes with a gradient of less than 2 percent. This reach has a short section with a 9 percent gradient, shallow depths, and few pools, which may be a partial fish migration barrier at low flows. The channel includes low-gradient riffles, glides (section of the stream coming out of a pool), and runs. There is no side channel development or potential large woody debris recruitment.

Upper Meadow Creek

Upper Meadow Creek encompasses the headwaters downstream to the location of proposed TSF Buttress. Upper Meadow Creek is confined and high gradient at the most upstream extent and low gradient and unconfined immediately upstream from the SODA in lower Meadow Creek, transitioning from a gradient of 4 to 8 percent to 2 to 4 percent. Habitat is composed of riffles, step runs (sequence of runs separated by shorter riffle steps), and pools. The presence of side channels in some portions provide potential for lateral channel movement in the less confined sections. Immediately upstream from the SODA, Meadow Creek is unconfined, with a gradient less than 1 percent. The reach is composed of low-gradient riffle, step run, and pool habitat. The floodplain is active with oxbow cutoffs, side channels, and backwater features.

East Fork Meadow Creek

The East Fork Meadow Creek (EFMC), also known as “Blowout Creek,” is a tributary to Meadow Creek that has been severely impacted as a result of legacy mining-related activities and the failure of a dam that had been constructed across its stream channel (Midas Gold 2016). The dam was constructed in 1929 to supply hydroelectric power for historical milling operations. The dam failed in 1965 due to record snow melt and runoff rates, depositing large volumes of sediment into Meadow Creek, the East Fork SFSR, and the YPP lake (URS Corporation 2000). This stream is considered to be the largest source of sediment to the East Fork SFSR in the analysis area.

The middle reach of EFMC flows through a lateral glacial moraine that eroded during the dam failure and is still considered unstable as it continues to deposit sediments into Meadow Creek and the East Fork SFSR. Upstream from this middle reach, EFMC has a low-gradient pool-riffle reach flowing through a large meadow. This reach is incised and continues to headcut in response to the dam failure. There are few trees and the banks have abundant grasses. The dominant streambed material is sand and gravel (MWH 2017). The EFMC headwaters are high gradient (4 to 20 percent) with cascades, high-gradient riffle, and plunge-pool habitat.

Immediately downstream from the historical dam location, the creek has a slightly steeper (8 to 20 percent) gradient and is composed of cascade habitat. Near the confluence with Meadow Creek, the EFMC passes through a multi-thread and unconfined alluvial fan with a 4 to 8 percent gradient. Sediment from the unstable slopes immediately upstream may contribute to the formation and maintenance of this alluvial fan.

Headwaters East Fork SFSR

Upstream from the Meadow Creek confluence, the East Fork SFSR is characterized by narrower channels with moderate gradient (2 to 4 percent), transitioning to higher-gradient (4 to 8 percent) step-pool habitat further upstream. Overall substrate size is generally smaller than downstream reaches, with sand, gravel, smaller cobble, and boulders. This reach of the East Fork SFSR has relatively abundant riparian vegetation and large amounts of large woody debris.

Kuzis (1997) found that the Headwaters East Fork SFSR displays evidence of a high sediment load, such as streambed aggradation (deposition of material), channel splitting, pool filling, and overbank deposits of fines. The combination of low-gradient, relatively wide valley, plentiful wood supply, and a high sediment supply have resulted in current channel conditions.

East Fork SFSR Between Sugar Creek and Profile Creek

The East Fork SFSR downstream from Sugar Creek is adjacent to the SGP mine site in the No Mans-East Fork SFSR subwatershed. The East Fork SFSR ranges from low-gradient habitat with pools to high gradient habitat with cascades. Substrate throughout the reach is variable, and dependent on the gradient, with the lower-gradient sections dominated by gravel and cobble, while the higher-gradient units are dominated by large cobble and boulders. Avalanches in 2014 have resulted in high concentrations of large woody debris in the East Fork SFSR downstream from Sugar Creek (MWH 2017). In April 2019, a series of avalanches and related landslides caused extensive damage to Stibnite Road (CR 50-412), and pushed snow, timber, and other debris into the East Fork SFSR (Midas Gold 2019b). These events were naturally occurring in burn areas and were related to rain-on-snow events.

Sugar Creek

Sugar Creek, a tributary to the East Fork SFSR, enters the river downstream from the YPP lake. It has a relatively low gradient. An officially closed road closely parallels Sugar Creek for nearly 3.2 km. This road may confine the movement of Sugar Creek, specifically in areas where the banks are bound with riprap rock material. Much of Sugar Creek has large aggregates of large woody debris. The dominant substrates are sand, gravel, and cobble.

This creek has widened channels, and excessive medial and lateral bar formation in response to past sediment inputs. In the 1940s, approximately 1 million cubic yards (approximately 76,455 cubic meters) of glacial overburden was removed from the East Fork SFSR channel and placed in both Sugar Creek and other parts of the East Fork SFSR (Kuzis 1997).

Sugar Creek supports spawning and rearing for all four salmonid species and represents one of the most productive fish habitats in the Upper East Fork SFSR watershed. Legacy mining-related impacts include construction of an access road adjacent to and in the stream channel, upstream sources of sediment, and mercury contamination.

6.1.3 Mine Site Watershed Condition Indicators

Baseline WCIs were determined for the stream reaches within the SGP mine site (**Table 6-3**). not all WCIs are equal in terms of evaluating the potential impacts of the SGP within the mine site. Some baseline WCIs are of historical interest, some would not be affected by the SGP, some are not well-established from a quantitative analysis perspective so they cannot be evaluated, and some WCIs are irrelevant to the SGP. For these reasons, five WCIs that have the greatest potential to accurately identify potential impacts due to the SGP were selected for detailed analysis. These WCIs are:

1. Water Temperature
2. Sediment/Turbidity
3. Chemical Contaminants
4. Physical Barriers
5. Change in Peak/Base Flows

A description of each of these WCIs and their current condition is provided in **Table 6-3**.

Table 6-3 Mine Site Stream Reaches Baseline Summary of Watershed Condition Indicators

Watershed Condition Indicator	East Fork SFSR and Tributaries from Sugar Creek to Meadow Creek	Meadow Creek and East Fork Meadow Creek	East Fork SFSR Upstream from Meadow Creek	East Fork SFSR Between Sugar Creek and Profile Creek	Sugar Creek
Bull Trout Local Population Characteristics within Core Area					
Local Population Size	FR	FR	FR	FR	FR
Growth and Survival	FR	FR	FR	FR	FR
Diversity and Isolation	FR	FR	FR	FR	FR
Persistence and Genetic Integrity	FR	FR	FR	FR	FR
Water Quality					
Temperature (Steelhead/Chinook salmon)	FR	FR	FR	FR	FR
Temperature (Bull trout)	FR	FR	FR	FR	FR
Sediment/Turbidity (Steelhead, Chinook salmon)	FUR	FUR	FUR	FUR	FUR
Sediment/Turbidity (Bull trout)	FUR	FUR	FUR	FUR	FUR
Chemical Contaminants	FUR	FR	FUR	FUR	FUR
Habitat Access					
Physical Barriers	FUR	FUR	FA	FA	FA
Substrate Embeddedness (Bull trout rearing areas)	FA	FA	FA	FA	FA
Large Woody Debris	FR	FA	FA	FA	FA
Pool Frequency and Quality	FR	FR	FR	FA	FR
Large Pools/Pool Quality (Bull trout)	FUR	FUR	FUR	FUR	FUR
Off Channel Habitat	FR	FR	FR	FR	FR
Refugia (Steelhead/Chinook salmon)	FR	FR	FR	FR	FR
Refugia (bull trout)	FR	FR	FR	FR	FR
Channel Conditions and Dynamics					

Watershed Condition Indicator	East Fork SFSR and Tributaries from Sugar Creek to Meadow Creek	Meadow Creek and East Fork Meadow Creek	East Fork SFSR Upstream from Meadow Creek	East Fork SFSR Between Sugar Creek and Profile Creek	Sugar Creek
Average Wetted Width/ Maximum Depth Ratio	FA	FA	FA	FA	FA
Streambank Condition	FA	FA	FA	FA	FA
Floodplain Connectivity	FR	FA	FR	FR	FR
Flow/Hydrology					
Change in Peak/Base Flows	FA	FA	FA	FA	FA
Change in Drainage Network	FA	FA	FA	FA	FA
Watershed Condition					
Road Density/Location	FUR	FUR	FUR	FR	FUR
Disturbance History	FR	FR	FR	FUR	FR
Riparian Conservation Areas	FA	FA	FA	FR	FA
Disturbance Regime	FR	FR	FA	FR	FR
Integration of Pathways					
Integration of Species/ Habitat Conditions	FR	FR	FR	FR	FR

Source: Rio ASE 2019, Forest Service 2010b; IDEQ 2017; Burns et al. 2005; Kuzis 1997, MWH 2017; USFWS 2015a, and Integration of Species and Habitat which is derived from professional judgment.
East Fork SFSR; FA = functioning appropriately; FR = functioning at risk; FUR = functioning at unacceptable risk

6.1.3.1 Water Temperature

Baseline water temperatures for the SGP mine area were evaluated using a Stream and Pit Lake Network Temperature (SPLNT) model developed by Brown and Caldwell (2021a). This model evaluated stream water temperatures and YPP lake water temperatures under baseline conditions and then potential changes that may occur as a result of proposed mine operations and subsequent reclamation. The SPLNT existing conditions model was developed and calibrated primarily using extensive site-specific meteorological, hydrologic, and stream data collected at the mine site (Brown and Caldwell 2021a). The model uses widely accepted numerical modeling approaches that consists of stream temperature and shading models (QUAL2K) and the General Lake Model for simulating pit lake temperatures (see Water Quality Specialist Report for further details on models).

Results of the SPLNT model describing existing conditions (maximum weekly summer (July) and fall (September) temperatures) are shown in **Table 6-4**.

Table 6-4 SPLNT Modeled Baseline Maximum Weekly Summer and Fall Stream Temperatures for Specific Stream Reaches

SPLNT Model Stream Reaches	Baseline Summer Daily Maximum Temperature (°C)	Baseline Fall Daily Maximum Temperature (°C)
Upper East Fork SFSR (upstream from Meadow Creek confluence)	13.4	11.0
Meadow Creek upstream from East Fork Meadow Creek confluence	14.0	12.0
Meadow Creek downstream from East Fork Meadow Creek confluence	19.4	15.9
Middle East Fork SFSR (between Meadow Creek and YPP)	17.3	13.9
Lower East Fork SFSR (between YPP and Sugar Creek)	14.1	11.2
East Fork SFSR downstream from Sugar Creek confluence	14.9	11.9

°C = degrees Celsius; East Fork SFSR = East Fork South Fork Salmon River; SPLNT = Stream and Pit Lake Network Temperature; YPP = Yellow Pine pit lake barrier

Establishing existing surface water temperature conditions at the SGP mine site was performed as part of the Surface Water Quality Baseline Study (HDR 2017) to provide a baseline dataset for comparing future temperature changes predicted by the SPLNT model.

The SPLNT model did not account for changes to stream temperatures caused by changing climate conditions. This means the model assumed future stream temperatures would be similar to the historic water temperature data without the SGP (Brown and Caldwell 2018). Given ongoing climate changes, modeled temperature results would likely be higher if climate change had been considered in the model. The effects of different air temperature conditions on stream temperatures were evaluated through a sensitivity analysis (Brown and Caldwell 2018) and an uncertainty analysis (Forest Service 2022c).

The NorWeST model, produced by the Forest Service Rocky Mountain Research Station, provides a variety of scenario-based parameters that represent future stream temperatures for National Hydrography Dataset (-Plus) reaches across the western U.S. NorWeST-modeled stream temperatures are presented (Isaak et al. 2016) alongside the SPLNT stream temperatures in **Table 6-5** and ESS 2019a to provide information regarding the possibility of changing climate conditions in the analysis area.

Table 6-5 Comparison of Baseline SPLNT Model Temperatures with NorWeST Model Stream Temperatures for Multiple Timeframes (Mean August Temperatures)

SPLNT Reach	Baseline SPLNT Modeled Stream Temperature (°C)	NorWeST Model Stream Temperature (°C)			
		1930-2011	2015	2030-2059	2070-2099
YPP Lake Headwater	11.9	11.57	12.18	12.86	13.7
Meadow Creek	11.8	10.38	10.99	11.64	12.46
Upper East Fork SFSR at Rabbit Creek	9.5	9.95	10.56	11.2	12.01
Sugar Creek	9.2	10.83	11.43	12.1	12.92

Source: Brown and Caldwell 2018, Isaak et al. 2016
°C = degrees Celsius; SPLNT = Stream and Pit Lake Network Temperature

Of the NorWeST parameters, modeled stream temperatures for 1993-2011 and 2015 are the most appropriate for comparison to existing condition (baseline) SPLNT modeled stream temperatures because they most closely coincide with the data that was used to represent baseline conditions. The NorWeST data from the above timeframes most closely coincides with the baseline data, which was collected between 2012 and 2019. There are two parameters within the NorWeST dataset that predict stream temperatures based on future scenarios; they are represented by warming trajectories 2040 (2030-2059) and 2080 (2070-2099). The exact year when the SGP would be implemented is unknown; however, if construction were to begin in 2022, then Mine Year 20 would occur in 2045 (3 years construction plus 20 years of operation and closure and reclamation activities), within the NorWeST 2040 (2030-2059) prediction timeframe. Year 112 would be outside of the predicted timeframes the NorWeST models provide, but the predictions through 2099 are representative of the modeled long-term trend applicable to that time period. These factors were considered when interpreting modeled future temperatures, especially the further into the future the modeled water temperatures represent.

These modeling results indicate that, depending on stream reach, climate change would increase water temperatures from baseline estimates to the end of the mine operations (2030-2059) by as much as 0.1° to 2.0°C. Into the future, baseline estimates for water temperatures would increase by as much as an additional degree (2070-2099). Depending on the salmonid species, climate change may have important biological impacts. The WCI criteria for water temperatures are species and life-stage-dependent (Rio ASE 2019). The criteria also are defined as the 7-day average of the maximum weekly maximum temperatures (MWMT). The WCI water temperature criteria for Chinook salmon and steelhead spawning and rearing, and bull trout spawning, incubation, and rearing, used in the WCI functional assessment are included in BioAnalysts (2019) and Forest Service (2003).

6.1.3.2 Sediment/Turbidity

All of the stream reaches in the Headwaters East Fork SFSR subwatershed are at unacceptable risk for Chinook salmon, steelhead, and bull trout due to baseline sediment conditions (**Table 6-3**). This is due to a variety of past disturbances at the SGP mine site that are currently affecting streambank stability and erosion, and the proximity to existing roads. The matrix WCIs use surface fines as a proxy to evaluate suspended sediment, turbidity, and salmonid spawning substrate quality.

6.1.3.3 Physical Barriers

Barriers to fish passage can impact the natural movement (e.g., migration) of fish species and fish population dynamics by reducing, or completely blocking, potential habitat during certain life stages. Barriers can impact fish habitat connectivity and disrupt the natural movement of fish and block important habitat for fish during all life cycles, including spawning and rearing. Fish passage barriers were identified and described within the SGP mine site (BioAnalysts 2021). Only the East Fork SFSR downstream from the mine site and Sugar Creek are without artificial (i.e., human-made) barriers (BioAnalysts 2021). Eleven artificial barriers to fish passage and one natural barrier were identified (BioAnalysts 2021). The status of these barriers were identified as either complete, meaning no fish species can pass at any time of year, or partial, meaning some or all fish may pass at moderate or high flows, but not at low flows. Artificial barriers can be attributed to various actions, for example, construction of culverts and stream alteration (BioAnalysts 2021). Of these eleven artificial barriers, six are located in non-fish bearing streams. The remaining five barriers are shown in **Figure 6-1** and described in more detail in ESS 2019b. **Table 6-6** presents the amount of total potential fish habitat upstream from each barrier.

BioAnalysts (2020) identified three major barriers to fish movement in the SGP mine site area: 1) the high gradient cascade in the East Fork SFSR upstream from the YPP lake; 2) East Fork SFSR box culvert; and 3) the high gradient cascade in Meadow Creek upstream from the confluence with the East Fork Meadow Creek. The high gradient cascade in the East Fork SFSR upstream from the YPP lake is a complete barrier to natural fish passage. The other two major barriers, the East Fork SFSR box culvert and Meadow Creek barriers, are flow-dependent partial barriers that can block seasonal migration, and only hinder migration of fish that reside in or were stocked upstream from the YPP lake (i.e., translocated Chinook salmon).

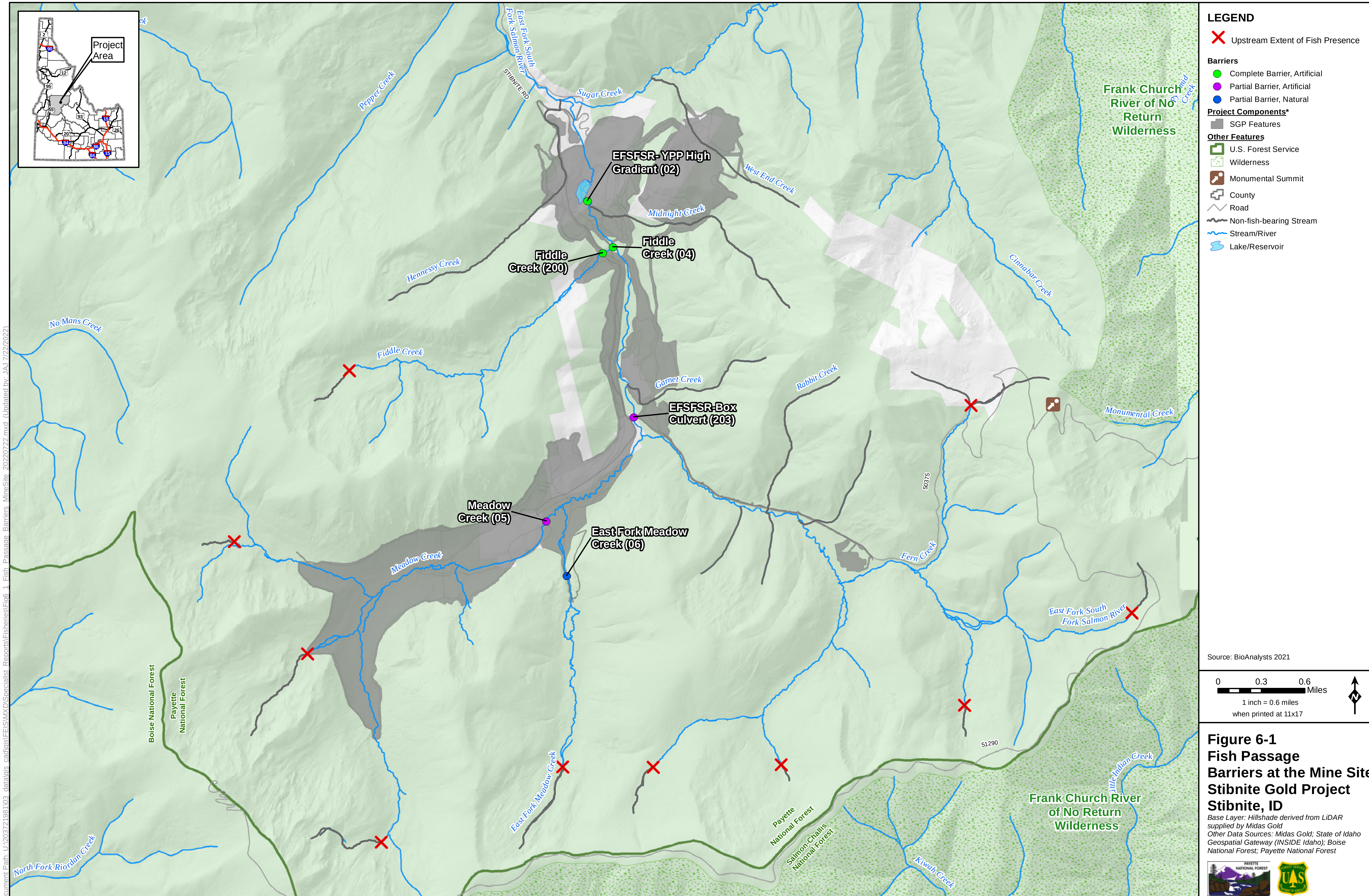


Figure 6-1
Fish Passage Barriers at the Mine Site
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Midas Gold
Other Data Sources: Midas Gold; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

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Table 6-6 Existing Fish Passage Barriers at the Proposed Mine Site and Potential Fish Habitat Under Baseline Conditions

Barrier	Status	Potential Bull Trout and Cutthroat Trout Habitat (km)		Potential Chinook Habitat (km)		Potential Steelhead Habitat (km)	
		Upstream from Barrier	Total Available[1]	Upstream from Barrier	Total Available[1]	Upstream from Barrier	Total Available[1]
East Fork SFSR above YPP (02) Artificial – Gradient	Complete	32.82[2] 19.54[3]	34.04[2] 22.12[3]	8.87[4] 25.88[3]	11.15[4] 28.16[3]	8.72[4]	10.67[4]
East Fork SFSR (203) Artificial – Box Culvert	Partial	26.43[2] 16.66[3]	34.04[2] 22.12[3]	6.29[4] 23.10[3]	11.15[4] 28.16[3]	6.89[4]	10.67[4]
Fiddle Creek (04) Artificial – Gradient	Complete	3.50[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]
Fiddle Creek (200) Artificial – Culvert	Complete	3.46[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]
Meadow Creek (05) Artificial – Gradient	Partial	8.23[2] 6.62[3]	34.04[2] 22.12[3]	1.02[4] 6.81[3]	11.15[4] 28.16[3]	1.69[4]	10.67[4]
East Fork Meadow Creek (06) Natural – Gradient	Partial	2.22[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]

[1] Not all of the Total Habitat is considered Usable Habitat
[2] Results based on Occupancy Probability for bull trout and cutthroat trout
[3] Results based on Critical Habitat for bull trout or modeled Critical Habitat for Chinook salmon
[4] Results based on usable Intrinsic Potential habitat
km = kilometer; YPP = Yellow Pine pit

6.1.3.4 Chemical Contaminants

This WCI is used to evaluate chemical contamination in surface waters in the analysis area at the mine site. The description of existing conditions relies upon data collected at eight surface water chemistry monitoring locations (**Figure 6-2**) and from information provided in the SGP Water Quality Specialist Report (Forest Service 2022c).

The description of chemical contaminants focuses on five constituents of concern: aluminum, copper, antimony, arsenic, and mercury. These five constituents of concern were selected because certain concentrations within the water or fish tissue can be detrimental to fish (potential effects to fish described in more detail below). **Table 6-7** provides the baseline conditions for these constituents of concern compared to the applicable criteria. Criteria were chosen based on consultation with the USFWS and NMFS. Explanations of the analysis criteria for the five constituents are provided in **Table 6-7** notes.

In sum, for the chemical contaminants WCI, the analysis area is “functioning at risk” or “functioning at unacceptable risk” (**Table 6-3**) due to existing levels of legacy mining contamination. No stream on the SGP mine site is considered functioning acceptably for chemical contaminants. The constituents that are currently exceeding thresholds are arsenic, antimony, copper, and mercury.

Aluminum

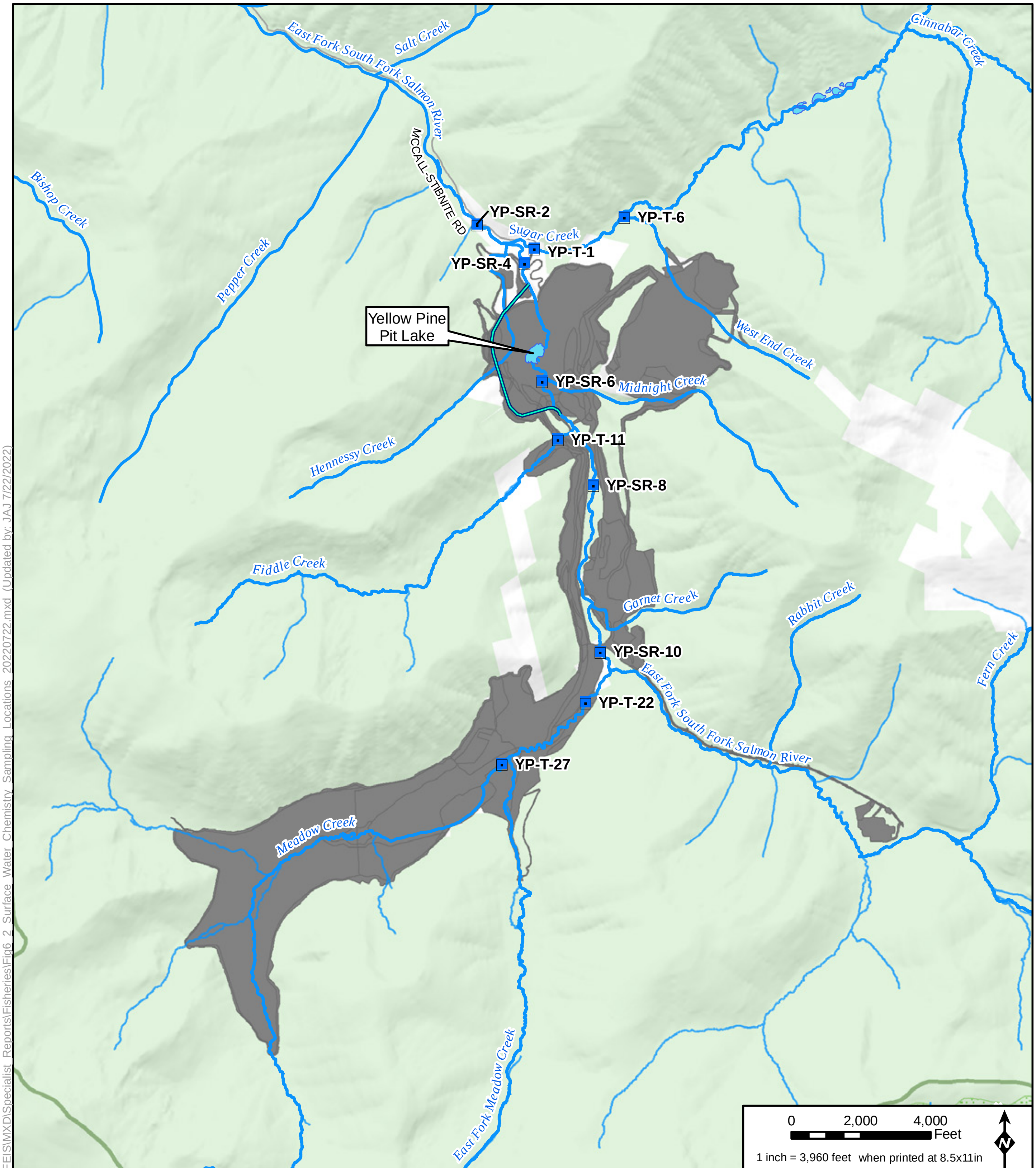
Aluminum can accumulate at the surface of the gill, leading to respiratory dysfunction and disruption of salt balance, and can cause mortality (EPA 2018). The aquatic life recommended criteria for aluminum for a site are based on site-specific conditions of pH, total hardness, and dissolved organic carbon. The EPA acute criteria for the same conditions as used in calculating the site-specific copper criteria based on the Biotic Ligand Model (Brown and Caldwell 2020b), range from 930 to 2,500 microgram per liter (µg/L) total recoverable aluminum, and the chronic criteria range from 360 to 1,700 µg/L total recoverable aluminum. The State of Idaho does not currently have a specific water quality standard for aluminum in place for the protection of aquatic life and the EPA criteria have not yet been adopted by the State of Idaho. Nevertheless, they reflect the most current knowledge of potential impacts of aluminum to aquatic life.

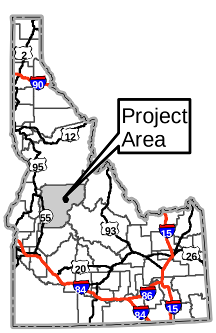
None of the assessment nodes show an exceedance of the analysis criteria for aluminum.

Copper

Copper and copper compounds are acutely toxic to fish and other aquatic life at low parts per billion levels (Eisler 1991, 2000; Hamilton and Buhl 1990). Copper is essential to the growth and metabolism of fish and other aquatic life, but it can cause irreversible harm at levels slightly higher than those required for growth and reproduction (Eisler 2000). Exposure to sublethal levels of copper can have a detrimental effect on the behavior of salmonids. McIntyre et al. (2012) evaluated the effects of copper exposure on juvenile Coho salmon (*Oncorhynchus kisutch*) predator avoidance behaviors and found that the exposed juveniles were unresponsive to their chemosensory environment, unprepared to evade nearby predators, and less likely to survive an attack sequence. Salmonids are known to avoid waters with sublethal concentrations of copper, and such concentrations alter other behavior as well.

The Biotic Ligand Model-based copper criteria indicated an exceedance in Sugar Creek at YP-T-1. However, of the 38 dissolved copper values reported for YP-T-1, only one value was higher than 0.00261 milligrams per liter (mg/L); therefore, it is likely that this single anomalous value was the result of a sampling, analytical, or data management error.





LEGEND

Surface Water Chemistry Sampling Locations

Diversion Tunnel

Project Components *

SGP Features

Other Features

U.S. Forest Service

Wilderness

County

Stream/River

Lake/Reservoir

Surface Management

Private

U.S. Forest Service

Figure 6-2
Surface Water Chemistry Sampling Locations
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

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Table 6-7 Average Measured Constituent Concentrations at Monitoring Locations

Constituent of Concern		Aluminum [1]	Copper[2]	Antimony [3]	Arsenic[4]	Mercury[5]
Analysis Criteria		**38 µg/L**	**2.4 µg/L**	**5.2 µg/L**	**10 µg/L**	**0.002 µg/L (total mercury)**
Node	**Stream**	**Average Measured Baseline (µg/L)**				
YP-T-27	Meadow Creek	1.2	0.3	6.1	35	0.0015
YP-T-22	Meadow Creek	1.2	0.3	8.1	34	0.0017
YP-SR-10	East Fork SFSR	9.4	0.2	12	25	0.0025
YP-SR-8	East Fork SFSR	9.4	0.3	17	28	0.0024
YP-SR-6	East Fork SFSR	9.8	0.2	19	31	0.0024
YP-SR-4	East Fork East Fork SFSR	12	0.3	31	63	0.0024
YP-SR-2	East Fork SFSR	14	0.2	22	45	0.0057
YP-T-11	Fiddle Creek	16	0.2	0.6	2	0.0018
YP-T-6	West End Creek	4.0	0.3	10.5	80	0.0042
YP-T-1	Sugar Creek	9.0	8.56[6]	34	13	0.159

Source: Midas Gold 2019a; SRK 2021

Analysis criteria pertain to fish species. Aluminum, arsenic, and mercury criteria are based on total concentrations while copper and antimony are based on dissolved concentrations.

[1] Aluminum: Lowest predicted for the SGP area based on Recommended Aquatic Life Criteria (EPA 2018); The same water quality data as in the Biotic Ligand Model were used (Brown and Caldwell 2020b).

[2] Copper criteria was derived using the Biotic Ligand Model per guidance contained in IDEQ (2017). A conservative chronic copper standard was estimated by applying the lowest of the 10th percentile chronic criteria based on regional classifications for the Salmon River Basin, Idaho Batholith, and third order streams. Per the SGP Water Quality Management Plan (Brown and Caldwell 2020c), preliminary calculations using the Biotic Ligand Model and site-specific data have produced similar values to the standard derived using these regional classifications.

[3] Antimony does not have a specified NMFS or USFWS criteria and is based on EPA's human health chronic criterion for consumption of water and organisms is 0.0056 mg/L.

[4] Arsenic: NMFS (2014) directed EPA to promulgate or approve new aquatic life criterion. In the interim, NMFS directed EPA to ensure the 10 µg/L human health criterion applied in all National Pollutant Discharge Elimination System permits. USFWS (2015b) directed EPA to ensure that the 10 microgram per liter recreational use standard is applied in all Water Quality Based Effluent Limitations (WQBELs) and Reasonable Potential to Exceed Calculations using the human health criteria and the current methodology for developing WQBELs to protect human health.

[5] Mercury: NMFS (2014) directed EPA to promulgate or approve a new criterion. In the interim, implement the fish tissue criterion that IDEQ adopted in 2005. Where fish tissue is not readily available, then NMFS specified application of a 2.0E-0 µg/L threshold (as total mercury) in the interim. USFWS (2015b) directed EPA to use the 2001 EPA/2005 Idaho human health fish tissue criterion of 0.3 milligram per kilogram wet weight for WQBELs and reasonable potential to exceed criterion calculations using the current methodology for developing WQBELs to protect human health.

[6] Of the 38 dissolved copper values reported for YP-T-1, only one value was higher than 0.00261 mg/L; therefore, it is likely that this single anomalous value was the result of a sampling, analytical, or data management error.

µg/L = micrograms per liter; East Fork SFSR = East Fork South Fork Salmon River

Antimony

Known effects of antimony on aquatic organisms are more limited than for other metals and most available information pre-date the last three decades. Antimony can be toxic to aquatic life and bioaccumulate in tissues but has not consistently shown a tendency to biomagnify within aquatic food webs as other metals (Obiakor et al. 2017). Ambient water quality criteria for the protection of aquatic life have not been established for antimony. Average antimony concentrations currently exceed the analysis criteria at every assessment node except YP-T-11 in Fiddle Creek (**Table 6-6**).

Arsenic

Arsenic criteria are specific to the inorganic form, which is the more toxic form to aquatic life and humans. Arsenic exposure can occur through both waterborne concentrations and through dietary exposure for aquatic life and humans. In the State of Idaho, criteria exist for both the protection of human health and the protection of aquatic life. NMFS directed the human health standard be used until new aquatic life criterion can be promulgated by EPA. Arsenic can concentrate in tissues of fish, but it does not biomagnify. The effects of arsenic on fish health include enzymatic, genetic, and immune system failure (Kumari et al. 2017). Arsenic is a suspected carcinogen in fish and is associated with necrotic and fibrous tissues and cell damage, especially in the liver. Arsenic can result in immediate death through increased mucus production and suffocation. Other effects include anemia and gallbladder inflammation (NMFS 2014).

Arsenic concentrations currently exceed the analysis criteria at all assessment nodes except YP-T-11 in Sugar Creek (**Table 6-6**).

Mercury

Mercury in the environment originates from both natural and anthropogenic (human-caused) sources. However, regionally, the most significant source of mercury in Idaho is air deposition. Methylation is a process by which inorganic mercury is converted to the organic form (methylmercury), which can be present in the water column and is the form that bioaccumulates in tissues of living organisms. Consuming methylmercury that has accumulated in other organisms is the primary form for mercury exposure for humans. Currently, the value of 0.3 milligrams of methylmercury per kilogram of fish tissue wet weight is set at a level to protect the general public from negative effects of mercury during a lifetime of exposure through the consumption of fish. It also is the human health standard of 0.3 milligram per kilogram fish tissue criterion that is protective of aquatic life (IDEQ 2005, 2018). Although the water column-based aquatic life chronic criterion for mercury in Idaho is 0.000012 mg/L (Total), the preferred value used for interpreting risks of mercury contamination to aquatic life is the fish tissue criterion of 0.3 milligram per kilogram wet weight, the same value used for protection of human health (IDEQ 2018).

Predatory species in the food web concentrate the highest amounts of mercury in their tissues, a process called biomagnification. Salmonids in the streams and rivers of Idaho may be the dominant predator species and can concentrate mercury at levels several times that of prey species, such as algae, aquatic insects, and fish that do not feed exclusively on other fish. Generally, piscivorous fish (fish-eating) will bioaccumulate the highest concentration of mercury. Larger fish, which also tend to be older, are expected to bioaccumulate the most methylmercury.

Mercury concentrations currently exceed the 2.0E-6 mg/L analysis criteria at six of the ten nodes including in the East Fork SFSR at nodes YP-SR-10, YP-SR-8, YP-SR-6, YP-SR-4, YP-SR-2, and in West End Creek at node YP-T-6 (**Table 6-6**).

6.1.3.5 Peak/Base Flow

USGS data were used to derive peak flow statistics for the ten major drainages in the analysis area (**Figure 6-3**). Results from the peak flow analysis were summarized in the baseline study (HydroGeo 2012) and are presented in the Water Quantity Specialist Report. Peak flows were calculated for the bottom of each drainage using the USGS StreamStats program. Predicted peak flows for a 1.5-year event ranged from 1.84 cubic feet per second (cfs) for West End Creek to 237 cfs for the East Fork SFSR, and for a 500-year event they ranged from 13.4 cfs to 931 cfs, respectively. Table 6-5 in the SGP Water Quantity Specialist Report (Forest Service 2022d) provides the maximum flow predicted to occur for various return periods from a 1.5-year event up to a 500-year event.

Base stream flow data were collected in conjunction with surface water quality sampling on a monthly or quarterly basis at 32 non-USGS monitoring stations. The monitoring points were selected at upstream and downstream locations to bracket historical and potential future mining activities in the analysis area (Brown and Caldwell 2017). Table 6-6 in the SGP Water Quantity Specialist Report (Forest Service 2022d) provides stream flow statistics derived from baseline measurements collected between 2012 and early 2016. The mean flows calculated from this dataset for the East Fork SFSR ranged from 4.47 cfs at the farthest upstream monitoring location to 31.31 cfs at the most downstream location.

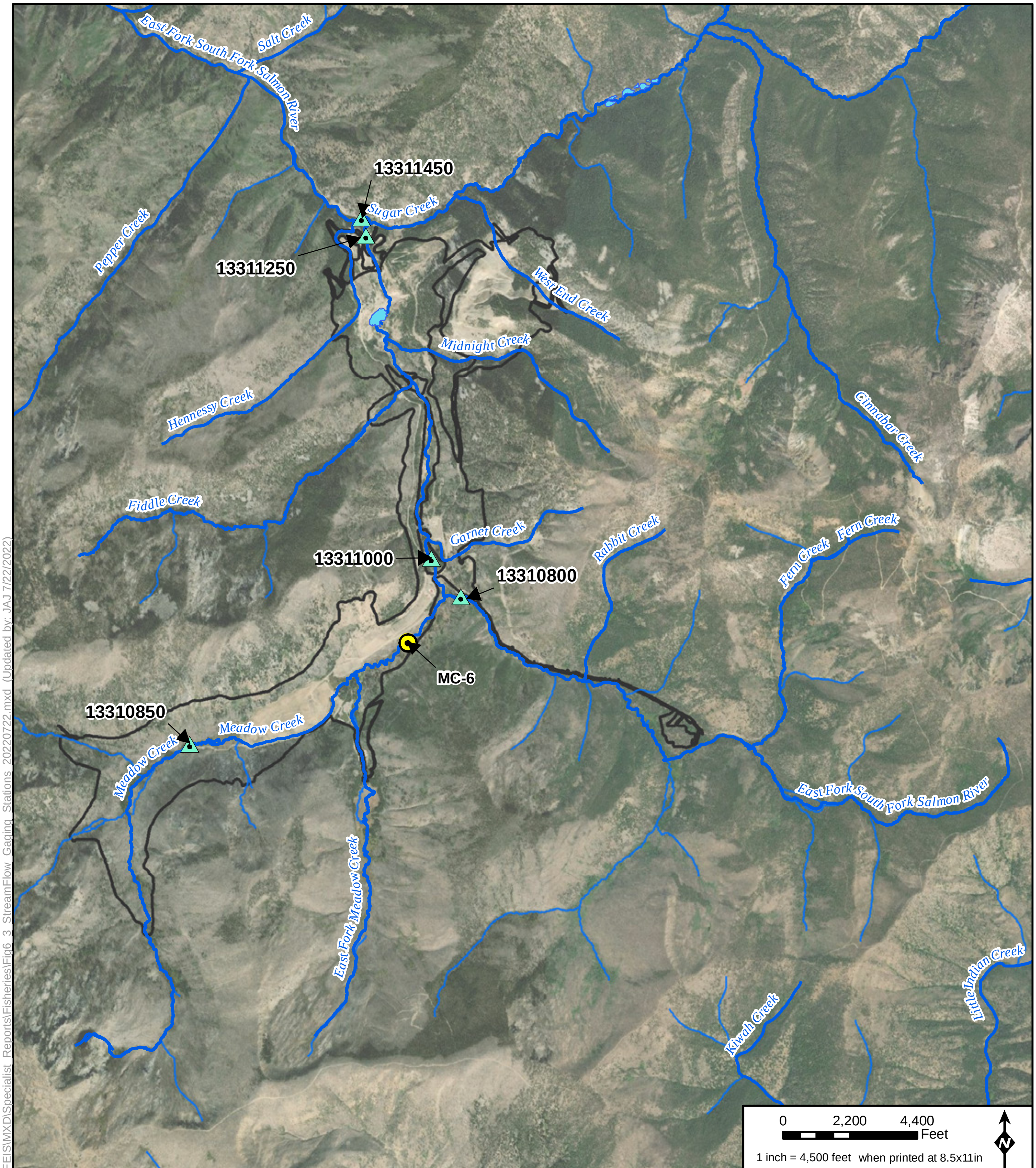
Table 6-8 shows average monthly stream flows during the August to March low flow period at five gaging stations and location in lower Meadow Creek in the SGP mine site streams for the years 1929 to 2017.

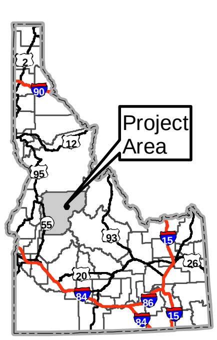
Climate change conditions resulting in increasing air temperatures would potentially transition snow to rain resulting in diminished snowpack and earlier season streamflow along with changes in groundwater recharge to aquifers that discharge to streams. Mean annual streamflow projections suggest a slight increase, but summer low flows are expected to decline (Halofsky et al. 2018).

Table 6-8 Average Monthly Stream Flow During the August-March Low Flow Period for 1929 to 2017 at USGS Gaging Stations and One Meadow Creek Location

Month	East Fork SFSR above Meadow: 13310800 (cfs)	East Fork SFSR at Stibnite: 13311000 (cfs)	East Fork SFSR above Sugar Creek: 13311250 (cfs)	Sugar Creek above East Fork SFSR: 13311450 (cfs)	Meadow Creek: 13310850 (cfs)	Meadow Creek: MC-6 (cfs)
August	7.3	15.4	17.3	12.5	4.1	7.7
September	5.7	11.9	13.1	9.0	3.0	5.9
October	5.3	11.5	12.6	8.3	3.1	5.8
November	4.6	10.8	12.8	8.3	3.4	5.8
December	3.7	9.0	11.0	7.2	2.8	4.8
January	3.5	8.0	9.9	6.5	2.3	4.2
February	3.3	7.7	9.5	6.4	1.9	3.8
March	3.4	8.7	10.5	7.3	2.2	4.3
Average	4.6	10.4	12.1	8.2	2.9	5.3

MC-6 is located in the lower reaches of Meadow Creek
cfs = cubic feet per second; USGS = U.S. Geological Survey.





LEGEND

USGS Active Gaging Station

MC-6

Project Components *

SGP Features

Stream/River

* SGP Features are associated with all Alternatives

Figure 6-3
Stream Flow Gaging Stations at the Mine Site
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI USA Topographic Basemap
Other Data Sources: United States Geological Survey; Perpetua; Boise National Forest; Payette National Forest

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6.2 Fish Density

Fish density refers to the number of individuals per unit area (e.g., square meters) or volume (e.g., cubic meters). In this document, the term "linear density" is also discussed. Linear density as used here is the number of fish per linear length of stream, typically per meter. Because the wetted area of streams varies with flow, it is useful to have a metric that is non-flow dependent, (i.e., stream length).

6.2.1 Stream Estimates

Fish abundance data collected during snorkel surveys in the mine site area in 2015 were used in conjunction with fish mark-recapture survey data collected at the same sites at the same time to develop fish relative abundance and density estimates. The objective of comparing snorkeling abundance data to mark-recapture data was to develop a metric that could be applied to the large number of snorkeling sites evaluated from 2012 to 2015. The details of how fish densities were derived are included in AECOM 2020b.

Several approaches to estimating salmonid densities were applied to the mine site subwatersheds and these approaches are described in detail in MWH 2017 and GeoEngineers 2017. In summary, it was determined that fish densities based on the mark-recapture method represent fair to good estimates of the fish density for most stream reaches evaluated (GeoEngineers 2017). Note that this analysis determines fish densities that can be used to estimate the salmonid abundance at a specific stream reach at the time of sampling.

The results adjusting the salmonid species areal and linear densities at snorkel survey sites within and adjacent to the mine site subwatersheds from 2012 to 2015 (**Figure 6-4**) are summarized in **Table 6-9**.

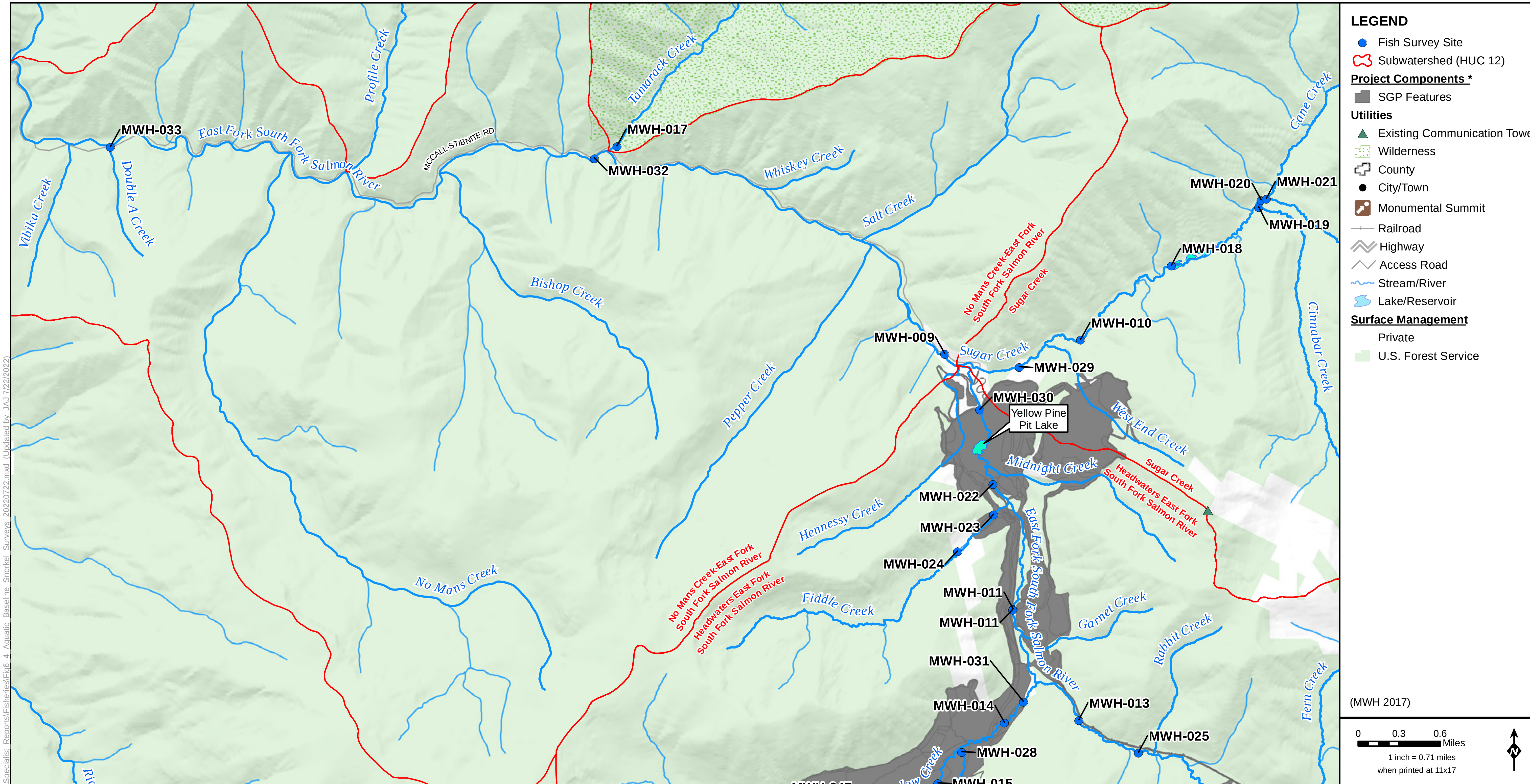

Figure 6-4
Aquatic Baseline Snorkel Survey Site Locations
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest, MWH and Stantec

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Table 6-9 Adjusted Salmonid Species Areal and Linear Densities at Snorkel Survey Sites Within and Adjacent to the Proposed Mine Site Subwatersheds from 2012 to 2015

Site ID (Downstream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m² (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
East Fork South Fork Salmon River Downstream from Sugar Creek and Tributaries, Sugar Creek, and Sugar Creek Tributaries								
MWH-033	East Fork SFSR	Upstream from Johnson Creek	2013	100/14.1	0.121 (1.701)	0.084 (1.174)	0.011 (0.148)	0.036 (0.500)
MWH-032	East Fork SFSR	Downstream from Tamarack Creek	2013, 2014	100/15.9	0.045 (0.675)	0.038 (0.574)	0.011 (0.162)	0.017 (0.250)
MWH-017	Tamarack Creek	Near confluence with East Fork SFSR	2012-2014	97/5.7	0.017 (0.097)	0.034 (0.195)	0.006 (0.032)	0.038 (0.218)
MWH-009	East Fork SFSR	Downstream from Sugar Creek	2012, 2014	95.5/8.4	0.059 (0.495)	0.050 (0.417)	0.022 (0.184)	0.014 (0.120)
MWH-029	Sugar Creek	Lower Reach	2012-2014	97/5.5	0.021 (0.116)	0.019 (0.107)	0.029 (0.162)	0.024 (0.134)
MWH-010	Sugar Creek	Middle Reach	2012-2014	97/5.5	0.023 (0.125)	0.024 (0.130)	0.048 (0.260)	0.022 (0.121)
MWH-018	Sugar Creek	Upper Reach	2012-2015	95.2/5.1	0.003 (0.018)	0.011 (0.057)	0.046 (0.234)	0.005 (0.025)
MWH-020	Sugar Creek	Upstream from Cinnabar Creek	2012-2013	95.5/3.6	0.002 (0.007)	0.006 (0.021)	0.080 (0.283)	NP
MWH-019	Cinnabar Creek	Lower Reach	2012-2015	93/2.8	NP	NP	0.095 (0.236)	0.006 (0.014)
MWH-021	Cane Creek	Lower Reach	2012-2013	55.5/3.0	NP	NP	0.107 (0.316)	NP
East Fork South Fork Salmon River Between Sugar Creek and YPP								
MWH-030	East Fork SFSR	Upstream from Sugar Creek	2012-2014	97/6.4	0.088 (0.561)	0.062 (0.394)	0.015 (0.093)	0.020 (0.125)

Site ID (Downstream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m² (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
East Fork South Fork Salmon River Between YPP and Meadow Creek and Tributaries								
MWH-022	East Fork SFSR	Upstream from Midnight Creek	2012-2014	80.3/7.8	0.606 (4.707)	NP	NP	0.009 (0.073)
MWH-011	East Fork SFSR	Near Mining Camp	2012-2015	97.8/5.3	0.397[1] (2.113)	NP	NP	0.027 (0.142)
MWH-023	Fiddle Creek	Lower Reach	2012-2014	97/2.0	NP	NP	NP	0.089 (0.181)
MWH-024	Fiddle Creek	Middle Reach	2012	22/2.0	NP	NP	NP	0.215 (0.430)
East Fork South Fork Salmon River Upstream from Meadow Creek								
MWH-013	East Fork SFSR	Near Meadow Creek Confluence	2012-2014	95.7/4.3	0.014 (0.061)	NP	NP	0.061 (0.263)
MWH-025	East Fork SFSR	Middle Reach	2012-2013, 2015	97/4.4	0.020 (0.088)	NP	NP	0.094 (0.418)
MWH-044	East Fork SFSR	Near Worker Housing	2013	100/3.0	NP	NP	NP	0.202 (0.608)
MWH-026	East Fork SFSR	Near Worker Housing	2012-2015	97.8/3.3	NP	NP	NP	0.044 (0.145)
Meadow Creek								
MWH-031	Meadow Creek	Near East Fork SFSR Confluence	2012	91/4.0	1.852[1] (7.407)	NP	0.004 (0.015)	0.067 (0.267)
MWH-014	Meadow Creek	Downstream from East Fork Meadow Creek Confluence	2013-2015	100/5.1	0.783[1] (4.020)	NP	NP	0.018 (0.090)
MWH-015	Meadow Creek	Downstream from TSF Buttress	2012-2014	97/4.8	0.005 (0.023)	NP	0.006 (0.028)	0.035 (0.167)
MWH-047	Meadow Creek	TSF Buttress	2013-2015	100/4.3	0.017 (0.072)	NP	0.002 (0.009)	0.044 (0.189)

Site ID (Downstream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m^2 (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
MWH-016	Meadow Creek	Along the TSF	2012, 2014-2015	97/3.9	NP	NP	0.005 (0.018)	0.168 (0.654)
MWH-034	Meadow Creek	Upper Reach	2013, 2015	100/3.2	NP	NP	0.004 (0.013)	0.075 (0.236)
East Fork Meadow Creek								
MWH-028	East Fork Meadow Creek	Near Confluence	2012-2014	97/2.4	2.573[1] (6.175)	NP	NP	0.041 (0.097)
MWH-027	East Fork Meadow Creek	In Meadow	2012-2014	97/1.6	NP	NP	NP	0.027 (0.044)

Source: MWH 2017

[1] Chinook salmon densities at these locations are higher than would naturally occur, as they were from translocated adults that spawned in a small, localized area.

Site IDs consisted of reaches ranging in length from 22 to 100 meters in length with most reaches set at 100 meters.

Daytime surveys only-all fish size classes combined

East Fork SFSR = East Fork South Fork Salmon River; m = meter; m^2 = square meter; NP = not present

6.2.2 Yellow Pine Pit Lake Estimates

Mark-recapture studies were undertaken at the YPP lake in 2018 and 2019 to evaluate movements of salmonids and to estimate population abundances (Brown and Caldwell 2019b, 2020a). **Table 6-10** summarizes the abundance estimate results. Detailed discussions are included in Brown and Caldwell (2019b, 2020a). No estimates were made for steelhead due to the low numbers captured (i.e., five in 2018 and nine in 2019). In addition to bull trout, cutthroat trout, Chinook salmon and steelhead/rainbow trout, mountain whitefish were captured, but no abundance estimates were made.

The results indicate limited abundance of these salmonids in the YPP lake. Brown and Caldwell (2019b) notes that several hundred whitefish also were captured suggesting the lake can support a large number of fish given suitable habitat.

Table 6-10 Salmonid Population Abundance Estimates for the Yellow Pine Pit Lake in 2018 and 2019

Species	Abundance Estimate by Month and Year					
	May 2018	July 2018	September 2018	July 2019	August 2019	September 2019
Bull Trout	57	104	82	104	45	47
Westslope Cutthroat Trout	48	48	33	67	80	101
Chinook Salmon	No Tagged Juvenile Fish Returned					

Source: Brown and Caldwell 2019b and 2020a
Four rainbow trout were tagged but the sample size was too small for an abundance estimate.

6.3 Fish Species

The four federally listed or Forest Service sensitive fish species (i.e., special status fish species) known to be present in the analysis area are Chinook salmon, steelhead trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and westslope cutthroat trout (*Oncorhynchus clarkia lewisi*). Chinook salmon, steelhead, and bull trout are all federally listed as threatened under the ESA, and westslope cutthroat trout is a Forest Service sensitive species. Bull trout is also a Forest Service Management Indicator Species on the PNF and the BNF and is among the most sensitive to changes in environmental variables, such as water temperature, sediment, or contaminants.

Other native fish species found within the analysis area include mottled sculpin (*Cottus bairdii*), longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*Entosphenus tridentatus*), and mountain sucker (*Catostomus platyrhynchus*).

AECOM 2020a includes a list of every fish species documented in the analysis area, including non-native fish introduced to the area.

6.3.1 Chinook Salmon

6.3.1.1 Status

The Snake River spring/summer-run Chinook Salmon Evolutionary Significant Unit was listed as threatened under the ESA in 1992 (57 Federal Register 14653). Most Chinook salmon in the analysis area are considered "summer-run" fish (NMFS 2017). These fish are found throughout the analysis area, including naturally in the SFSR subbasin and the East Fork SFSR drainage upstream to the YPP lake within the mine site and upstream from the YPP when transplanted as discussed below.

A cascade with a current slope of 22 percent, caused by historic mining activities, located upstream from YPP lake is a barrier to further upstream natural migration for adult Chinook salmon. Juvenile fish, however, can move downstream through the cascade because adult Chinook salmon have been reintroduced upstream from the YPP lake by the IDFG. Spawning-ready adult Chinook salmon are periodically translocated from the SFSR to upstream from the barrier with support from the Nez Perce Tribe.

Historically, the Snake River was considered the Columbia River Basin's most productive drainage for salmon, supporting more than 40 percent of all Columbia River spring/summer Chinook salmon (Fulton 1968; NMFS 1995 in NMFS 2017). Strong runs of Chinook salmon returned each year to spawn and rear in the mainstem and tributary reaches of the Snake River extending upstream to Shoshone Falls near Twin Falls, Idaho. The fish also ranged into most Snake River tributaries stretching across portions of the states of Oregon, Washington, Idaho, and Nevada.

Currently, the stock has been severely depleted from a variety of activities, including hydropower systems, hatcheries, harvest, fish passage, and pathogens/predation/competition. Chinook salmon remain at risk of becoming endangered within 100 years (NMFS 2017). Multiple threats across their life cycle contribute to their current status and need to be addressed to ensure that Snake River spring/summer Chinook salmon populations can be self-sustaining in the wild over the long term (NMFS 2017).

The proposed status for the East Fork SFSR population is considered "maintained," indicating there is a moderate (25 percent or less) risk of extinction over 100 years (NMFS 2017).

6.3.1.2 Critical Habitat and Essential Fish Habitat

Critical habitat for Chinook salmon was originally designated in 1993 (58 Federal Register 68543) and re-designated in 1999 (64 Federal Register 57399). As defined, designated Critical Habitat includes all "river reaches presently or historically accessible (except reaches above impassible natural barriers (including Napias Creek Falls [Napias Creek tributary to the Salmon River]) and Dworshak and Hells Canyon Dams)" (64 Federal Register 57403). Thus, designated Critical Habitat includes all presently and historically accessible rivers and streams within the analysis area, except for the Payette River drainage. The Payette River drainage historically supported anadromous fish but is excluded by rule from being designated as Critical Habitat because it is now upstream from the Hells Canyon Dam Complex.

Given the very broad definition of Critical Habitat for Chinook salmon, a more refined description of the affected environment for the SGP was needed. Two different sets of information were used to address this need. First, data on the distribution of Chinook salmon occurrences (fish observations and spawning redd counts) were compiled for 1985 to 2011 to determine the actual locations occupied by Chinook salmon (Isaak et al. 2017). The premise was that such locations with species presence demonstrated empirical evidence of Chinook salmon Critical Habitat.

Second, available Geographic Information System data was used to model what likely is Critical Habitat for Chinook salmon within the mine site area upstream from the YPP (ESS 2019e). This approach identified a 12 percent maximum gradient (percent slope) within occupied NHD lines (Isaak et al. 2017), meaning Chinook salmon can migrate upstream through stream reaches that have a less than 12 percent gradient. Within the SGP mine site, stream segments below the gradient cut-off point were modeled as Critical Habitat, (i.e., areas with steeper slopes were not identified as modeled Critical Habitat) (ESS 2019e). Currently, there is an estimated 26.5 km of modeled Chinook salmon Critical Habitat upstream from the YPP lake barrier (**Figure 6-5**).

The EFH characteristics important for anadromous salmon for freshwater spawning and rearing include water quality, water quantity, substrate, floodplain connectivity, forage, natural cover, and reaches free of artificial obstructions for freshwater migration (NMFS 2017). EFH has been designated for Chinook salmon within all streams and other waterbodies occupied or historically accessible to Chinook salmon (67 Federal Register 2343, 2002).

6.3.1.3 Physical and Biological Features and Recovery Plan

NMFS (2017) designated the following sites and essential physical and biological features as primary constituent elements for anadromous salmon and steelhead in freshwater:

- Freshwater spawning (water quality, water quantity, and substrate);
- Freshwater rearing (water quantity and floodplain connectivity, water quality and forage, and natural cover);
- Freshwater migration (free of artificial obstruction, water quality and quantity, and natural cover).

These physical and biological features have been designated because of their potential to develop or improve and eventually provide the needed ecological functions to support species recovery (NMFS 2017). The 2017 NMFS Recovery Plan identified recovery strategies for Snake River spring/summer Chinook salmon for the Lower East Fork SFSR and Upper East Fork SFSR watersheds (mine site location) including:

- Maintain current wilderness protection and protect pristine tributary habitat;
- Provide/improve passage to and from areas with high intrinsic potential through barrier removal;
- Reduce and prevent sediment delivery to streams by improving road systems and riparian communities, and rehabilitating abandoned mine sites; and
- Manage risks from tributary fisheries according to an abundance-based schedule.

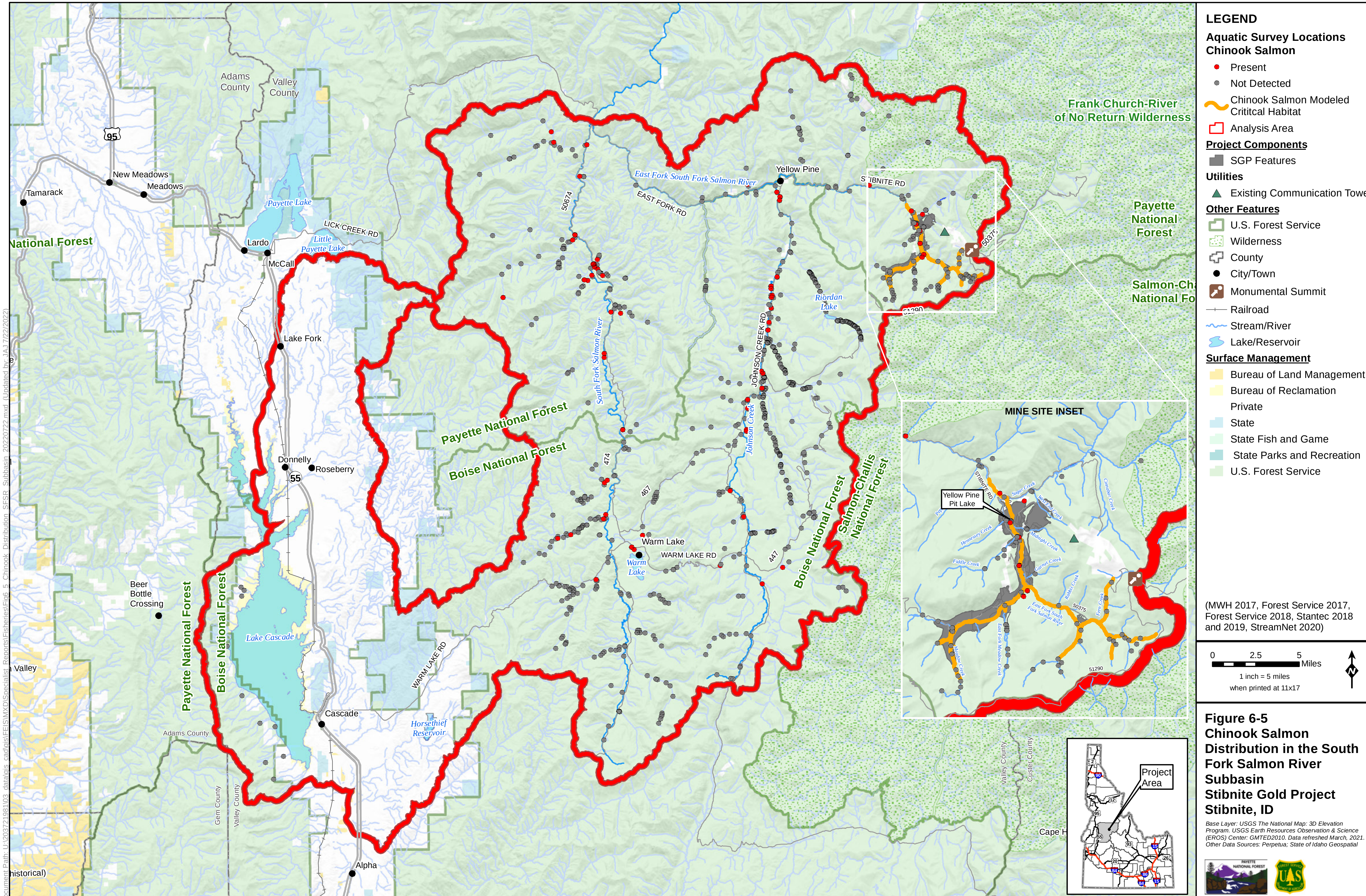


Figure 6-5
Chinook Salmon Distribution in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

6.3.1.4 Temperature Requirements and Baseline Conditions

Chinook salmon have different temperature requirements or limitations for their various life stages. Exceeding thresholds could impact various life-stages and could cause fish to avoid areas or even mortality. The periodicity (i.e., recurring intervals) of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature into ESS 2019a, a condensed version of which is presented in **Table 6-11**.

Using the QUAL2K predicted MWMT stream values, and stream segment lengths from the SPLNT Model Refined Modified Proposed Action (ModPRO2) report (Brown and Caldwell 2021a), the length of proposed mine site streams within the temperature thresholds identified in **Table 6-11** was estimated. The QUAL2K stream segments that contain the segments in which there was modeled Intrinsic Potential (IP) habitat (see **Section 6.3.1.1**) were evaluated for thermally suitable habitat (based on MWMT) for all life stages except juvenile rearing. However, it is important to note, the IP model applied more refined spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Hence, the stream segments evaluated for temperature could have lengths that extended beyond the ends of the segments evaluated for IP. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer than the length of habitat with IP.

For juvenile rearing, the QUAL2K stream segments that contain segments in which there was modeled Critical Habitat (see **Section 6.3.1.2**) were evaluated for thermally suitable habitat. Modeled Critical Habitat extends to a much larger area than IP because the criteria defining Critical Habitat is based on a 12 percent gradient cut-off, whereas IP criteria are based on channel conditions, gradient, and valley bottom conditions (see **Section 6.3.1.1**). It is assumed that juvenile Chinook salmon are able to access a larger range of habitat conditions than the other life stages, and therefore, less restrictive habitat conditions were applied in the analysis.

The East Fork SFSR from 0.89 kilometer (km) downstream from the confluence with Sugar Creek to around 3.4 km upstream from the confluence with Meadow Creek (total of 8.59 km), and around 4.35 km of Meadow Creek were evaluated for the temperature thresholds. **Table 6-11** shows that of the entire 12.93 km of potential habitat is within the temperature thresholds for adult spawning and juvenile rearing; however, only 9.49 km (73.4 percent) and 3.44 km (26.6 percent) is within the water temperature threshold for adult migration and incubation and emergence based on comparison to summer and fall MWMT. Of these total lengths, 10.92 km of suitable conditions for spawning and rearing, and all of the suitable conditions for migration and incubation and emergence are upstream from the YPP lake cascade barrier.

It is important to note that they do experience significant diurnal variations, and that for mobile life stages (i.e., adults and juveniles), if MWMT are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges.

Table 6-11 Chinook Salmon Optimal Temperature Thresholds and Modeled Length of Stream Within the Water Temperature Thresholds

Life Stage / Season[1]	Range of Optimal Temperature Thresholds (°C)	Total Stream Length Above YPP / Below YPP	Stream Length Within Optimal Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Migration/ May – September[2]	12-19	10.92 / 2.01	7.48	2.01	9.49 (73.4%)[3]
Adult Spawning/ July – September[4]	4-14	10.92 / 2.01	10.92	2.01	12.93 (100%)[3]
Incubation/Emergence/ July – April[4]	6-10	10.92 / 2.01	3.44	0	3.44 (26.6%)[3]
Juvenile Rearing/ Year-round[2]	10-20	17.51 / 2.01	17.51	2.01	19.53 (100%)[5]

Source: EPA 2003, Poole et al. 2001, IDAPA 58.01.02
[1] The months in the life stage are not applicable for comparison to the SPLNT model results.
[2] Analysis based Summer Maximum (July) 7 Day Average of the Daily Maximum.
[3] Percent of stream length within the modeled usable Intrinsic Potential habitat.
[4] Analysis based on Fall Maximum (September) 7 Day Average of the Daily Maximum.
[5] Percent of stream length within the modeled Critical Habitat.
% = Percent; °C = degrees Celsius; km = kilometers; YPP = Yellow Pine pit

6.3.1.5 Distribution

Chinook salmon are distributed throughout the analysis area (**Figure 6-5**); however, this section focuses on the mine site area and the travel corridor on Johnson Creek Road and the Burntlog Route. The East Fork SFSR population was historically a large population, with spawning areas throughout the East Fork SFSR mainstem and Johnson Creek (NMFS 2017). Anadromous fish passage in the East Fork SFSR upstream from the YPP lake was blocked in 1938 when activities for mining diverted the East Fork SFSR in surface ditches and later into a bypass tunnel (constructed in 1943). The East Fork SFSR was routed back through the YPP after mining ceased, but the remaining 22 percent gradient cascade, just upstream from the YPP lake, prevents Chinook from traveling upstream. There is a supplementation program to spawning habitat in Meadow Creek above the YPP, discussed below.

Chinook salmon occurrence in the analysis area varies by life stage. Adult migration occurs between May and mid-September, with most reaching the upper East Fork SFSR watershed by late July and August. Spawning occurs from mid-July to September, with peak spawning in August, particularly in the mine site, where spawning is not typically observed before mid-August. Egg incubation begins after spawning, and emergence of larval fish occurs between January and April. Juvenile rearing occurs year-round and juvenile outmigration to the ocean occurs between mid-March to November (ESS 2019a).

Surplus Supplementation

The Nez Perce Tribe began the Johnson Creek Artificial Propagation Enhancement Project in 1998 in response to critically low numbers of returning adult Chinook salmon to Johnson Creek (Columbia River Inter-Tribal Fish Commission 2018). The program uses only natural-origin returns for broodstock, and currently has an annual target release level of 100,000 yearling smolts into Johnson Creek (NMFS 2016).

The Nez Perce Tribe and IDFG translocated adult Chinook salmon from the SFSR to Meadow Creek (upstream from the YPP), but not as part of the Johnson Creek Artificial Propagation Enhancement Project. This out-planting program has been highlighted in the IDFG Fisheries Management Plan (IDFG

2019a). Between 2008 and 2017 (excluding 2014), Chinook salmon spawners were released into Meadow Creek when there are surplus adults from the McCall Fish Hatchery South Fork Salmon River Chinook Salmon Mitigation Program. It should be noted that any juvenile Chinook salmon upstream from the YPP lake cascade barrier were entirely human assisted; without fish translocation there are no naturally occurring Chinook salmon upstream from the YPP lake barrier.

Redd Surveys

A redd is defined as a depression or hollow that a salmon creates in the stream substrate (i.e., bed) to deposit eggs. The Nez Perce Tribe has conducted redd surveys for Chinook salmon upstream from the YPP lake in the East Fork SFSR, Meadow Creek, and in other SFSR subbasin streams (e.g., Lower East Fork SFSR, Burntlog Creek, Johnson Creek, Sugar Creek, and Tamarack Creek) since 2008 (Nez Perce Tribe unpublished data 2018; Rabe et al. 2018). **Table 6-12** shows the number of redd counts between 2008 and 2018 in the East Fork SFSR and tributaries within or near the mine site and those that might be affected by the travel corridor on Johnson Creek Road and the Burntlog Route.

Redds observed upstream from the YPP cascade barrier are all from translocated Chinook salmon. During years when adults were translocated into Meadow Creek, redd counts varied from 24 (2017) to 128 (2016). In general, lower numbers of Chinook salmon redds were found in the East Fork SFSR, likely because Chinook salmon are translocated to Meadow Creek and tend to spawn in close proximity to their introduction sites and the fact that the fish are ready to spawn at the time of release. Chinook salmon redds documented in the East Fork SFSR (between the YPP lake and Meadow Creek) have ranged from 1 (2013) to 13 (2011), with an average of 5 redds per year over 11 years. The number of Chinook salmon translocated and the number of redds observed demonstrate a clear, positive relationship. As the number of adults translocated increased so did the number of redds.

Johnson Creek, a tributary of the East Fork SFSR downstream from the mine site, had the highest numbers of Chinook salmon redd counts in the Upper East Fork SFSR watershed, ranging from 193 (2008, 2011) to 376 (2014), with an average count of 207 redds per year.

Flow-Productivity

The effects of streamflow changes on Chinook salmon productivity within the mine site area were based upon a SGP flow-productivity model that was developed using the flow-productivity modeling approach for the Big Creek Water Diversion Project (NMFS 2013). Productivity (also referred to as adult or whole life cycle productivity) is estimated as the ratio of the number of returning adults to the total number of fish allowed to spawn naturally during the brood year (Morrow 2018). Therefore, productivity is a unitless measure of the adult escapement. The SGP flow-productivity model then regresses productivity against flow metrics using simple linear regression to output flow-productivity (ESS 2019d).

Table 6-12 Chinook Salmon Redd Counts in Upper East Fork South Fork Salmon River and Johnson Creek Watersheds Between 2008 and 2018

Year	Streams from Upstream to Downstream							
	Meadow Creek - Proposed TSF to Confluence (6.3 km)	East Fork SFSR - Between Meadow Creek and Fiddle Creek (2.4 km)	East Fork SFSR – YPP Lake to Sugar Creek (1.1 km)	Sugar Creek -Cinnabar Creek to Confluence (4.3 km)	East Fork SFSR – Sugar Creek to Quartz Creek (15 km)	East Fork SFSR -Town of Yellow Pine to Confluence (0.8 km)	Johnson Creek -Upper Johnson Creek to Confluence (45.5 km)	Burntlog Creek – East Fork Burntlog Creek to Confluence (8.5 km)
2008	0	0	0	3	2	0	193	30
2009	41	10	10	40	46	2	235	16
2010	74	81	3	43	3	0	345	52
2011	89	131	0	10	73	3	194	41
2012	50	7	10	17	47	0	234	63
2013	40	1	3	11	46	0	201	34
2014	0	0	7	17	42	2	376	41
2015	64	3	3	5	43	0	257	20
2016	128	7	18	13	55	0	253	28
2017	24	0	3	2	16	ND	ND	ND
2018	0	0	0	11	18	ND	ND	ND
2019	0	0	1	0	18	0	68	10
2020	0	0	1	0	11	0	107	6
2021	0	0	0	0	16	0	101	6

Source: Nez Perce Tribe unpublished data; Rabe et al 2018
East Fork SFSR = East Fork South Fork Salmon River; km = kilometers; ND = No Data; TSF= tailings storage facility; YPP = Yellow Pine pit

The SGP flow-productivity model uses proxy data from nearby Johnson Creek and assumes that the physical and biological conditions in Johnson Creek are relatable to the mine site streams. However, there are many physical differences between upper East Fork SFSR and Johnson Creek, including drainage size, flow regime, and Chinook populations. Also, the SGP flow-productivity model assumes a fixed number of Chinook salmon spawners each year that occurred in Johnson Creek to occur across all of the mine site streams (ESS 20219d). Therefore, these flow-productivity estimates provide a rough approximation of changes in productivity due to flow within the mine site. Additionally, the differences in streamflow regimes, physical habitat characteristics, population sizes, and other differences between Johnson Creek and the mine site streams creates uncertainty that cannot be addressed with the available data.

The flow-productivity analysis predicts changes in productivity based solely on streamflow changes and it does not factor in additional habitat changes that would also occur in the analysis area (e.g., direct loss of habitat, water temperature changes, etc.) The model outputs help to show the relative effects of flow modifications on Chinook salmon productivity at the reach level. Chinook salmon productivity was assessed in four stream reaches (East Fork SFSR above Meadow Creek, East Fork SFSR at Stibnite, East Fork SFSR above Sugar Creek, and lower Meadow Creek). The lower Meadow Creek site (MC-6) was set up to supplement the system of USGS gages. MC-6 specifically examines conditions in the portion of Meadow Creek that is routed through a constructed channel to divert the stream away from historical mine waste.

The flow-productivity model outputs productivity values that are compared to baseline productivity values to calculate the predicted annual percent change in Chinook salmon productivity from baseline productivity. The baseline Chinook salmon productivity of 1.06 was derived from productivity data collected on Johnson Creek (Morrow 2018). Again, the interpretation of the predicted annual percent change in productivity is based upon the baseline productivity calculated with Johnson Creek data because data is not available within the mine site. Because the productivity value is greater than 1.0, if Johnson Creek were unimpaired, there would be slightly more returning adults than the spawning brood year.

Intrinsic Potential

To assist with describing the existing conditions and predicted potential changes in Chinook salmon habitat at the mine site, a site-specific IP model was developed to derive a predictive metric for streams in the mine site that could potentially support spawning and early-rearing habitat for the Chinook salmon. In general, the IP is the underlying capacity (i.e., potential) of a stream to provide habitat based on channel slope and dimensions. The IP model was used to estimate the potential for spawning and rearing habitat in the headwaters of the East Fork SFSR subwatershed (**Figure 6-6**). This subwatershed encompasses the mine site where mining-related activities are proposed; which includes the East Fork SFSR and tributaries upstream from YPP, Meadow Creek and East Fork Meadow Creek, East Fork SFSR and tributaries between YPP and Sugar Creek, and East Fork SFSR downstream from Sugar Creek. Flow reductions attributable to the project would typically be less than 1 percent with a maximum monthly difference of 3 percent. Flow differences of this magnitude would have little influence on the wetted width, bankfull width, gradient, valley bottom width, and valley width ration parameters used to assess IP. However, Chinook salmon are known to occupy Sugar Creek under its existing IP condition which would not be measurably modified by the project.

The output from the IP model provides a classification that varies from "negligible" (minimal IP to support habitat) to "high" (likely to provide habitat) with low and medium classifications in between. See Intrinsic Potential Model Chinook Salmon and Steelhead Technical Memorandum (ESS 2019c) for a detailed description and discussion of the model and results.

The methodology followed the IP approach developed by Cooney and Holzer (2006) for the Interior Columbia Basin but was refined for the mine site using site-specific data (i.e., Light Detection and Ranging (LiDAR) topography and field data). The IP modeling used key landscape characteristics of gradient, channel characteristics, and valley confinement (i.e., valley bottom) at a local SGP-specific scale (i.e., the mine site) to estimate the linear potential within the subwatershed to support spawning and early-rearing habitat for Chinook salmon. Field data (wetted width and bankfull width) and modeled parameters were used as inputs to the IP model. Other important information for the model included the following:

- Modeling was performed at a 30-meter linear reach-scale; and
- The IP model analysis identified Chinook salmon spawning and early-rearing habitat potential for waters upstream from the YPP cascade barrier; however, this area is not currently accessible by natural upstream migration of adult fish.

Table 6-13 shows the input Chinook and steelhead IP model parameters and their source(s).

The IP model was used to evaluate over 51 km of stream habitat. Under baseline conditions, modeled IP stream length shows only 11.1 km of the 51 km have potential spawning and early-rearing habitat for Chinook salmon (**Figure 6-6** and **Table 6-14**) The majority of the IP habitat is rated as low potential, followed by medium and negligible, with high potential having the least amount available (**Table 6-14**).

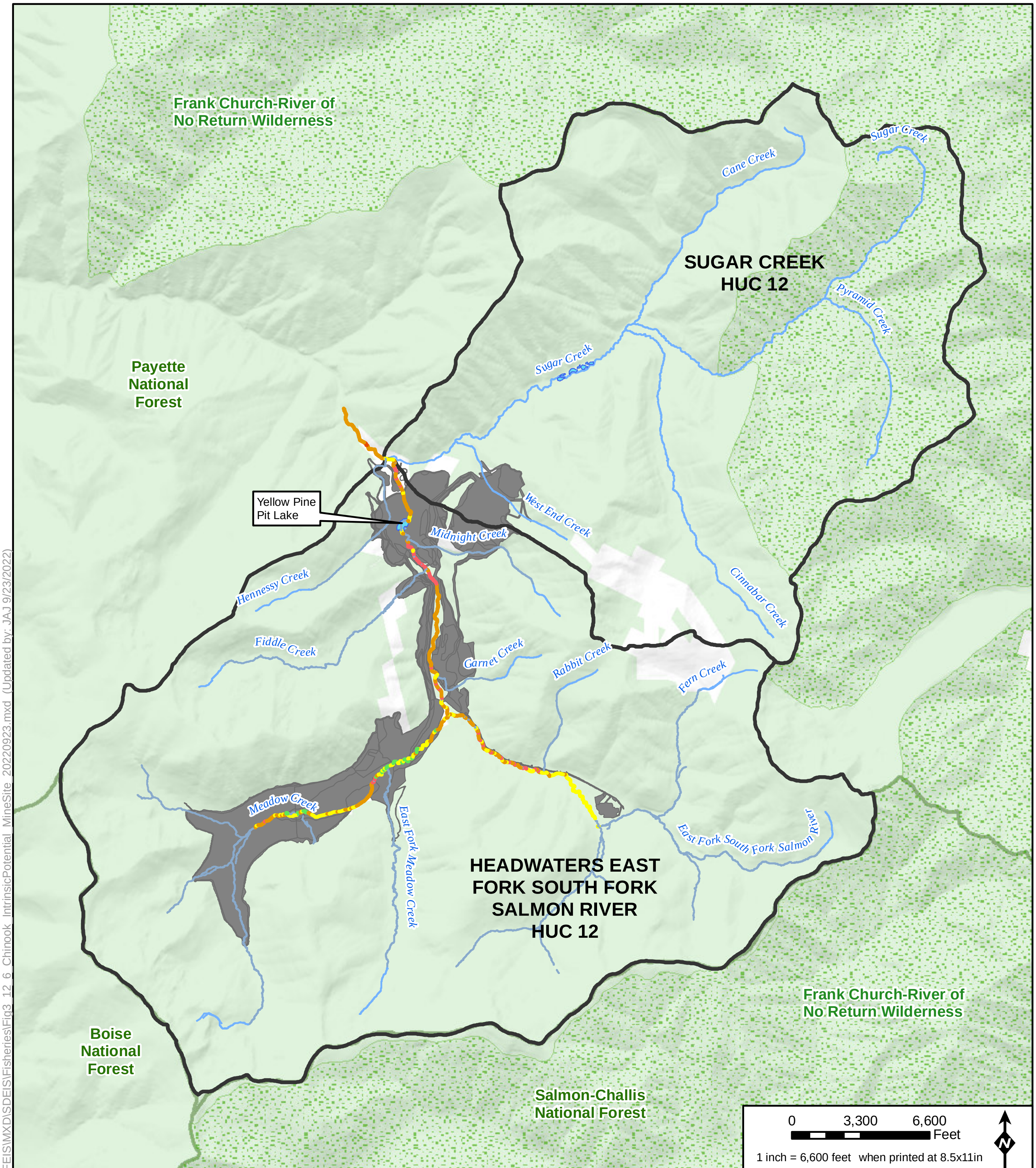
Table 6-13 Data and Parameters Used in the Intrinsic Potential Model for Chinook Salmon and Steelhead

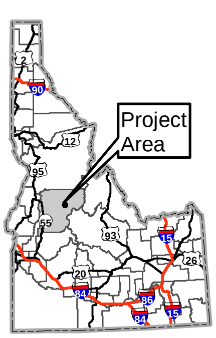
Parameter	Chinook	Steelhead	Source
Wetted Width (WW)	≥3.6 m	N/A	PIBO and Rio ASE field data Rio ASE wetted width (WW) calculation: WW = BF * 0.799
Bankfull Width (BF)	N/A	≥3.8 m	PIBO and Rio ASE field data Rio ASE BF calculation based on drainage area (DA) and then converted to meters: BF (ft)[1] = $6.868 * DA^{0.407}$
Gradient (% slope)	<7%	<7%	Derived in ESRI ArcGIS based on LiDAR data and streamline segment
Valley Bottom Width (VBW)	Stream Reach Dependent	Stream Reach Dependent	Derived in ESRI ArcGIS using the Valley Bottom Extraction Tool (VBET)
Valley Width Ratio (VWR)	VBW / BF	VBW / BF	Derived in ESRI ArcGIS by dividing the VBW by its corresponding segments bankfull width (VWR = VBW/BF)

Source: ESS 2019c

[1] The equation used to calculate the wetted width uses feet (ft), the total is then the BF is converted to meters (m)

< = less than; ≥ = greater than or equal to; % = percent; DA = drainage area; ft = foot; LiDAR = light detection and ranging; m = meter; N/A = not applicable; PIBO = Pacific Anadromous Fish Strategy/Inland Fish Strategy Biological Opinion





LEGEND

- Subwatershed (HUC 12)

Chinook Salmon Intrinsic Potential

- High
- Medium
- Low
- Negligible
- None

Project Components

- Mine Site Components

Other Features

- U.S. Forest Service
- Wilderness
- County
- Stream/River
- Lake/Reservoir

Surface Management

- Private
- U.S. Forest Service

Figure 6-6
Chinook Salmon Intrinsic Potential Habitat Within the Mine Site Subwatershed
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Table 6-14 Chinook Salmon Intrinsic Potential Habitat Under Baseline Conditions

Chinook Salmon IP[1]	East Fork SFSR and Tributaries Upstream from YPP Lake[2]		Meadow Creek and East Fork Meadow Creek		East Fork SFSR and Tributaries between YPP Lake and Sugar Creek		East Fork SFSR Downstream from Sugar Creek		Total IP Habitat in Mine Site Area (km)[3]
	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	
High	0	0	0.66	3.9	0	0	0	0	0.66
Medium	0.66	2.3	0.90	5.3	0.18	4.5	0.03	2.7	1.76
Low	4.29	14.8	1.21	7.1	0.84	19.4	1.02	91.9	7.36
Negligible	1.05	3.6	0.10	0.6	0.15	3.5	0.06	5.4	1.36
Total IP Habitat	6.00	20.7	2.86	16.97	1.17	27.0	1.11	100.0	11.1 (22%)[4]
Total Length Evaluated	29.01	-	16.93	-	4.34	-	1.11	-	51.39

[1] Results are presented in the table as the length (kilometers) of stream with usable IP. For Chinook salmon the IP is rated as high, medium, low, and negligible. "Useable" habitat is defined as all of these classes combined (usable = high + medium + low + negligible).
[2] Does not include the East Fork SFSR tributaries Meadow Creek and East Fork Meadow Creek.
[3] Does not include Sugar Creek.
[4] Total percent of IP habitat within the total length of streams evaluated.
% = percent; East Fork SFSR = East Fork South Fork Salmon River; IP = Intrinsic Potential; km = kilometer; YPP = Yellow Pine pit

6.3.2 Steelhead

6.3.2.1 Status

The Snake River Basin Steelhead Distinct Population Segment (DPS) is found in the East Fork SFSR drainage and its tributaries downstream from the YPP lake. Steelhead were initially listed as federally threatened under the ESA in August 1997 (62 Federal Register 43937) with the geographic listing area including all natural-origin populations of steelhead in the Snake River Basin. In 2006, Snake River steelhead were subsequently reclassified as a threatened DPS (71 Federal Register 834).

The Interior Columbia Technical Recovery Team (ICTRT) identified five extant major population groups (MPGs) in the Snake River Basin steelhead DPS, which includes the Salmon River Steelhead MPG (ICTRT 2008 as cited in NMFS 2017). The Salmon River Steelhead MPG consists of 12 demographically different steelhead populations all of which are presently considered non-viable (NMFS 2017). The Salmon River Steelhead MPG includes the SFSR population (NMFS 2017), which is within the analysis area. The SFSR population includes fish in the SFSR and all of its tributaries, except the Secesh River. This population is found within three major tributaries in the analysis area: the East Fork SFSR, Johnson Creek, and the Upper SFSR. The SFSR steelhead population is considered “maintained,” with a tentative moderate abundance/productivity risk and low distribution and diversity risk (ICTRT 2008). This population is targeted to achieve a proposed status of “viable,” which requires a minimum of low abundance/productivity risk.

Habitat limiting factors for the SFSR steelhead population are linked to human disturbances, such as mining and road construction. Human disturbances and heavy precipitation make the subbasin susceptible to large sediment-producing events that degrade habitat quality for steelhead. Roads located near streams encroach on riparian habitat, limit potential sources of large woody debris, and create passage barriers at road-stream crossings. Priorities for addressing limiting factors in the SFSR steelhead population include mitigation and elimination of sediment inputs from human-caused disturbances and elimination of artificial fish passage barriers.

6.3.2.2 Critical Habitat

The final rule designating Critical Habitat was implemented in January 2006 (70 Federal Register 52630). Critical Habitat for Snake River Basin steelhead is designated throughout much of the analysis area (**Figure 6-7**). Within the areas directly affected by construction and operations, Critical Habitat is designated in the East Fork SFSR drainage to approximately 0.4 km upstream from the confluence with Sugar Creek, including Sugar Creek, and two creeks in the Johnson Creek watershed, Burntlog Creek, and Riordan Creek. Critical habitat for steelhead is not designated upstream from the YPP lake; however, it is assumed that steelhead were found in the headwaters of the East Fork SFSR prior to 1938. Similar to Chinook salmon, the YPP lake cascade barrier precludes steelhead from migrating upstream from the YPP lake, however, NMFS does not consider habitat upstream from the YPP lake to be designated Critical Habitat for steelhead (70 Federal Register 52630).

6.3.2.3 Physical and Biological Features and Recovery Plan

NMFS designated the following essential physical and biological features as primary constituent elements for anadromous salmon and steelhead in freshwater:

- Freshwater spawning (water quality, water quantity, and substrate);
- Freshwater rearing (water quantity and floodplain connectivity, water quality and forage, and natural cover); and

- Freshwater migration (free of artificial obstruction, water quality and quantity, and natural cover).

These physical and biological features were designated because of their potential to develop or improve and eventually provide the needed ecological functions to support species recovery (NMFS 2017).

The 2017 NMFS Recovery Plan included recovery strategies for Salmon River steelhead. Priorities for steelhead populations specific to the East Fork SFSR watershed include: (1) collect and analyze population-specific data to accurately determine population status; (2) maintain wilderness protection and protect pristine tributary habitat; (3) eliminate artificial passage barriers and improve connectivity to historical habitat; (4) reduce and prevent sediment delivery to streams by rehabilitating roads and mining sites; and (5) manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans according to an abundance-based schedule.

6.3.2.4 Temperature Requirements and Baseline

Steelhead have different thermal requirements or limitations for their various life stages. Exceeding thresholds could impact various life-stages and could cause fish to avoid areas or even mortality. The periodicity of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature (ESS 2019a), a condensed version of which is provided in **Table 6-15**.

Using the QUAL2K predicted MWMT stream values, and stream segment lengths from the SPLNT Model Refined Modified Proposed Action (ModPRO2)report (Brown and Caldwell 2021a), the length of proposed mine site streams within these temperature thresholds was estimated. The QUAL2K stream segments that contain the segments in which there was modeled IP habitat (see **Section 6.3.2.5**) were evaluated for thermally suitable habitat for all life stages. However, it is important to note, the IP model applied more refined spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Hence, the stream segments evaluated for temperature could have lengths that extended beyond the ends of the segments evaluated for IP. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer than the length of habitat with IP.

A total of 2.01 km of the East Fork SFSR, starting from 0.89 km below confluence with Sugar Creek up to the YPP cascade barrier, were evaluated for the temperature thresholds. The East Fork SFSR evaluated was based on the modeled IP habitat (see **Section 6.3.2.5** for additional detail). However, it is important to note, the IP model applied more refined spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer than the length of habitat with IP.

Table 6-15 shows that of the entire 2.01 km of potential habitat is within the temperature thresholds for juvenile rearing. It is important to note that the length of potential habitat for steelhead incubation is based on July MWMT; however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Therefore, while summer temperatures may show zero miles of suitable habitat, this may not be a true representation of the conditions in the river.

It is important to note that the creeks do experience significant diurnal variations, and that for mobile life stages (i.e., adults and juveniles), if temperatures are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges.

Table 6-15 Steelhead Optimal Temperature Thresholds and Modeled Length of Stream within the Water Temperature Thresholds

Life Stage / Season[1]	Range of Optimal Temperature Thresholds (°C)	Total Stream Length Above YPP/ Below YPP	Stream Length Within Optimal Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Migration/ March – May	12-19	0 / 2.01	0	--	--
Adult Spawning/ April – June	4-14	0 / 2.01	0	--	--
Incubation/ Emergence/ April – August[2]	6-10	0 / 2.01	0	0	0
Juvenile Rearing / Year-round[2]	10-17	0 / 2.01	0	2.01	2.01 (100%)[3]

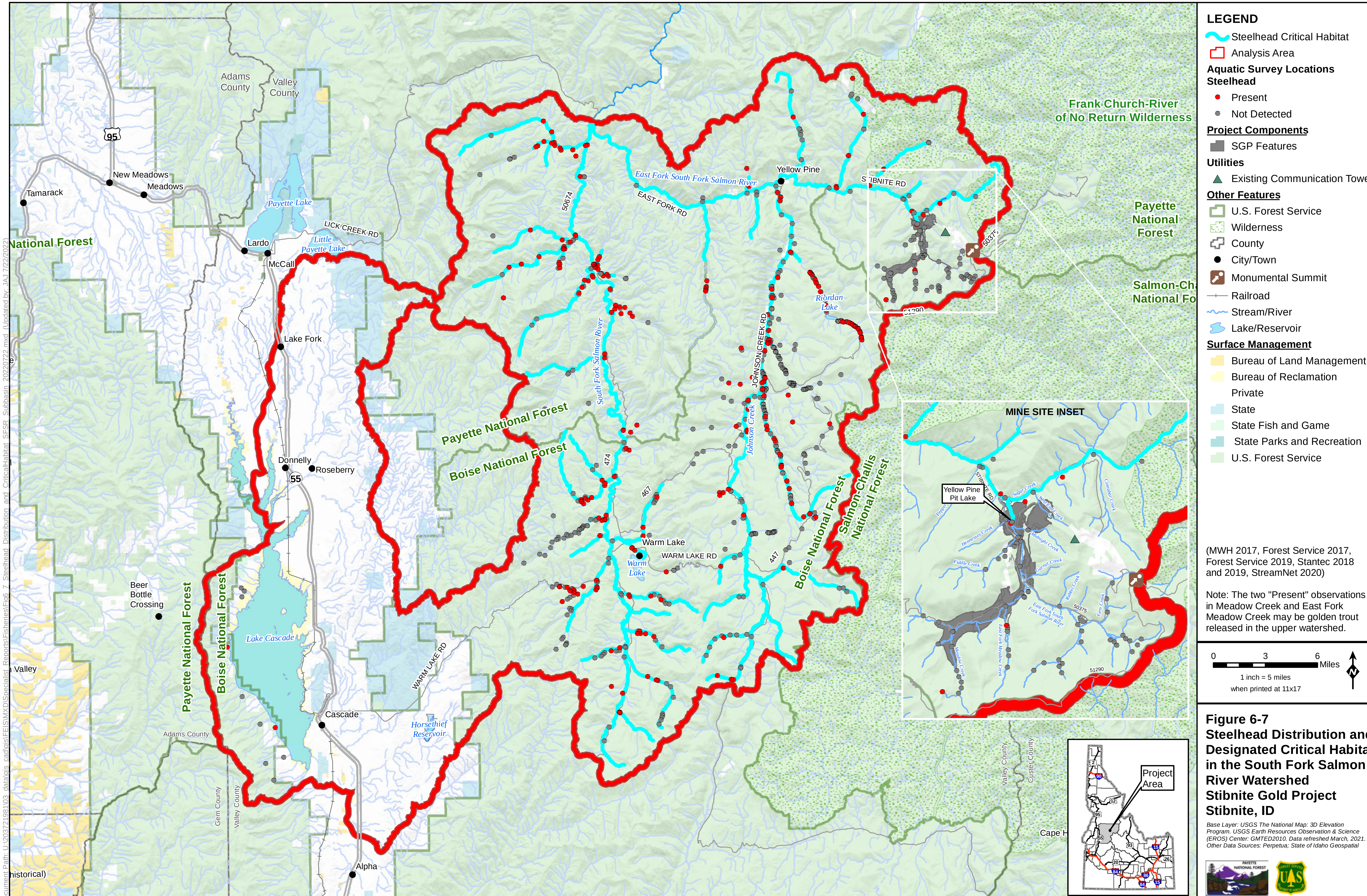
Source: EPA 2003, IDAPA 58.01.02, Poole et al. 2001
[1] It should be noted that the months in the life stage are not applicable for comparison to the SPLNT model results.
[2] Analysis based Summer Maximum (July) 7-Day Average of the Daily Maximum.
[3] Percent of stream length within the usable Intrinsic Potential habitat.
°C = degrees Celsius; % = percent; km = kilometer; YPP = Yellow Pine pit

6.3.2.5 Distribution

Steelhead occur throughout much of the analysis area (**Figure 6-7**), but within the areas affected by construction and operations, their distribution in the East Fork SFSR, up to YPP where a steep high gradient riffle/cascade caused by past mining activities is thought to preclude upstream migration. Steelhead can maneuver through higher gradients than Chinook salmon; however, genetic sampling suggest such migration does not occur above the YPP lake.

While eDNA can detect *O. mykiss* DNA, it cannot distinguish between subspecies (e.g., steelhead, redband trout), nor can it identify hybrids. Hybridization between cutthroat trout and rainbow trout (*Oncorhynchus mykiss spp*.), in waters where they co-occur, is common. Of the 153 individual fish tissue genetic samples collected in 2015 in Meadow Creek and the East Fork SFSR near Meadow Creek (upstream from the YPP), 146 tissue samples were pure westslope cutthroat trout (95.4 percent), and seven tissue samples were westslope cutthroat trout/rainbow trout hybrids (MWH 2017). An additional 33 eDNA and fish tissue samples from various locations upstream from the YPP lake (between 2014–2016) were collected and two fish tested positive for rainbow trout DNA (0.6 percent), one in Meadow Creek Lake and one in the East Fork Meadow Creek. It is likely that the rainbow trout genetics detected from these locations are, in fact, California golden trout (*Oncorhynchus mykiss aguabonita*), a subspecies of rainbow trout that were released in Meadow Creek Lake and are not native to the region.

Golden trout are still stocked by the IDFG in Meadow Creek Lake (IDFG 2019b). Carim et al. (2017) studied fish presence and distribution in Upper East Fork SFSR and Meadow Creek Lake, partially to determine whether eDNA-based detections of rainbow trout could be explained by the presence of the California golden trout subspecies originating from stocked fish in Meadow Creek Lake. This study concluded that the eDNA-based detections of rainbow trout could be explained by the presence of California golden trout originating from the stocked fish in Meadow Creek Lake.



(MWH 2017, Forest Service 2017, Forest Service 2019, Stantec 2018 and 2019, StreamNet 2020)

Note: The two "Present" observations in Meadow Creek and East Fork Meadow Creek may be golden trout released in the upper watershed.

Figure 6-7 Steelhead Distribution and Designated Critical Habitat in the South Fork Salmon River Watershed Stibnite Gold Project Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial

Little is known about steelhead use of the YPP lake, but it is likely the distribution is limited. In 2018 and 2019, only 5 and 9 *O. mykiss* were identified in YPP lake, respectively, and were noted as rainbow trout due to the size and time of year of capture (Brown and Caldwell 2019b, 2020a). Unlike Chinook salmon (via trap and haul) and bull trout, steelhead have not been found upstream from the YPP lake since the initiation of historic mining activities (given no documentation prior to mining, it is unknown if they occurred prior to mining activities). However, it is possible some migrating steelhead adults may use YPP lake as a holding area before migrating downstream to more suitable spawning grounds. Similarly, the lake may be used for rearing by some juvenile steelhead that have dispersed upstream from downstream spawning areas (Brown and Caldwell 2019b).

Steelhead occurrence in the analysis area varies by life stage and season. Adult migration occurs between mid-March through May. Spawning occurs from April to mid-June. Incubation/emergence occurs between April and mid-August. Juvenile rearing occurs year-round, with out-migration occurring primarily in June through and September.

Flow-Productivity

The effects of streamflow changes on steelhead productivity within the mine site are based upon a SGP flow-productivity model that was developed using the flow-productivity modeling approach for the Big Creek Water Diversion Project (NMFS 2013) Productivity (also referred to as adult or whole life cycle productivity) is estimated as the ratio of the number of returning adults to the total number of fish allowed to spawn naturally during the brood year (Morrow 2018). Therefore, productivity is a unitless measure or quantity of the number of returning adults. The SGP flow-productivity model then regresses productivity against flow metrics using simple linear regression to output flow-productivity (ESS 2019d).

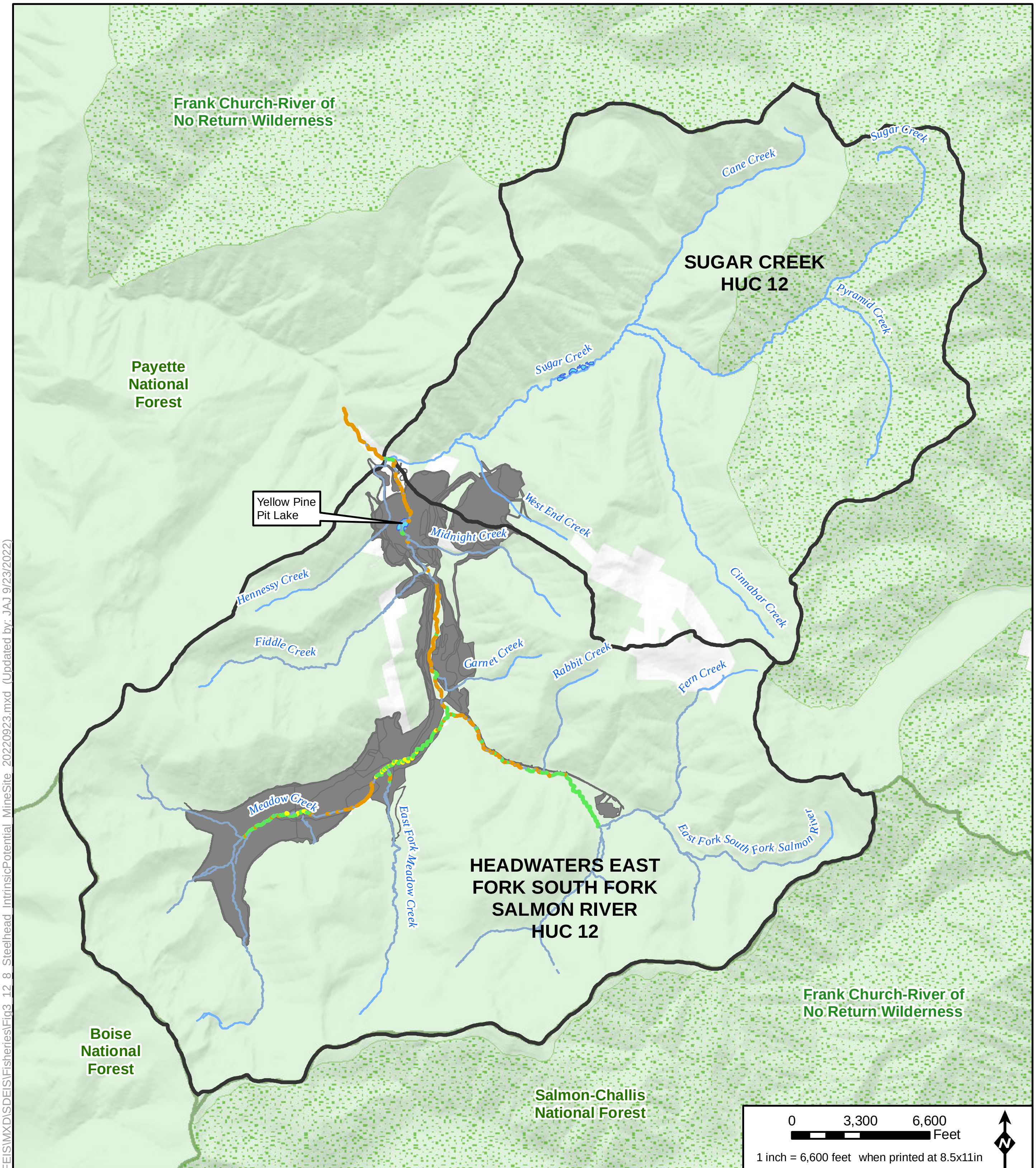
The SGP flow-productivity model uses proxy data from the Lemhi River and assumes that the physical and biological conditions in the Lemhi River are relatable to the mine site streams. However, there are many physical differences between the upper East Fork SFSR and the Lemhi River, including drainage size, flow regime and steelhead populations. Also, the SGP flow-productivity model assumes a fixed number of steelhead spawners each year that occurred in the Lemhi River to occur across all of the mine site streams (ESS 2019d). Therefore, these productivity estimates provide a rough approximation of changes in productivity due to flow within the mine site. Additionally, the differences in streamflow regimes, physical habitat characteristics, population sizes, and other differences between the Lemhi River and the mine site streams creates uncertainty that cannot be addressed with the available data.

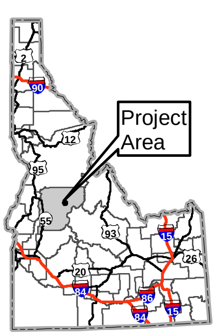
The flow-productivity analysis predicts changes in productivity based solely on streamflow changes and it does not factor in additional habitat changes that would also occur in the analysis area (e.g., direct loss of habitat, water temperature changes, etc.). The model outputs help to show the relative effects of flow modifications on steelhead productivity at the reach level. Steelhead productivity was assessed in four stream reaches (East Fork SFSR above Meadow Creek, East Fork SFSR at Stibnite, East Fork SFSR above Sugar Creek, and lower Meadow Creek). The lower Meadow Creek site (MC-6) was set up to supplement the system of USGS gages. MC-6 specifically examines conditions in the portion of Meadow Creek that is routed through a constructed channel to divert the stream away from historical mine waste.

The flow-productivity model outputs productivity values that are compared to baseline productivity values to calculate the predicted annual percent change in steelhead productivity from baseline productivity. The baseline steelhead productivity value of 1.24 was derived from productivity data collected on the Lemhi River (NMFS 2013). Again, the interpretation of the predicted annual percent change in productivity is based upon the baseline productivity calculated with the Lemhi River data because data is not available within the mine site. Because the productivity value is greater than 1.0, if Lemhi River were an unimpaired system, there would be slightly more returning adults than the spawning brood year.

Intrinsic Potential

The IP model is described in **Section 6.3.1.1**. The IP model was applied to classify the potential for spawning and rearing habitat for steelhead in headwaters of the East Fork SFSR subwatershed (**Figure 6-8**). This area encompasses the mine site area; which includes the East Fork SFSR and tributaries upstream from YPP, Meadow Creek and East Fork Meadow Creek, East Fork SFSR and tributaries between YPP and Sugar Creek, East Fork SFSR downstream from Sugar Creek. Over 51 km were evaluated for IP for steelhead, and under baseline conditions, modeled IP stream length shows approximately 10.67 of potential spawning and early-rearing habitat for steelhead in the mine site area (**Table 6-1**). As shown in **Figure 6-8**, high-rated and low-rated steelhead spawning and early-rearing habitat potentially occurs throughout the East Fork SFSR and Meadow Creek and the additional section of the East Fork SFSR below the confluence with Sugar Creek.





LEGEND

Subwatershed (HUC 12)

Steelhead Intrinsic Potential
- High
- Medium
- Low
- Negligible
- None

Project Components
- Mine Site Components

Other Features
- U.S. Forest Service
- Wilderness
- County
- Stream/River
- Lake/Reservoir

Surface Management
- Private
- U.S. Forest Service

Figure 6-8 Steelhead Intrinsic Potential Habitat Within the Mine Site Subwatershed Stibnite Gold Project Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Table 6-16 Steelhead Intrinsic Potential Habitat for Existing/Baseline Conditions

Steelhead IP[1]	East Fork SFSR and Tributaries Upstream from YPP[2]		Meadow Creek and East Fork Meadow Creek		East Fork SFSR and Tributaries between YPP and Sugar Creek		East Fork SFSR Downstream from Sugar Creek		Total IP Habitat in Mine Site Area (km)[3]
	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	
High	2.16	7.4	2.18	12.9	0.18	4.1	0.03	2.7	4.55
Medium	0	0	0.60	3.5	0	0	0	0	0.60
Low	2.91	10.0	0.87	5.1	0.72	16.6	1.02	91.9	5.52
Total IP Habitat	5.07	17.5	3.65	21.6	0.90	20.7	1.05	94.6	10.67 (21%)[4]
Total Length Evaluated	29.01	-	16.93	-	4.34	-	1.11	-	51.39

[1] Results are presented in the table as the length (kilometers) of stream with usable IP. For steelhead, the IP is rated as high, medium, low, and negligible. "Useable" habitat is defined as all of these classes combined (usable = high + medium + low + negligible).
[2] Does not include the East Fork SFSR tributaries Meadow Creek and East Fork Meadow Creek.
[3] Does not include Sugar Creek.
[4] Total percent of IP habitat within the total length of streams evaluated.
% = percent; East Fork SFSR = East Fork South Fork Salmon River; IP = Intrinsic Potential; km = kilometer; YPP = Yellow Pine pit lake

6.3.3 Bull Trout

6.3.3.1 Status

The USFWS listed the Columbia River DPS of bull trout (*Salvelinus confluentus*) as threatened in June 1998 (63 Federal Register 31647).

Bull trout are currently known to use spawning and rearing habitat in at least 28 streams within the SFSR subbasin, including Burntlog Creek, Trapper Creek, Riordan Lake, East Fork SFSR, Sugar Creek, Tamarack Creek, and Profile Creek. IDFG trend data indicates that the geographic extent of bull trout is increasing (IDFG 2005). Potential threats to the population within the SFSR subbasin include connectivity impairment, habitat degradation, and competition from invasive brook trout (USFWS 2015a); however, fish sampling has not documented brook trout in any of the mine site streams, but this species may occur in several streams in the vicinity of the Burntlog Route (Adams et al. 2002).

6.3.3.2 Critical Habitat

Within the analysis area, the USFWS has designated Critical Habitat for bull trout throughout the South Fork Salmon watershed, including but not limited to in the East Fork SFSR, and in Burntlog, Cane, Cinnabar, Meadow, Tamarack, Trapper, Riordan, and Sugar creeks (75 Federal Register 63898). **Figure 6-9** shows the occurrence locations of bull trout and designated Critical Habitat in the analysis area.

6.3.3.3 Physical and Biological Features and Recovery Plan

Primary constituent elements are physical and biological features that are essential to the conservation of the species. For bull trout these include but are not limited to space for individual and population growth and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species (USFWS 2010).

The most recent 5-year status review for bull trout was published in April 2008 (USFWS 2008); however, a new 5-year review is currently in progress (85 Federal Register 14240; March 11, 2020). The 2008 review concluded that listing the species as "threatened" remained warranted range-wide in the coterminous U.S. Based on this status review, the 2010 recovery report to Congress stated that bull trout were generally "stable" range wide. Since the listing of bull trout, there has been very little change in the general distribution in the coterminous U.S.

The 2015 Recovery Plan for the Coterminous United States Population of Bull Trout (USFWS 2015a) provided recovery unit implementation plans for specific recovery units, including the Upper Snake Recovery Unit, which includes bull trout in the analysis area. Four strategies were identified for the recovery of bull trout and include:

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

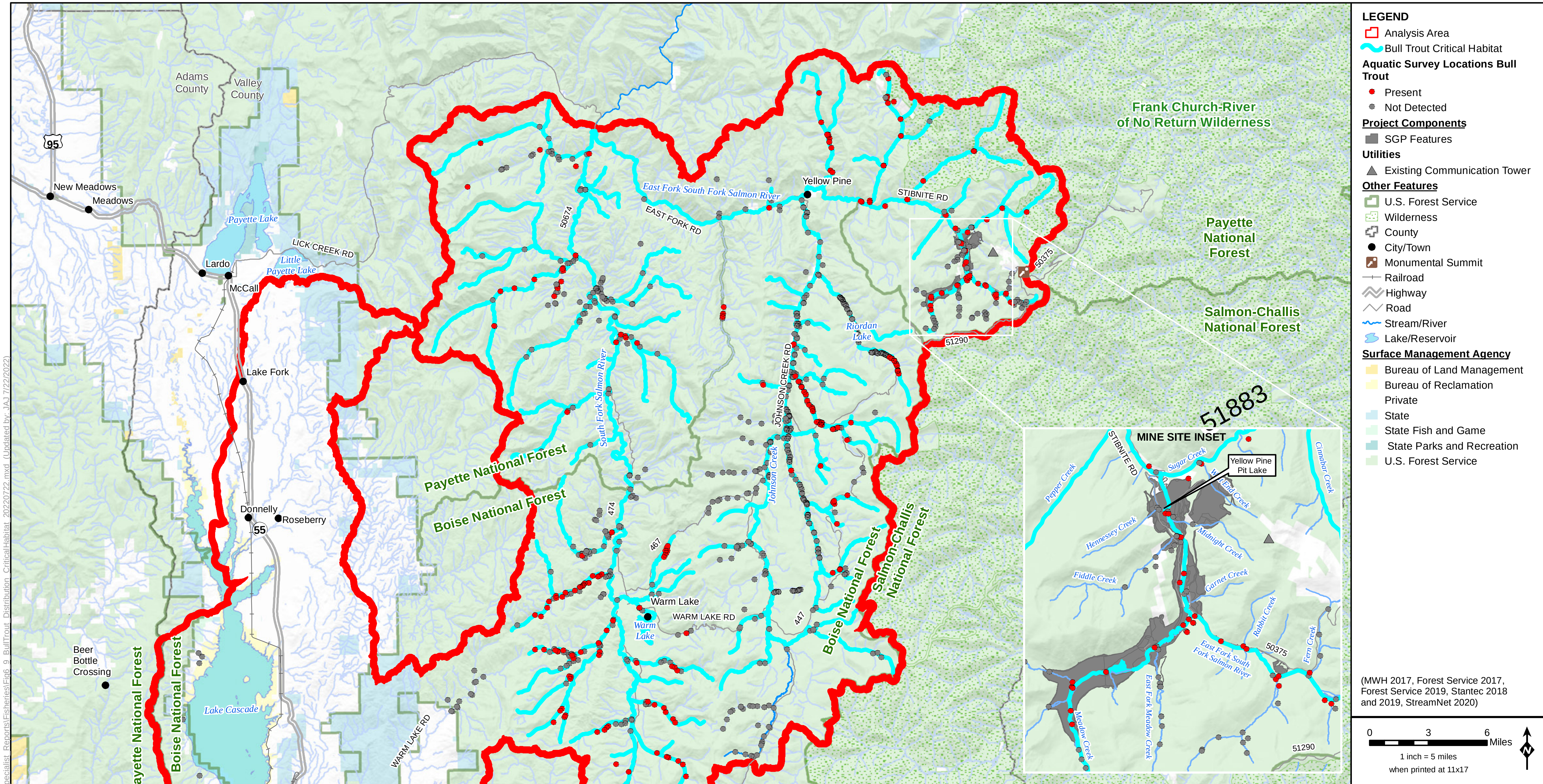


Figure 6-9
Bull Trout Distribution and Designated Critical Habitat in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

Base Layer: USFS Shaded Relief
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

Large areas of intact habitat exist primarily in the Salmon River drainage, which is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation diversions or instream barriers (USFWS 2015a).

Bull trout exhibit three life-history strategies in the analysis area: fluvial (stream and river dwelling, spawning in small tributaries); adfluvial (lake dwelling and river spawning); and non-migratory or resident (found in small streams and headwater tributaries). Historically, the Upper Snake Recovery Unit is believed to have largely supported the fluvial life history form; however, many core areas are now isolated or have become fragmented watersheds, resulting in replacement of the fluvial life history with resident or adfluvial forms. The USFWS identified threats to bull trout persistence as “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 into diversion channels; and introduced non-native species” (64 Federal Register 58910).

6.3.3.4 Temperature Requirements and Baseline

Bull trout have different thermal requirements or limitations for their various life stages. If temperatures are above or below threshold for various life-stages, fish may avoid areas within streams if they are able. Using the QUAL2K predicted stream temperature values and stream segment lengths from the SPLNT Model Refined Modified Proposed Action (ModPRO2) report (Brown and Caldwell 2021a), the length of proposed mine site streams (East Fork SFSR, Meadow Creek, East Fork Meadow Creek, and Fiddle Creek) within these temperature thresholds was estimated (**Table 6-1**). The QUAL2K stream segments that contain the segments in which there was modeled habitat with occupancy probability (see **Section 6.3.3.5**) were evaluated for thermally suitable habitat for all life stages. However, it is important to note, the Occupancy Model (OM) applied a different spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Hence, the stream segments evaluated for temperature could have lengths that extended beyond the ends of the segments evaluated for OM. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer or shorter than the length of habitat with OM.

The periodicity of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature ESS 2019a, a condensed version of which is presented in **Table 6-1**.

The East Fork SFSR from 0.89 km downstream from the confluence with Sugar Creek to around 5 km upstream from the confluence with Meadow Creek, including Fiddle Creek (total of 12.94 km), and around 13.27 km of Meadow Creek and East Fork Meadow Creek were evaluated for the temperature thresholds.

Overall, there are 26.21 km of available habitat, none of it is within optimal thresholds for incubation/emergence, almost half of it is optimal for juvenile rearing, approximately 6 percent is within the thresholds for adult spawning.

Table 6-17 Bull Trout Optimal Temperature Thresholds and Modeled Length of Stream within the Water Temperature Thresholds

Life Stage / Season	Range of Optimal Water Temperature Thresholds (°C)	Total Stream Length Above YPP / Below YPP	Stream Length Within Optimal Water Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Spawning/ August – September[1]					
FA	4 – 9	24.20 / 2.01	1.62	0	1.62 (6.2%)[2]
FR	9 – 10	24.20 / 2.01	7.76	0	7.76 (29.7%)[2]
FUR	>10	24.20 / 2.01	14.82	2.01	16.83 (64.5%)[2]
Incubation/Emergence/ April – August[1]					
FA	2 – 5	24.20 / 2.01	0	0	0
FR	5 – 6	24.20 / 2.01	0	0	0
FUR	>6	24.20 / 2.01	24.20	2.01	26.21 (100%)[2]
Juvenile Rearing/ Year-round[3]					
FA	4 – 12	24.20 / 2.01	12.16	0	12.16 (46.6%)[2]
FR	12 – 15	24.20 / 2.01	9.60	2.01	11.61 (44.5%)[2]
FUR	>15	24.20 / 2.01	2.43	0	2.43 (9.3%)[2]

Source: EPA 2003, Forest Service 2003
[1] Analysis based on Fall Maximum 7 Day Average of the Daily Maximum
[2] Percent of stream length is based on the modeled potential habitat
[3] Analysis based Summer Maximum 7 Day Average of the Daily Maximum
°C = degrees Celsius; > = greater than; % = Percent; km = kilometer; FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; km = kilometer; YPP = Yellow Pine pit

It is important to note that the length of potential habitat for bull trout incubation is based on September MWMT, however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Additionally, while the length of stream above and below YPP are not FA and often even FR, there are all life stages of bull trout present, which means successful reproduction is occurring. Therefore, while fall MWMT may show zero miles of suitable spawning and incubation habitat, this may not be a true representation of the conditions in the river. Additionally, if MWMT that for mobile life stages (i.e., adults and juveniles), if temperatures are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges.

6.3.3.5 Distribution

Figure 6-9 displays the distribution of bull trout in the analysis area. Bull trout are not found outside of the SFSR subbasin within the analysis area (Burns et al. 2005). Bull trout occupy most streams affected by both construction and operation of the SGP (MWH 2017).

A subpopulation of bull trout using an adfluvial life history strategy uses the YPP lake for overwintering, with downstream migration to tributaries for spawning (Hogen and Scarnecchia 2006). Hogen and Scarnecchia (2006) found bull trout overwintered in the large rivers downstream from the East Fork SFSR (SFSR and the Salmon River further downstream), and then migrated upstream to the East Fork SFSR in June and July, and further into small tributaries to spawn in August and September. Migrants stage at the mouths of presumptive spawning tributaries from mid-July to mid-August, then migrate into tributaries to spawn from mid-August to mid-September. ESS 2019h provides more detail regarding bull trout use of the YPP lake.

Fluvial populations downstream from the YPP lake quickly out-migrate as far as the mainstem Salmon River (Hogen and Scarnecchia 2006) or move up and into the YPP lake for overwintering. The YPP cascade barrier blocks upstream passage of fluvial populations. Upstream from the YPP cascade barrier, bull trout use either the fluvial or the resident life-history strategy. The extent of available habitat upstream from the YPP lake is limited by gradient barriers, as well, the access to upstream habitat by fluvial populations downstream from the YPP barrier is blocked. Additional information on a population study in the YPP lake is provided in **Section 6.2.2**.

Habitat for bull trout is measured using two different tools – OM to determine occupancy probability and looking at how changes in stream flow affects the amount of available habitat through the use of Physical Habitat Simulation modeling (PHABSIM). Both are described below.

Occupancy Probability

The OM is a tool used to determine the probability of a fish species occupying a particular stream reach (occupancy probability) and to predict changes in the probability given changes to site physical characteristics (Isaak et al. 2015, 2017). The OM was adapted to the scale of the mine site study area and uses data collected at the mine site. The mine site OM quantifies potential habitat for each stream reach by assigning probabilities (expressed as a percent from 0 to 100) that each of the species would occur in a given stream reach but does not necessarily define their actual presence. There are streams in which there are potential habitat identified from the OM, but where bull trout have not been identified through field surveys.

The length of a stream reach has either a low, medium-low, medium-high, or high occupancy probability (referred to as “available habitat”) , which are based on the quartile in which the occupancy probability falls, that is, the first quartile, or the lowest 25 percent, represents a low occupancy probability, and the fourth quartile, or the highest 25 percent, represents a high occupancy probability. Greater detail regarding occupancy modeling is presented in ESS 2019f.

A distance-weighted average was used to represent the average occupancy probability of each stream segment, in other words, the usability of habitat for bull trout. This was calculated by multiplying the proportion of the OM stream reach length within the stream segment (e.g., East Fork SFSR upstream from Meadow Creek) with the occupancy probability of each OM stream reach within the stream segment.

Occupancy modeling methods originate from studies completed by the Rocky Mountain Research Station, a group of scientists funded by the United States Department of Agriculture (Isaak et al. 2015, 2017). The OM was based on three site physical characteristic variables: stream discharge (i.e., flow), summer stream temperature, and reach slope (Isaak et al. 2017), and was conducted at the finer HUC-scale of the mine site area. As part of the Rocky Mountain Research Station studies, data on stream reach variables for large stream networks in the Rocky Mountains/Pacific Northwest were fit to bull trout and westslope cutthroat trout occurrence datasets (presence/absence data) to create parameter estimates used in a logistic regression model. The results of the model can be used to estimate occupancy probabilities for specific areas within any given stream reach where stream flow, summer water temperatures and reach slope are known. For example, an occupancy probability of 10 percent implies that a species will be present in one out of every ten reaches with similar characteristics (temperature, flow and slope) across the region (Rocky Mountains/Pacific Northwest) used to fit the model. Understanding the distinction between the scale of the Isaak et al. 2017 model and the scale of the SGP OM model is important context for placing the results in context.

A site-specific OM was developed to employ the logistical regression derived from the Rocky Mountain Research Station studies to estimate probabilities for both bull trout and westslope cutthroat trout in four stream reaches within the headwaters East Fork SFSR subwatershed (ESS 2019f): East Fork SRSR upstream from the Meadow Creek confluence; Meadow Creek including the East Fork Meadow Creek; East Fork SFSR upstream from the YPP lake and the Meadow Creek confluence, and the East Fork SFSR from the YPP lake and the Sugar Creek confluence. The regression model utilizes parameter values for reach slope, barriers, and changes in stream discharge and water temperature to quantify changes in occupancy probability. This model differs from other analytical approaches in this section which utilize comparisons of parameter values such as stream temperatures to threshold values. Because the OM model regression relates a change in occupancy probability to a change in stream temperature, its results indicate an incremental reduction in occupancy probability associated with an increase in stream temperature instead of a complete reduction upon exceedance of a threshold value. Therefore, because the OM model applies a regression of multiple parameters to the refined stream reaches above, it may provide different results than examination of individual parameters compared to threshold values.

The data for each of the three site physical characteristic variables (i.e., stream discharge, summer stream temperature, and reach slope) were sourced from site-specific models and/or datasets. Stream discharge data were modeled using a basin area-to-streamflow regression equation provided by Rio ASE (2019). Stream temperature data were modeled using QUAL2K, which is a one-dimensional river and stream water quality model, as provided from the SPLNT Existing Conditions Report (Brown and Caldwell 2018). Stream reach slope data were sourced from a site-specific Lidar dataset by extracting the upstream and downstream endpoint elevations from a digital elevation model and dividing the difference by stream reach length.

Stream reaches were eliminated from the data set if they were not suitable to sustain bull trout, either due to having a stream discharge less than 0.2 cubic feet per second, being intermittent in flow, or having a channel slope greater than 15 percent. **Table 6-18** presents a summary of the information applicable for the three variable datasets used in the OM.

Table 6-18 Mine Site Occupancy Model Variable Summary

Parameter	Stream Temperature	Stream Flow	Reach Slope
Unit of Measurement	Mean Temperature (°C)	Mean Discharge (cfs)	Percent Slope
Temporal Resolution	August	July 16 – September 30	Not Applicable
Data Source	SPLNT Model Existing Conditions Report	Basin area-to streamflow regression equation	Delineated in GIS using a 1-meter LiDAR DEM

Source: Brown and Caldwell 2018, RioASE 2019a
°C = degrees Celsius; cfs = cubic feet per second; DEM = Digital Elevation Model; GIS = Geographic Information System; LiDAR = Light Detection and Ranging; SPLNT = Stream and Pit Lake Network Temperature

Lengths of habitat and distance-weighted occupancy probabilities for bull trout for each stream reach are presented in **Table 6-1** and **Figure 6-10**. In total, the East Fork SFSR subwatershed contains approximately 33.9 km of habitat available for potential occupancy for bull trout, which is about 69.5 percent of the total length of streams modeled (49 km). Bull trout have not been observed nor their DNA detected in the upper East Fork Meadow Creek nor in Fiddle Creek (MWH 2017), so may not occur in these two systems. Passage into both the upper East Fork Meadow Creek and Fiddle Creek would not be provided as a result of the project. Therefore, while the model results show occupancy probability in these creeks, it does not mean that bull trout do occur, or would occur as a result of the SGP.

A distance-weighted average method was used to represent the average occupancy probability for each stream segment, shown in **Table 6-19**. To produce the distance-weighted average, the occupancy probability of each OM reach was multiplied by the proportion of the reach's stream length to the total length of each stream segment that has some likelihood of being occupied by bull trout.

Based on the model, the Headwaters East Fork SFSR subwatershed (East Fork SFSR upstream from Sugar Creek, Meadow Creek, and EFMC) has an estimated distance weighted average total occupancy probability for bull trout of 7.9 percent for portions of stream reaches with low to high occupancy probabilities. As shown in **Table 6-19** and **Figure 6-10**, the East Fork SFSR has habitat with high occupancy probability, while Meadow Creek does not. The relatively low occupancy probability numbers for bull trout (less than 20 percent) indicate a higher sensitivity to the model input parameters, particularly water temperature and flow.

Table 6-19 Length of Available Habitat and Distance Weighted Average in Percent Occupancy Probability for Bull Trout Under Baseline Conditions

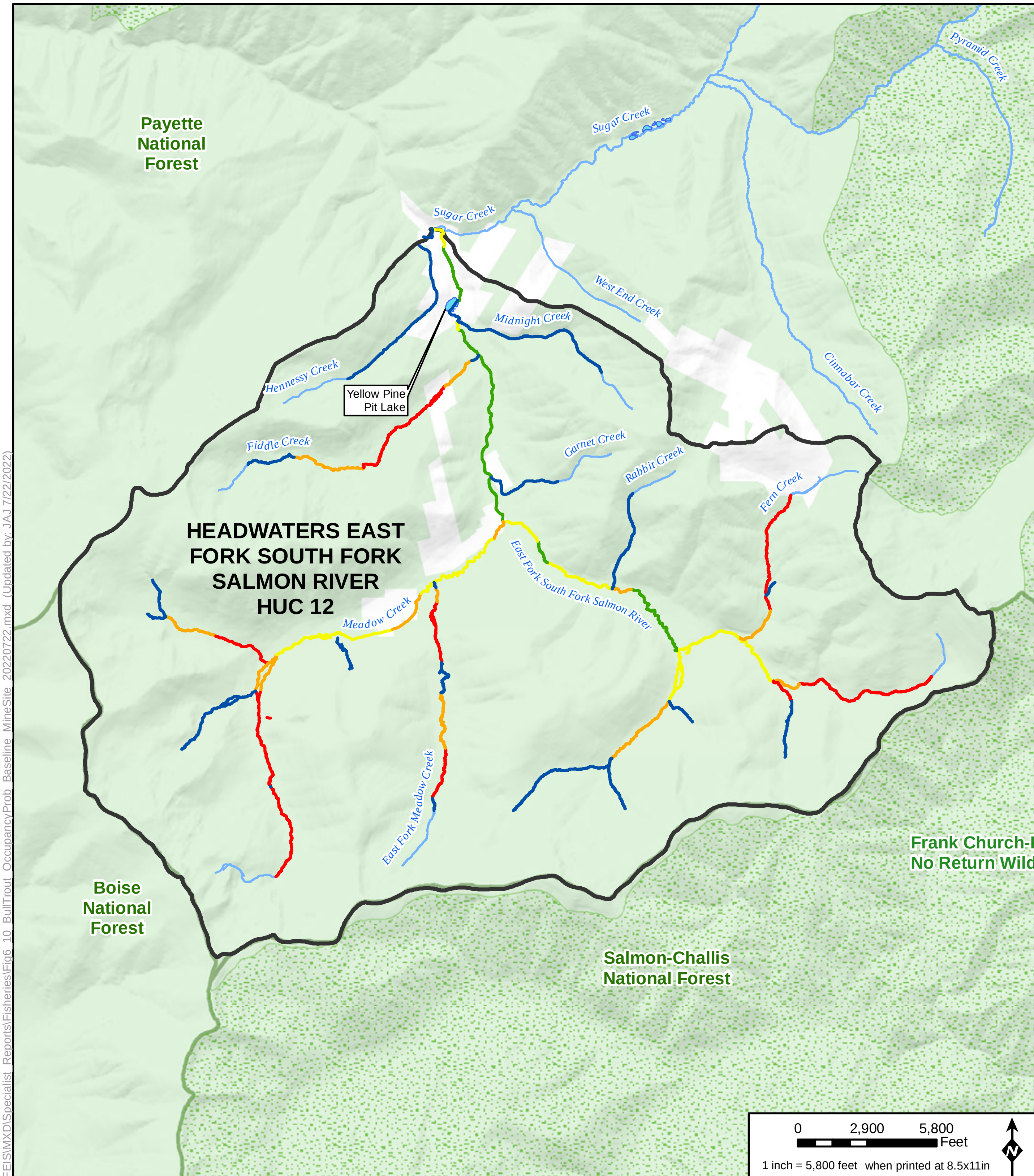
Occupancy Category	East Fork SFSR Upstream from Meadow Creek		Meadow Creak and East Fork Meadow Creek		East Fork SFSR Between Meadow Creek and YPP Lake		East Fork SFSR Between YPP Lake and Sugar Creek	
	km	OP	km	OP	km	OP	km	OP
High	1.59	18.1	0	0	2.91	17.6	0.80	16.2
Medium-High	4.82	11.5	3.45	10.4	0.13	13.2	0.37	13.4
Medium-Low	2.52	6.3	3.43	6.7	1.57	4.4	0	0
Low	4.19	2.3	6.18	2.5	1.93	3.2	0	0
Total	13.12	8.4	13.06	5.7	6.54	10.0	1.17	15.3

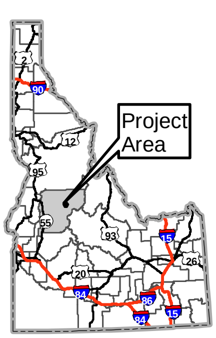
East Fork SFSR = East Fork South Fork Salmon River; km = kilometer: OP = occupancy probability; YPP = Yellow Pine pit

Stream Flow (PHABSIM)

PHABSIM is a modelling technique that predicts the amount of potential fish habitat in a stream or river associated with different volumes of streamflow. First developed by USFWS, the PHABSIM model is widely used as a tool to understand the relationship between streamflow and potential fish habitat. In the late 1980s and early 1990s, the Forest Service conducted a PHABSIM modeling study at several stream locations in the East Fork SFSR watershed as part of the Snake River Basin Adjudication (Maret et al. 2006). The results of this previous study are informative in understanding the potential effects of the SGP on fish habitat. PHABSIM was used for bull trout and cutthroat trout because there was no similar flow-productivity analysis as was applied for Chinook salmon and steelhead using a NMFS-derived tool (ESS 2019g). A summary of the PHABSIM model is provided below. A detailed description of the model and results are provided in ESS 2019g.

The PHABSIM model calculates an index of the amount of microhabitat available for target organisms and life stages at different flow levels, incorporating two major analytical components: stream hydraulics and organism/life stage-specific habitat requirements. These calculations are based on three physical variables: water depth, water velocity, and substrate composition (i.e., streambed particle size). The model uses discrete values of water depth and velocity data collected at a given stream site to simulate the same variables over a broad range of stream flows of interest. Substrate does not change in the model over the range of simulated flows. For each streamflow of interest, the model converts the simulated physical variables into equivalent values of potential fish habitat. This conversion is based on a functional relationship between the three physical variables and fish habitat suitability. Separate conversions were performed in the model for different species (bull trout and cutthroat trout) and life stages of fish. Model output is expressed as Weighted Usable Area (WUA), which represents the square feet of usable habitat per 1,000 feet of stream.





LEGEND

Occupancy Probability Quartile

- Low
- Medium Low
- Medium High
- High
- Unavailable OM Stream Habitat
- Subwatershed (HUC 12)

Other Features

- U.S. Forest Service
- Wilderness
- County
- Lake/Reservoir

Surface Management

- Private
- U.S. Forest Service

Figure 6-10
Bull Trout Occupancy Model Probabilities Under Baseline Conditions in the Mine Site Area
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

To determine general and relative relationships between streamflow and habitat in the mining reaches, the PHABSIM study compared representative streams that contained similar hydrological and geographical characteristics to the stream characteristics at the proposed mine site. This comparative analysis yielded a general grouping of the PHABSIM study site and proposed mine site streams into three index categories, basically reflecting stream size and discharge: Index 1 (small streams); Index 2 (medium size streams); and Index 3 (large streams). At the proposed mine site, each stream reach (defined below) was assigned an index (**Table 6-20**). For example, Meadow Creek and the East Fork SFSR upstream from Meadow Creek are represented by Stream Index 1, both of which are similar to the Summit Creek site of the PHABSIM study.

Table 6-20 Representative Streams and Corresponding Indices used in the PHABSIM Analysis to Represent Three Types of Flow Conditions at Comparative Mine Site Stream Reaches

Mine Site Stream Reach	Stream Index Number	Representative Stream in PHABSIM Analysis	Representative Mean Discharge (cfs)	Representative Mid-Point Discharge (cfs)	Representative Lower Discharge (cfs)
Meadow Creek and East Fork Meadow Creek	1	Summit Creek	7.8	4.4	1
East Fork SFSR Between Sugar Creek and YPP	2	Sugar Creek	9.9	5.4	1
East Fork SFSR at Stibnite	3	East Fork SFSR Downstream from Sugar Creek	63	44	25

cfs = cubic feet per second; East Fork SFSR = East Fork South Fork Salmon River; PHABSIM = Physical Habitat Simulation; YPP = Yellow Pine pit

PHABSIM model output generates a significant volume of information on the relationship between streamflow and WUA (**Table 6-21**). To simplify model output for the purposes of evaluating fish habitat effects of the SGP, two refinements were made to the model results. First, the model output used for the proposed mine site centered on the low-flow period of the year, defined as the months of August through March. Second, the WUA for different life stages of bull trout were evaluated for three key stream flows within the low-flow period: the mean discharge rate, a lower rate close to the minimum discharge rate value for the period, and a mid-point rate between the mean and minimum values (**Table 6-21**).

The quantification of potential SGP impacts on bull trout and cutthroat trout habitat, as defined by WUA, is dependent on several factors. One important factor is the predicted change in baseline flows that would occur in the various mine site stream reaches. Unique changes would occur in each reach throughout the life of the SGP. Another factor is the non-linear relationship between flow and WUA for each fish life stage. The PHABSIM model predicts separate habitat values for all species and all life stages of interest for several stream flow rates, which when viewed graphically, represent a non-linear relationship. Lastly, the PHABSIM model results are based upon WUA data collected from index streams that do not exactly represent the physical and biological conditions of the mine site stream reaches.

Table 6-21 Bull Trout Weighted Usable Area for Three Discharge Rates for Representative Streams

Representative Stream	Discharge		Weighted Usable Area[1]							
	cfs[2]	Percent Change	Adult	Percent Change	Spawning	Percent Change	Fry	Percent Change	Juvenile	Percent Change
Summit Creek (Index 1)	7.8	--	2,505	--	0	N/A	ND	N/A	5,940	--
	4.4	-44	1,451	-42	0	N/A	ND	N/A	3,524	-41
	1.0	-87	261	-90	0	N/A	ND	N/A	635	-89
Sugar Creek (Index 2)	9.9	--	1,176	--	2,127	--	ND	N/A	2,709	--
	5.4	-46	746	-37	1,443	-32	ND	N/A	1,811	-33
	1.0	-90	144	-88	66	-97	ND	N/A	351	-87
East Fork SFSR Downstream from Sugar Creek (Index 3)	63	--	2,184	--	0	N/A	ND	N/A	4,900	--
	44	-30	1,846	-15	0	N/A	ND	N/A	4,340	-11
	25	-60	1,108	-49	0	N/A	ND	N/A	2,690	-45

[1] Weighted Usable Area is defined as the sum of stream surface area within a study site, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each, and normalized to square units (either feet or meters) per 1000 linear units.
[2] Discharge is measured in cfs.
[3] The underlined value is the mean low-flow-period discharge rate.
cfs = cubic feet per second; East Fork SFSR = East Fork South Fork Salmon River; ND = no data; N/A: not applicable.

6.3.4 Westslope Cutthroat Trout

6.3.4.1 Status

Due to declines in distribution and abundance, westslope cutthroat trout (cutthroat trout) is designated by the Forest Service as a sensitive species. There was a petition to list westslope cutthroat trout as a threatened species under ESA (63 Federal Register 31691); however, the USFWS determined that such a listing was not warranted (65 Federal Register 20120 April 2000).

6.3.4.2 Temperature Requirements and Baseline

Cutthroat trout have different thermal requirements/limitations for their various life stages. The periodicity of each life stage and the accepted stream temperature thresholds/ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature (ESS 2019a), a condensed version of which are presented in **Table 6-22**.

Using stream temperature values and stream segment lengths from the SPLNT Model Refined Modified Proposed Action (ModPRO2) report (Brown and Caldwell 2021a), the length of mine site streams within these thresholds was estimated (**Table 6-22**). The East Fork SFSR from 0.89 km downstream from the confluence with Sugar Creek to around 5 km upstream from the confluence with Meadow Creek, including Fiddle Creek (total of 12.94 km), and around 13.27 km of Meadow Creek and East Fork Meadow Creek were evaluated for the temperature thresholds. The sections of the creeks evaluated were based on the modeled OP habitat (see **Section 6.3.3.5** for additional detail). However, it is important to note, the OM applied a different spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer or shorter than the length of habitat with an occupancy probability.

Table 6-22 Westslope Cutthroat Trout Optimal Temperature Thresholds, and Modeled Length of Stream within the Water Temperature Thresholds

Life Stage / Season	Range of Optimal Temperature Thresholds (°C)	Total Stream Length Above YPP / Below YPP	Stream Length Within Water Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Migration/ March – June	15 – 19	24.10 / 2.01	--	--	--
Adult Spawning/ April – mid-July	4 – 14	24.10 / 2.01	--	--	--
Incubation/Emergence/ April – August[1]	6 – 10	24.10 / 2.01	0.85	0	0.85
Juvenile Rearing/ Year-round[1]	10 – 20	24.10 / 2.01	23.34	2.01	25.35 (87.8%)[2]

Source: EPA 2003, Rio ASE 2019.
[1] Analysis based Summer (July) MWMT
[2] Percent of stream length within modeled potential habitat.
°C = degrees Celsius; % = Percent; km = kilometer; YPP = Yellow Pine pit

Overall, there is minimal habitat suitable for incubation/emergence, but a significant portion of the usable habitat is within the temperature thresholds for juvenile rearing (**Table 6-22**). It is important to note that the length of potential habitat for westslope cutthroat trout incubation is based on September MWMT; however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Additionally, while the length of stream above and below the YPP do not always meet the thermal requirements, there are all life stages of cutthroat trout present, which means successful reproduction is occurring. Therefore, while fall MWMT may show less than one mile of suitable incubation habitat, this may not be a true representation of the conditions in the river. Additionally, if MWMT for mobile life stages (i.e., adults and juveniles) are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges.

6.3.4.3 Distribution

Cutthroat trout are not found outside of the SFSR subbasin within the analysis area. They are found both upstream and downstream from the YPP lake. The distribution of westslope cutthroat trout in the analysis area is shown in **Figure 6-11**.

Cutthroat trout spatial and temporal occurrence in the analysis area varies by life stage, (e.g., juveniles using nursery and rearing habitat or spawning adults). Adult migration occurs between mid-March and July with the peak from mid-April to mid-June. Spawning occurs from late April to July when water temperatures are near 10°C. Peak spawning is between early May and early July. Incubation/emergence occurs between mid-April and September. Juvenile rearing occurs year-round. Emigration occurs between April and December. Life stage periodicity tables are presented in ESS 2019a.

Cutthroat trout begin to mature at age three, but usually spawn first at age four or five. Cutthroat trout may be resident (non-migratory carry out all life processes in tributaries), fluvial (migratory: reside in rivers and streams and migrate to tributaries to spawn), or adfluvial (lake-dwelling and migrate to tributaries to spawn).

Recent fish sampling was performed in the YPP lake to provide information on relative abundance and movement of cutthroat trout (Brown and Caldwell 2019b, 2020a). A total of 32 cutthroat trout were captured over three sampling events in May, July, and September 2018, leading to only one population estimate of 50 individuals. The movement study results showed the majority of the 32 tagged cutthroat trout remained in the YPP lake; only four moved downstream and were not detected returning upstream. The 2019 study resulted in population estimates ranging from 33 to 101 individuals. The size structure of westslope cutthroat trout was skewed towards larger fish. Fish less than 150- to 200-millimeter fork length were not found.

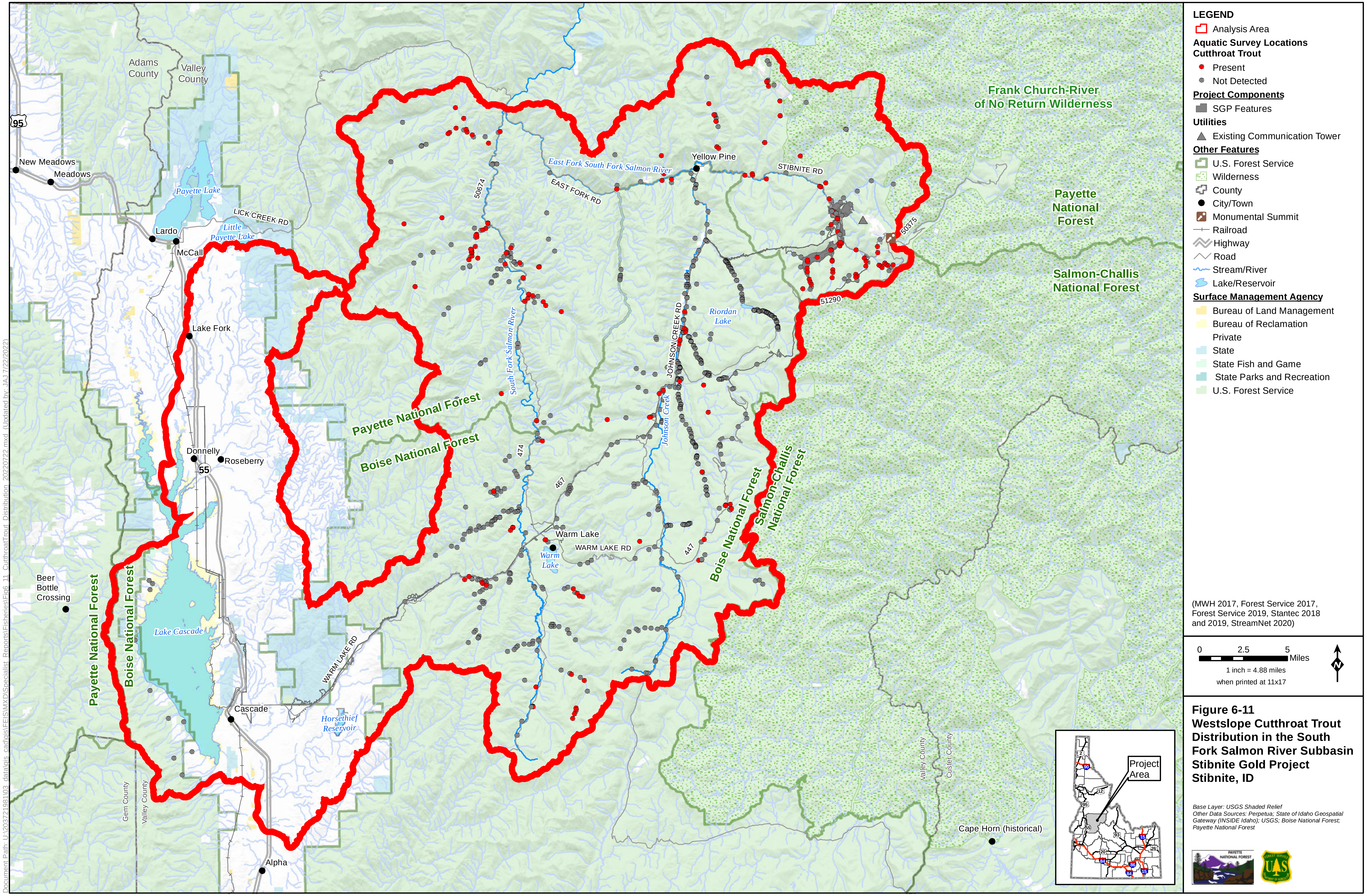


Figure 6-11
Westslope Cutthroat Trout Distribution in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS Shaded Relief
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

Document Path: U:\2037218103_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Fisheries\Fig6_11_CutthroatTrout_Distribution_20220722.mxd (Updated by: JAJ 7/22/2022)

Occupancy Probability

Occupancy modeling was performed for westslope cutthroat trout using the same approach as bull trout (**Section 6.3.3.5**). Based on field surveys, westslope cutthroat trout occur in throughout the headwaters of the East Fork SFSR, including in Meadow Creek, East Fork Meadow Creek, and Fiddle Creek. Occupancy modeling provides probabilities for potential habitat in each of these systems.

In total, the Headwaters East Fork SFSR subwatershed contains nearly 34 km of stream channel that is potential usable habitat for western cutthroat trout (**Table 6-23** and **Figure 6-12**) based on OM results, which is approximately 67 percent of the total length of streams in the subwatershed (50.6 km). The Headwaters East Fork SFSR subwatershed has a distance weighted average occupancy probability of 64.3 percent for portions of stream reaches with low to high occupancy probabilities and each reach within the subwatershed are presented in **Table 6-23** and **Figure 6-12**. The relatively high occupancy probability numbers for cutthroat trout (mostly greater than 60 percent) indicate a higher tolerance to the model input parameters, particularly water temperature and flow.

Descriptive statistics for lengths of available habitat and occupancy probabilities by stream reach are presented in detail in ESS 2019f.

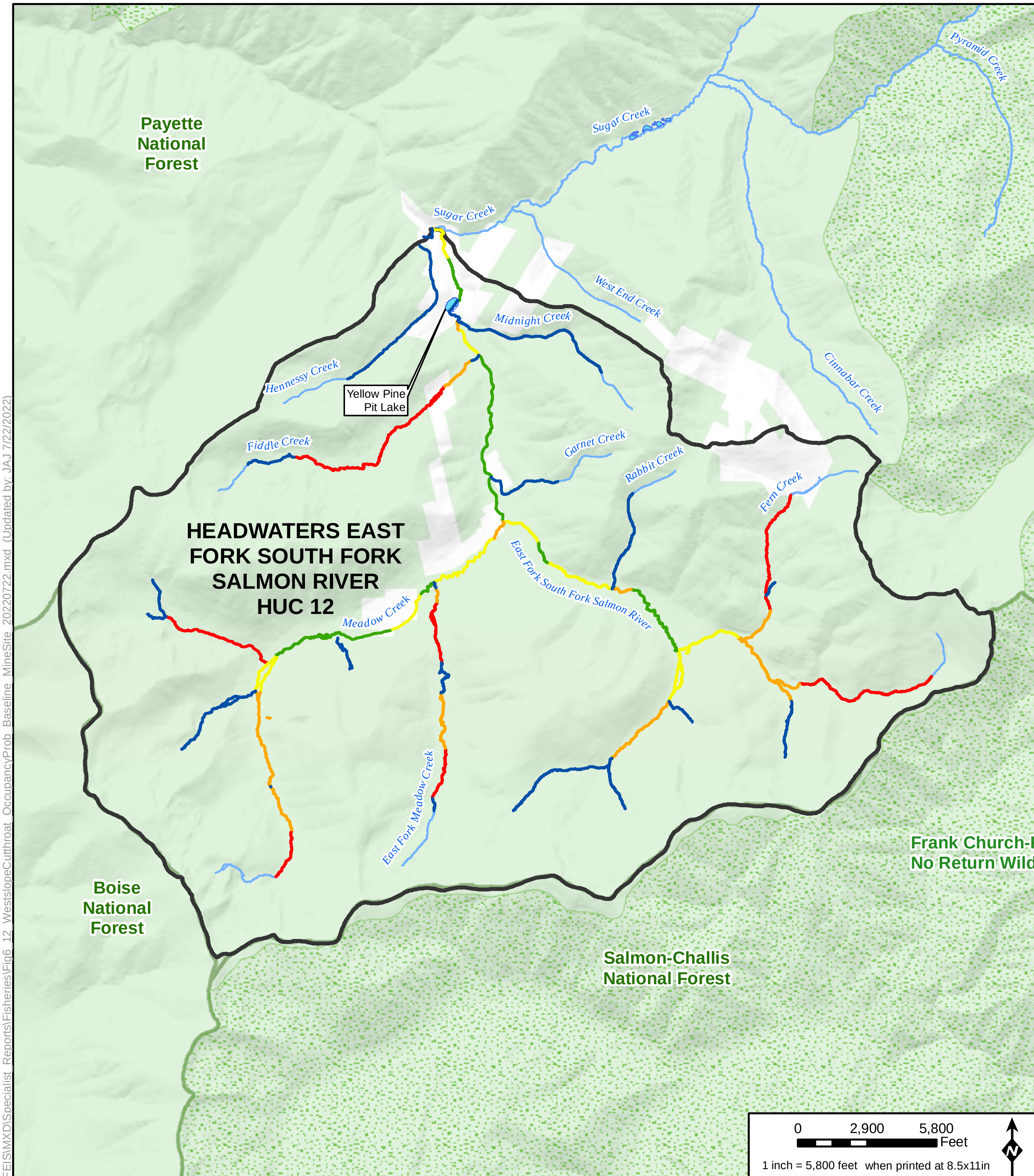
Table 6-23 Length of Available Habitat and Distance Weighted Average in Percent Occupancy Probability for Westslope Cutthroat Trout Under Baseline Conditions

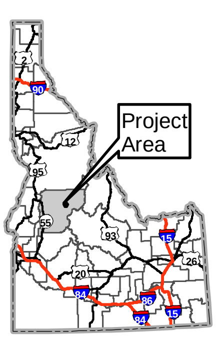
Occupancy Category	East Fork SFSR Upstream from Meadow Creek		Meadow Creek and East Fork Meadow Creek		East Fork SFSR Between Meadow Creek and YPP Lake		East Fork SFSR Between YPP Lake and Sugar Creek	
	km	OP	km	OP	km	OP	km	OP
High	1.59	69.5	2.21	68.8	2.54	69.7	0.64	68.8
Medium-High	3.95	67.1	3.04	67.2	0.46	67.6	0.53	67.0
Medium-Low	3.78	64.3	3.68	64.1	0.64	63.0	0	0
Low	3.79	59.1	4.13	58.6	2.98	59.7	0	0
Total	13.12	64.3	13.06	63.9	6.54	64.2	1.17	68.0

East Fork SFSR = East Fork South Fork Salmon River; km = kilometer; OP = Occupancy Probability; YPP = Yellow Pine Pit

Stream Flows (PHABSIM)

The same PHABSIM approach previously described for bull trout was used for westslope cutthroat trout (see **Section 6.3.3.5**) For each of the three discharge rates and Stream Index, **Table 6-24** provides the WUA value for four westslope cutthroat trout life stages, along with a percentage reduction in WUA relative to the mean discharge rate WUA value.





LEGEND

Occupancy Probability Quartile
- Low
- Medium Low
- Medium High
- High
- Unavailable OM Stream Habitat
- Subwatershed (HUC 12)

Other Features
- U.S. Forest Service
- Wilderness
- County
- Lake/Reservoir

Surface Management
- Private
- U.S. Forest Service

Figure 6-12
Westslope Cutthroat Trout Occupancy Model Probabilities Under Baseline Conditions in the Mine Site Area
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Table 6-24 Westslope Cutthroat Trout Weighted Usable Area for Three Discharge Rates for Representative Streams

Representative Stream	Discharge		Weighted Usable Area[1]							
	cfs[2]	Percent Change	Adult	Percent Change	Spawning	Percent Change	Fry	Percent Change	Juvenile	Percent Change
Summit Creek (Index 1)	7.8[3]	--	2,007	--	14,320	--	9,084	--	0	N/A
	4.4	-44	891	-56	13,111	-8	5,989	-34	0	N/A
	1	-87	8	-99	7,117	-50	1,589	-83	0	N/A
Sugar Creek (Index 2)	9.9[3]	--	1,687	--	7,338	--	5,849	--	2,958	--
	5.4	-46	794	-53	6,896	-6	4,256	-27	2,139	-28
	1	-90	20	-99	3,997	-46	1,270	-78	428	-86
East Fork SFSR Downstream from Sugar Creek (Index 3)	63[3]	--	9,788	--	13,345	--	16,220	--	0	N/A
	44	-30	6,640	-32	14,644	10	15,254	-6	0	N/A
	25	-60	3,196	-67	15,272	14	12,393	-24	0	N/A

[1] Weighted Usable Area is defined as the sum of stream surface area within a study site, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each, and normalized to square units (either feet or meters) per 1000 linear units.
[2] Discharge is measured in cfs.
[3] The underlined value is the mean low-flow-period discharge rate.
cfs = cubic feet per second; East Fork SFSR = East Fork South Fork Salmon River; ND: No data were available from the PHABSIM study; N/A: not applicable.

7.0 Environmental Consequences

7.1 Impact Definitions

The impacts definitions for intensity, duration (FSH 1909.15, 152b), and context are provided in **Table 7-1**.

Table 7-1 Impact Definitions

Attribute	Term	Description
Intensity	Negligible	Impacts would result in a change in current conditions that would be too small to be physically measured using normal methods or would not be perceptible. There is no noticeable effect on the natural or baseline setting. There are no required changes in management or utilization of the resource.
Intensity	Minor	Impacts would result in a change in current conditions that would be just measurable with normal methods or barely perceptible. The change may affect individuals of a population or a small portion of a resource, but it would not result in a modification in the overall population, or the value or productivity of the resource. There are no required changes in management or utilization of the resource.
Intensity	Moderate	Impacts would result in an easily measurable change in current conditions that is readily noticeable. The change affects a large percentage of a population, or portion of a resource which may lead to modification or loss in viability, value, or productivity in the overall population or resource. There are some required changes in management or utilization of the resource.
Intensity	Major	Impacts are considered significant. Impacts would result in a large, measurable change in current conditions that is easily recognized. The change affects a majority of a resource or individuals of a population, which leads to significant modification in the overall population, or the value or productivity of the resource. This impact may not be in compliance with applicable regulatory standards or impact thresholds, requiring large changes in management or utilization of the resource.
Duration	Temporary	Impacts that are anticipated to last no longer than 1 year.
Duration	Short-Term	Impacts that are anticipated to begin and end within the first 3 years during the construction phase.
Duration	Long-Term	Impacts lasting beyond 3 years to the end of mine operations and through reclamation, approximately 20 years.
Duration	Permanent	Impacts that would remain after reclamation is completed.
Context	Localized	Impacts would occur within the analysis area or the general vicinity of the Operations Area Boundary.
Context	Regional	Impacts would extend beyond the Operations Area Boundary and local area boundaries.

Intensity is the severity or levels of magnitude of an impact.
Duration is the length of time an effect would occur.
Context is the effect(s) of an action that must be analyzed within a framework, or within physical or conceptual limits.

7.2 Direct and Indirect Effects

Direct and indirect effects described in this section are considered to be negative unless explicitly described as beneficial.

7.2.1 Assumptions and Information Availability

To analyze impacts on fish resources and fish habitat the following assumptions were made:

- The proposed East Fork SFSR fish tunnel under the 2021 MMP would provide passage for all four special status fish species. This assumption is based on professional judgment and review of other similar or longer tunnels that have been documented to be fish passable (Gowans et al. 2003; Rogers and Cane 1979; Wollebaek et al. 2011). This analysis also includes a brief description of the effects if the tunnel does not provide passage as planned (USFWS 2019).
- The constructed and enhanced stream reaches would perform as described in the Stream Design Report (Rio ASE 2021).
- The stream temperature analysis is based on the duration of SGP phases as: construction – 3 years; mining – 15 years; closure and reclamation – 5 years; and post-closure to Mine Year 112.
- The stream flow analysis within the combined stream and pit water temperature models (SPLNT models, Brown and Caldwell 2018, 2021a, 2021b) accurately reflect future conditions, which is based on historic conditions.

Much of the fish habitat modeling and analysis presented in this section is based on the hydrologic and site-wide water chemistry modeling performed by Perpetua or its consultants. Predictions generated by groundwater and hydrologic models (Brown and Caldwell 2021b) are associated with a degree of uncertainty and can be limited in their predictive ability (see model uncertainty sections of Forest Service 2021c, 2021d).

Several assumptions regarding physical, biological, and chemical conditions were made to address incomplete information at the time of this analysis.

- Reach-specific fish spatial distribution (i.e., presence/absence) data were not available for all streams potentially affected by the action alternatives, especially the streams outside the mine site. Population estimates were not available; as described in the Aquatic Resources 2016 Baseline Study Report Addendum (GeoEngineers 2017), the results of the multiple years of diver-based snorkel surveys are limited and variable.
- Some habitat conditions could not be quantitatively evaluated due to a lack of available data or a suitable site-specific model (e.g., impacts of stream flow reductions on overwintering fish, and a site-specific stream flow/productivity model). Other examples include lack of modeling of existing habitat for many fish at multiple life stages. There is a lack of a site-specific, two-dimensional hydraulic-based habitat suitability model. The nearest sites where data have been collected and modeling performed are on several streams in the Upper East Fork SFSR (Sugar Creek, Tamarack Creek, Profile Creek, Quartz Creek, and the East Fork SFSR).

7.2.2 No Action Alternative

Under the No Action Alternative, the Forest Service would not approve the SGP, and therefore no activities proposed on Forest Service lands would be approved.

Under the No Action Alternative, there would be no surface (open-pit) mining or ore processing to extract gold, silver, and antimony, and no underground exploration or sampling or related operations and facilities on NFS lands. Perpetua could continue to conduct surface exploration that has been previously approved. Perpetua would continue to comply with reclamation and monitoring commitments included in the applicable Golden Meadows Exploration Project Plan of Operations (Midas Gold 2016). These commitments include reclamation of the drill pads and temporary roads and monitoring to ensure that BMPs are in place and effective so that soil erosion and other potential resource impacts are avoided or minimized. This also would include monitoring commitments required by the Forest Service relating to the Golden Meadows Exploration Environmental Assessment (Forest Service 2015).

In the absence of the SGP, current uses by Perpetua on patented mine/mill site claims, and on PNF and BNF would continue. Uses of NFS lands include mineral exploration, dispersed and developed recreation, such as pleasure driving, hunting, off-highway-vehicle use, camping, hiking, snowmobiling, bird watching, target shooting, firewood cutting, and other forms of recreation. Private businesses, such as outfitter and guide services, also operate on the Forest through special use permits. Access to public land in the area would continue as governed by law, regulation, policy, and existing and future landownership constraints, the latter of which may include denial of access over private land.

Under the No Action Alternative there would be no SGP-caused impacts on physical stream channels, WCIs, individual fish (including federally listed and forest service species sensitive species), or fish habitat.

7.2.3 2021 Modified Mine Plan

The descriptions of effects are organized as follows: direct impact-causing activities (i.e., physical stream channel changes) and the Direct Effects to Individuals section, are discussed first because those activities would have the greatest potential to impact fish and fish habitat at the mine site. Habitat changes are described next (Watershed Condition Indicators/Habitat Elements) and separated into two subsections (mine site and off-site). This is followed by more detailed descriptions of impacts to each of the four main species (Chinook salmon, steelhead, bull trout, and westslope cutthroat trout).

7.2.3.1 Direct Impacts to Individuals

The following analysis of effects associated with fish resources and fish habitat is considered within the overall context that resident and anadromous fish species could be affected, including three species listed as threatened under the ESA, and one Forest Service sensitive species, the westslope cutthroat trout. While these listed and sensitive species are the focus of the analyses, the effects described are expected to be similar for all fish species in the analysis area.

Dewatering, Fish Salvage, Relocation

Stream Crossings

Dewatering, fish salvage, and relocation may be necessary for culvert replacement, new culvert installation, and potentially for bridge maintenance, and could cause injury or mortality to fish in the immediate vicinity or during relocation activities if required. The standard procedures to be developed for dewatering at the mine site also would be used for activities in all other SGP areas (Brown and Caldwell, McMillen Jacobs, and BioAnalysts, 2021b); therefore, the number of injuries or mortalities is expected to be minimized. Approximately 71 water crossings would be required for access roads, and a number of these would cross fish-bearing waterbodies. Fish salvage would be required for dewatering and all in-water work at stream crossings in all fish-bearing water bodies and fish impacts would be limited to minor (less than 10 percent) incidental take associated with fish salvage. Fish salvage work would require prior state and federal agency consultations and follow USFWS Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards (USFWS 2012). Dewatering and in-water work at stream crossings would be spatially limited relative to the larger-scale work occurring in the active mine area. Therefore, effects of the SGP on fish at stream crossings would be negligible, temporary, and localized.

Stream Channels

Fish salvage and relocation would be conducted prior to stream channel dewatering due to mining, construction, restoration, road crossing maintenance, or other activities. The Fisheries and Aquatic Resources Mitigation Plan (Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b) outlines the sequence for fish salvage work including site preparation, work area isolation, fish capture, fish handling, and fish relocation. Dewatering would impact streams including East Fork SFSR upstream from YPP lake, East Fork SFSR downstream from YPP lake, Fiddle Creek, Meadow Creek and tributaries, and East Fork Meadow Creek. In total, 17.11 km of stream channel are estimated to be subject to dewatering and fish salvage, with some reaches dewatered, and fish salvaged, more than once (**Table 7-2**). Fish relocation areas have been established for both permanent and temporary removal associated with different salvage locations (**Table 7-3**). Permanent fish relocation would be used where stream channels would be diverted and dewatered over long periods of time. Temporary relocation areas would be used where short-term operation activities would require relocation upstream from the isolated work area, and the fish would then be allowed to migrate back into the work area once the instream work is completed and access is re-established.

Fish salvage would prevent population-level impacts to fish within the active mine area but result in some incidental mortality (generally less than 10 percent), and have a moderate, localized, long-term impact on all fish species within the analysis area. Additional information on the rescue and relocation protocols and implementation is provided in the Fisheries and Aquatic Resources Mitigation Plan (Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b).

Table 7-2 Purpose, Location, Stream Length and Lake Area Affected

Purpose	Location	Stream Length Affected (m)	Lake Area Affected (m^2)	Fish Salvage Operations
Mine Site Excavation and East Fork SFSR Tunnel	East Fork SFSR upstream from YPP lake	475	N/A	Work area isolation, fish salvage, relocation
	YPP Lake	N/A	18,267	
	East Fork SFSR downstream from YPP Lake	639	N/A	
Grown Media Stockpile	Fiddle Creek	515	N/A	
TSF Development	Meadow Creek and Tributaries	7,249	N/A	
Hangar Flats Development	Meadow Creek	2,175	N/A	
Stream Restoration	East Fork Meadow Creek	2,532	N/A	
East Fork SFSR Tunnel Maintenance	East Fork SFSR	Variable	N/A	Work area isolation, fish salvage, and temporary displacement
Stream Enhancement	Meadow Creek	718	N/A	
Stream Enhancement	East Fork SFSR	2,706	N/A	

Purpose	Location	Stream Length Affected (m)	Lake Area Affected (m^2)	Fish Salvage Operations
Culvert Replacement	East Fork SFSR Box Culvert	100	N/A	

Source: Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b
Key: East Fork SFSR = East Fork South Fork Salmon River; N/A = Not Applicable; m = meter; m^2 = square meter; TSF = tailings storage facility; YPP = Yellow Pine pit

Table 7-3 Fish Salvage Locations and Permanent and Temporary Fish Relocation Areas

Fish Salvage Location	Fish Relocation Type	Relocation Stream	Relocation Area
East Fork SFSR from YPP lake outlet to North Portal of Tunnel	Permanent	East Fork SFSR	Downstream from North Portal of Tunnel to confluence with Sugar Creek
		East Fork SFSR	Downstream from confluence with Sugar Creek
		Sugar Creek	Upstream from confluence with East Fork SFSR
YPP Lake	Permanent	East Fork SFSR	Downstream from North Portal of Tunnel to confluence with Sugar Creek
		East Fork SFSR	Downstream from confluence with Sugar Creek
		Sugar Creek	Upstream from confluence with East Fork SFSR
East Fork SFSR from South Portal of Tunnel to YPP lake inlet	Permanent	East Fork SFSR	Downstream from North Portal of Tunnel to confluence with Sugar Creek
		East Fork SFSR	Downstream from confluence with Sugar Creek
		Sugar Creek	Upstream from confluence with East Fork SFSR
Fiddle Creek	Permanent	Fiddle Creek	Upstream from Fiddle Creek media stockpile
Meadow Creek	Permanent	Meadow Creek	Downstream from TSF development
		East Fork SFSR	Upstream from confluence with Meadow Creek
		East Fork SFSR	Downstream from confluence with Meadow Creek
East Fork SFSR Box Culvert Replacement	Temporary	East Fork SFSR	East Fork SFSR downstream from isolation work area
			East Fork SFSR upstream from isolation work area
Meadow Creek (restoration)	Temporary	Meadow Creek	Upstream from isolation work area
Meadow Creek (enhancement)	Temporary	Meadow Creek	Upstream from isolation work area

Source: Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b
Key: East Fork SFSR = East Fork South Fork Salmon River; TSF = tailings storage facility; YPP = Yellow Pine pit

Yellow Pine Pit Lake

Salvage and relocation of fish from the YPP lake (19,267 square meters) would require a larger and longer effort than fish salvage in dewatered stream reaches. However, impacts to fish species present and incidental mortality are expected to be similar. A fish barrier would be installed and designed to allow fish to leave the YPP lake but not allow fish to migrate upstream. The purpose of the barrier would be to ensure that the fewest number of individual ESA-listed fish species are present in the YPP lake when the draining process begins. The upstream fish barrier would be in place in advance of the completion of the

East Fork SFSR fish tunnel and diversion of the East Fork SFSR into the tunnel to minimize fish abundance in the lake prior to dewatering (Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b). In other respects, dewatering and fish salvage in the YPP lake would be similar to other areas of the SGP with prior agency consultation, less than 10 percent mortality, and following USFWS Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards (USFWS 2012). Dewatering and associated fish salvage in the YPP lake would have a moderate, localized, long-term impact on all fish species within the analysis area.

Noise and Vibration

Access Roads, Utilities, and Offsite Facilities

Blasting would occur during construction of portions of the Burntlog Route and the new transmission line. Blasting can cause serious injury or mortality to fish; however, these activities would follow applicable regulations and standards (described in more detail below). Therefore, negligible, temporary, and localized effects to fish or fish habitat are expected from blasting along portions of the Burntlog Route.

Operations

Explosives would be used to fracture rock from mine operations. Explosives detonated near water produce shock waves that may be lethal or damaging to fish, fish eggs, or other aquatic organisms. Outside of the zone of lethal or harmful shock waves, the vibrations caused by drilling and blasting have the potential to disturb fish causing stress or altering behavior. Most of the blasting required at the mine site would be in and near the Yellow Pine, Hangar Flats, and West End pits, with some that may be required for construction of stream diversions at the TSF, YPP, and TSF Buttress. Such blasting would generally occur on hillsides and at higher elevations, with considerable distance between streams and the origin of the blasts.

Blasting and drilling activities near fish-bearing streams have the potential to affect fish by producing hydrostatic pressure waves, and create underwater noise and vibration, thereby temporarily altering in-stream conditions. Effects on fish from changes in hydrostatic pressure are not related to the distance of the fish from the point of impact, but to the level and duration of the sound exposure (Hastings and Popper 2005).

In order to avoid injury, instantaneous sound levels should be less than 206 peak decibels (dB) and extended time should be less than 187 dB (183 dB for fish less than 2 grams) sound exposure level, referenced at 1 micropascal for sound traveling through water, measured at a distance of 10 meters (Fisheries Hydroacoustic Working Group 2008).

In addition to sound effects, excessive ground vibrations have the potential to affect fish, particularly the sensitive egg life stage (Timothy 2013, Kolden and Aimone-Martin 2013). Smirnov (1954, as cited in Alaska Department of Fish and Game 1991) found significant egg mortality caused by ground vibrations with a peak particle velocity (PPV) of 2 inches per second (ips). Jensen and Collins (2003) found that a PPV of 5.8 ips resulted in 10 percent mortality of Chinook salmon embryos. Faulkner et al. (2008) found that PPVs up to 9.7 ips resulted in significantly higher mortality in O. mykiss eggs but there was no increase in mortality when exposed to PPVs of 5.2 or less. The Alaska Department of Fish and Game have PPV restrictions of 2.0 ips to protect salmonids (Timothy 2013). The reported PPV value for an *in-situ* soil sampling rig at a distance of 100 feet is 0.011 ips (ATS Consulting 2013).

Safe setback distances for blasting in or near water for the protection of fish have been established (Dunlap 2009; Kolden and Aimone-Martin 2013; Timothy 2013; Wright and Hopsky 1998). Perpetua (2021a) has committed to comply with blasting standards set forth in Wright and Hopky (1998), and

Timothy (2013). These standards have been shown to minimize the risk of injury or mortality to all life stages of fish.

As part of the SGP Environmental Monitoring and Management Plan, an Explosives and Blasting Management Plan would be developed that would ensure compliance with the blasting requirements of the Mine Safety and Health Administration, 30 Code of Federal Regulations 56, Subpart E – Explosives and 30 Code of Federal Regulations 57, Subpart E – Explosives. The blasting plan would include the setback distances and other BMPs.

A spreadsheet tool was developed to compute the required setback distances from fish-bearing streams and lakes (Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b). The results indicate that a 425-foot blasting setback from the closest point in the blast field to stream and lake habitats should be protective in most cases, assuming a 40-foot bench height. These findings were used to examine likely areas where blasting would be near streams or lakes. For a 20-foot bench height, the examination indicated that a 239-foot blasting setback could be met everywhere within the mine plan. Considering a 40-foot bench, blasts may encroach on the 425-foot blasting setback in limited areas adjacent to the YPP lake near the East Fork SFSR fish tunnel and adjacent to the Hangar Flats pit where Meadow Creek is closest to the pit. In those areas where blasting is nearer to streams and lakes and impacts may occur, it is possible that the bench heights could be adjusted to 20 feet, reducing the required setback.

In addition to protective setbacks and bench height, Perpetua may employ other methods when warranted, such as using controlled blasting techniques following industry BMPs, modifying blasting variables including charge size, and vibration and overpressure monitoring.

Because all blasting would be conducted in compliance with applicable regulations and standards (Brown and Caldwell, McMillen Jacobs, and BioAnalysts 2021b), the noise and vibration effects of the SGP to fish are expected to be negligible, long-term, and localized.

Spill Risk

There is the potential for spills to occur along access roads as fuel and other materials are trucked to and from the SGP during construction of the access roads and mine facilities. If a spill were to occur at a stream crossing or near a stream, surface water could be impacted. Although not all waterbodies crossed via culvert are fish-bearing, spills into any waterway could travel downstream to fish-bearing waters.

Overall, design features required by the Forest Service (**Table 2-2**), design features proposed by Perpetua (**Table 2-3**), and permit stipulations and regulatory requirements from state and federal agencies would reduce the risk of spills and ensure that effective response is provided should a spill occur.

Mine transport begins on Warm Lake Road (CR 10-579) where the risk of spills would be lower, as it is paved and maintained by Valley County and has overall gentler grades. At the intersection of Warm Lake Road and Johnson Creek Road (CR 10-413) the two mine access routes begin, with the Johnson Creek Route north along Johnson Creek Road (CR 10-413) and the Burntlog Route east onto Burnt Log Road (Forest Road 447). The location of the spill risk would change as the SGP progresses under the 2021 MMP. Johnson Creek and the portion of the East Fork SFSR between the village of Yellow Pine and the Operations Area Boundary would be at risk of any significant spills of hazardous materials during the first one to two years of the SGP when the Johnson Creek Route would be used as the access route during the Burntlog Route construction. For the remainder of the mine life, the waterbodies along the Burntlog Route would be at risk from any significant spills.

The combination of the proposed monitoring, planning, and control practices described in the preceding narrative for transport and handling of fuels and hazardous materials and committed design measures would minimize the risk of accidental releases during the transportation, storage, management, and use of hazardous materials. Nevertheless, the proximity of the access roads to surface water resources increases the potential for a release to enter water which could result in major consequences. It is expected that the risk of a spill large enough to negatively affect fish or aquatic habitat would be low, but the risk occurs throughout the period of the operations. The effects of the SGP on fish and aquatic habitat from contaminants from a spill are expected to be minor, long-term, and localized.

Altered Physical Stream Structure

The SGP would result in stream channel changes, including dewatering, restoration, and enhancements within the active mine area (**Figure 7-1)**. Physical alterations to stream structure from the SGP that would result in impacts to fish generally fall into three phased categories:

- Construction: Dewatering of some stream channels and other aquatic habits and facility construction prior to the active mining period. Fish salvage and other measures would minimize impacts
- Active Mining Period: Maximum dewatering and reduction of stream habitat would occur during this period. Operation of the East Fork SFSR fishway would occur during this period to allow fish to bypass active mining areas and minimize impacts. Reclamation and restoration of some stream habitats would occur during this period
- Reclamation and Restoration: Excavated areas would be filled and reclaimed. Stream channel would be restored and fish barriers eliminated resulting in a net increase in accessible stream habitat relative to baseline conditions.

Construction and operation under the 2021 MMP would eliminate the existing YPP lake, and important bull trout rearing/feeding habitat, and stream reaches currently occupied by Chinook salmon, steelhead, bull trout, and westslope cutthroat trout. The YPP lake would be replaced with a lake feature called Stibnite Lake which would be designed to serve similar functions to the existing YPP lake including lentic fish rearing/feeding habitat and temperature buffering (Rio ASE 2021). Relative to baseline conditions, construction during the active life of the mine would result in a maximum of 4 percent loss of stream channel habitat above the Sugar Creek confluence occurring by Mine Year 12 based on total estimated stream length (Rio ASE 2021). Reclamation and restoration starting in the active mining period and continuing post-closure would result in a 4 percent increase in total channel habitat length relative to baseline conditions. Specific stream channel restoration plans are discussed in the Stibnite Gold Stream Design Report (Rio ASE 2021). **Table 7-4** presents the annual timeline of major changes to physical stream habitats including elimination and restoration.

Table 7-4 Annual Timeline of Major Changes to Physical Stream Habitats

Period and Mine Years	Activity
Pre-Production/Construction (-3 to -1)	
-3 to -1	Existing Garnet Creek diversion extended around plant site; restored downstream from plant site
	Begin construction of East Fork SFSR fish tunnel around Yellow Pine pit (up to approximately 2 years to build)
	Divert Meadow Creek and tributaries around TSF and TSF buttress area including low-flow pipes to moderate temperature
-1	Fiddle Creek piped beneath growth media stockpile
	Midnight Creek diverted into East Fork SFSR upstream from the tunnel, and Hennessy Creek diverted into Fiddle Creek

Period and Mine Years	Activity
-1 continued	East Fork SFSR tunnel and associated fishway completed; East Fork SFSR diverted into tunnel and Yellow Pine pit lake dewatering begins
	Upper Midnight Creek placed in pipe under the West End haul road
	West End Creek diverted around West End pit
	Enhancement in East Fork SFSR (excluding Yellow Pine pit) and the lower portion of Meadow Creek
	Sediment control and rock drain constructed on East Fork Meadow Creek
Mine Operations (1 to 15)	
1	Upper East Fork Meadow Creek meadow, groundwater table, and associated wetlands restored
3	Divert Meadow Creek into a restored channel around Hangar Flats pit footprint and downstream approximately 1000 feet
	Restore the lower section of East Fork Meadow Creek (downstream from the rock drain) to its new confluence with Meadow Creek
5	Yellow Pine pit backfill begins
6-7	Hangar Flats pit backfilled
8	Midnight pit backfilled
10	Yellow Pine pit backfill completed
	Yellow Pine pit backfill surface preparation for stream liner and placement of floodplain material and growth media
	Construct West End Lake overflow channel
11	Yellow Pine pit stream restoration including East Fork SFSR, Hennessy Creek, and Midnight Creek
	Flow restored to East Fork SFSR and Hennessy Creek over the Yellow Pine backfill
	East Fork SFSR diversion tunnel inactive with option to divert extreme high flows through tunnel to protect riparian vegetation development
	Stibnite lake fills and spills
12	Pipe removed from upper Midnight Creek haul roads and stream segment restored
13	Flow restored to lower Midnight Creek including restored stream over Yellow Pine pit backfill
	Remaining road crossings removed and remaining portions of Midnight Creek restored (upstream from Yellow Pine pit)
	Removal of diversion around West End pit
	West End Lake begins to fill; not expected to spill except possibly in extreme runoff
15	Final tailings deposited into TSF; TSF allowed to consolidate before placing stream liner and growth media
	East Fork SFSR diversion tunnel deactivated
	Plant site and ancillary facilities decommissioning/reclamation begins
Closure and Post-Closure (16 to 112)	
17	Non-perennial streams restored on TSF Buttress
	Stockpiles used up from Hangar Flats stockpile area; non-perennial streams and wetlands restored over the backfilled pit

Period and Mine Years	Activity
18	Meadow Creek Restored from toe of TSF Buttress to previously restored channel around Hangar Flats footprint
19-23	Meadow Creek surface prep for stream liner; placement of floodplain material and growth media atop TSF and TSF Buttress
	TSF contact water collection basins installed outside of Meadow Creek floodplain corridor; treated contact water discharged to non-perennial streams on TSF Buttress draining to restored wetland on backfilled Hangar Flats pit
23	Plant site decommissioning completed
	Garnet Creek and associated wetland restored through decommissioned plant site
	Meadow Creek stream restoration at TSF and TSF Buttress completed; restore perennial flow into new Meadow Creek channel and deactivate low flow pipes in Meadow Creek diversions
	Maintain former Meadow Creek diversions for non-perennial hillslope runoff to reduce volume of TSF contact water
24	Fiddle Creek restored after growth media stockpile removed
40	End water treatment
41	TSF contact water collection basins deactivated and Meadow Creek non-perennial diversions fully decommissioned, and non-perennial streams restored on TSF
41	Water treatment plant decommissioned, and water treatment plant site reclaimed

East Fork SFSR = East Fork South Fork Salmon River; TSF = tailings storage facility

The construction and operation of the East Fork SFSR fishway would allow any fish passing through the fishway to access upstream areas thereby limiting the overall fish population impact of habitat reduction in the area of the active mine for a period of approximately 12 years. The fishway would serve to reduce the overall impacts of dewatering, diversion, and stream channel elimination in the active mine. Protective measures, such as routing stream flow around construction areas or during stream restoration activities would be implemented to protect water quality.

Changes in age structure, habitat use, productivity, and species composition would occur within the analysis area during the period of active mining due to extensive physical stream structure changes (**Figure 7-1**). However, the spatial extent and magnitude of these changes would be reduced by fisheries protection measures such as the East Fork SFSR fishway. By Mine Year 11, the fishway would be replaced with an open channel through which volitional passage could occur. Incremental improvements in fish passage and habitat quality would occur through the restoration process leading to an improved permanent condition relative to baseline.

Restoration of stream and lake habitats and riparian vegetation within the active mine area after reclamation would result in a net increase in stream length and accessible fish habitat post-closure relative to baseline conditions and volitional fish access to habitats upstream from YPP lake (Rio ASE 2021). The YPP lake would be replaced with the proposed Stibnite Lake which would provide lentic rearing habitat within the mine area for bull trout and other species without impeding upstream passage. During the 12-year period in which the YPP lake is unavailable and before the Stibnite Lake is created, bull trout would not have access in the mine area to lake habitat, an important habitat for the adfluvial bull trout. This would result in a major, long-term, localize impact to bull trout.

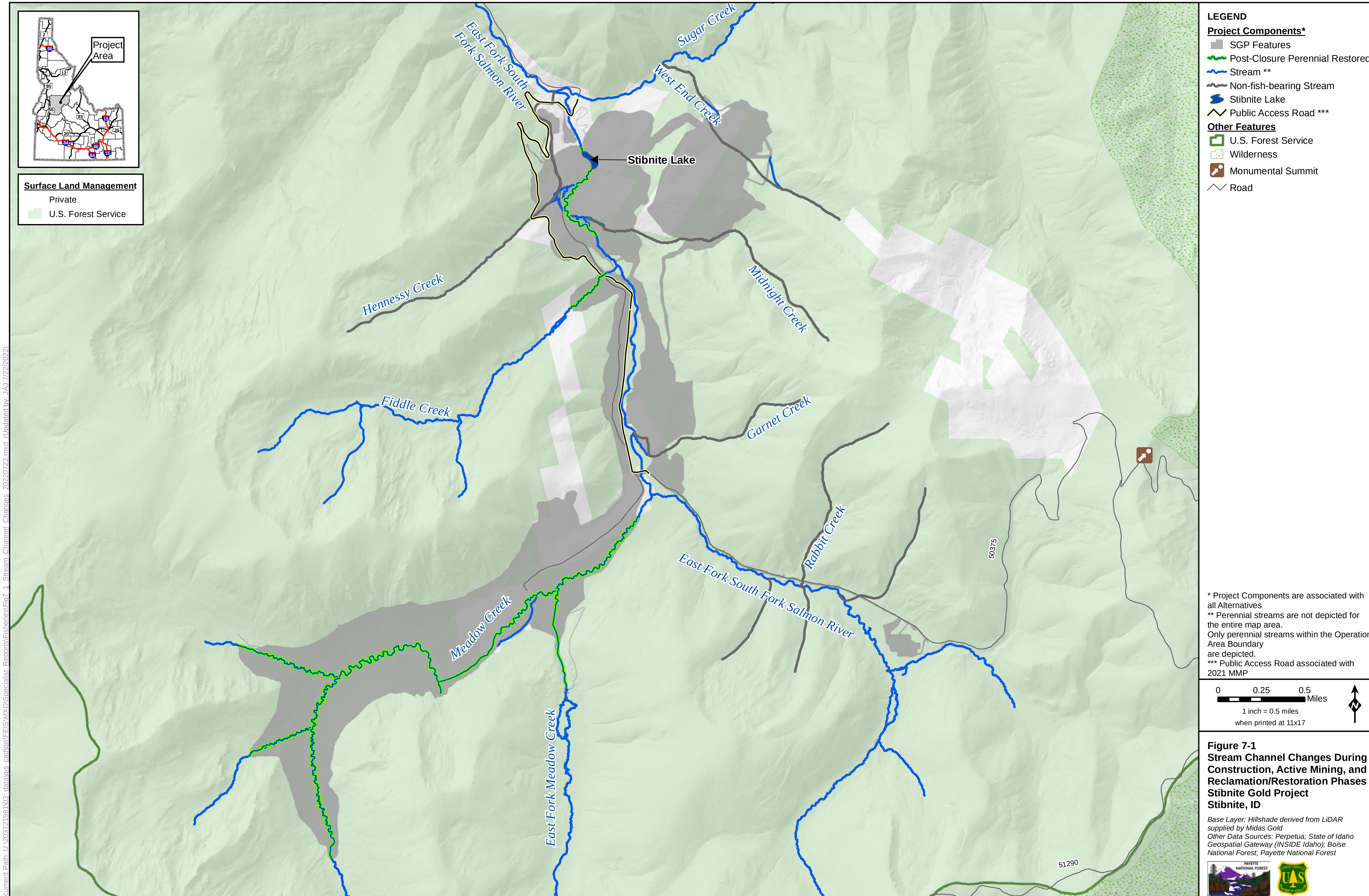


Figure 7-1
Stream Channel Changes During Construction, Active Mining, and Reclamation/Restoration Phases
Stibnite Gold Project
Stibnite, ID

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Fisheries\Fig7_1_Stream_Channel_Changes_20220722.mxd (Updated by: JAJ 7/22/2022)

Stream enhancements in the East Fork SFSR and lower Meadow Creek would include improvements to physical channel processes and habitat largely within the existing stream channel. This would be accomplished by selectively installing large woody debris and rock structures, creating pools, enabling improved sediment sorting, and generally increasing hydraulic and habitat diversity. Enhancement efforts also may include floodplain reconnection and establishment of riparian vegetation, achieved by excavation of legacy fill material down to bankfull level (Rio ASE 2021).

The Fisheries and Aquatic Resource Mitigation Plan and the Fishway Operations and Management Plan (Brown and Caldwell 2021a) describe in detail how impacts to fish populations within the SGP would be mitigated through fish salvage/rescue in dewatered channels, minimizing runoff impacts, use of fish screens to prevent entrainment, and operation of the East Fork SFSR fishway or trap and truck alternatives.

The effects of the SGP construction activities would have a major, short-term, localized impact on Chinook salmon, steelhead, bull trout, and westslope cutthroat trout. The effects of the SGP and disturbance to the streams due to mining activities would have a major, long-term, and localized, impact on Chinook salmon, steelhead, bull trout, and westslope cutthroat trout. The restoration activities, particularly providing volitional passage in the East Fork SFSR, would result in a major, permanent, regional and beneficial effect on Chinook salmon, steelhead, bull trout, and westslope cutthroat trout within the vicinity of the mine.

7.2.3.2 Impacts to Watershed Condition Indicators/Fish Habitat Elements

WCIs, described in **Section 6.1.3**, analyzed in detail at the mine site of impacts described in the following sections.

Water Temperature

Predicted future temperature increases resulting from the 2021 MMP were evaluated using a SPLNT model (Brown and Caldwell 2021a) which calculated a MWMT. **Section 6.3.1.4** provides additional detail on the methods applied, and the SGP Water Quality Specialist Report for additional information on the modeling results (see Table 7-21 in the SGP Water Quality Specialist Report, Forest Service 2022c).

The fish species of greatest management concern considered in this analysis that would be impacted by the SGP are all salmonids that are adapted to a cold-water thermal regime, requiring cooler water to complete their life cycle. When water temperatures exceed the tolerance limits for the species life stages, they may be impaired or their survivability decreases.

A summary of predicted water temperatures under the 2021 MMP are presented in **Table 7-5**. The periods evaluated include the baseline conditions, those within the mine operations (Mine Years 6, 12 and 18), one within the closure and reclamation period (Mine Year 22), and several in the post-closure period (Mine Years 27, 32, 52 and 112). The post-closure period represents how the mine site would function after the facilities and permitted discharges have been removed, dewatering and mining have been discontinued, and the channels and vegetation have been fully reclaimed.

It should be noted the SPLNT model used for the temperature predictions in **Table 7-5** do not account for changes to stream temperatures caused by changing climate conditions. This means that modeled future water temperatures (e.g., Mine Year 112) assumed that without the 2021 MMP, stream temperatures would be similar to the historic water temperature data (Brown and Caldwell 2018). In reality, water temperatures would likely be higher if climate change had been incorporated into the model. As described in **Section 6.1.3.1**, climate change would be expected to increase water temperatures from baseline estimates to the end of the mine operations by as much as 0.1°C to 2.0°C based on forecasts for 2030-2059 (Isaak et al. 2016). This range of expected temperature increase attributable to climate change is based on a forecast period approximately 75 years shorter than the model predictions through Mine Year 112. Due to the potential effects of climate change and other uncertainties in stream water temperatures over the long-term such as effects of stream restoration and riparian shading, later year model predictions have more uncertainty than earlier year model predictions. This uncertainty is discussed further in the sensitivity analysis section of Brown and Caldwell 2018 and the uncertainty analysis section of Forest Service 2022c.

In the East Fork SFSR upstream from Meadow Creek, water temperatures tend to be cooler than the downstream reaches because this consists of the headwaters. Water temperatures in this section of the East Fork SFSR under the 2021 MMP would be similar to those under baseline conditions.

Meadow Creek upstream from East Fork Meadow Creek has decreasing water temperatures during mine operations and closure/reclamation activities (Mine Year 6 through Mine Year 18 as shown in **Table 7-5**) because water being piped is not exposed to solar radiation. Once the pipeline is removed, however, water temperatures increase until around Mine Year 27, at which time the replanted riparian vegetation becomes more established and stream shade is increased and water temperatures begin to decrease. This decrease continues through at least Mine Year 112. The temperature changes within the portion of Meadow Creek adjacent to the TSF area were also examined. This portion of Meadow Creek exhibits the specific effects of existing mining disturbance on the baseline condition and then the specific effects of TSF operation followed by stream restoration across the TSF and TSF Buttress. Predicted temperatures during the early years of restored flow across the TSF and TSF Buttress are higher than average temperatures over the entirety of Meadow Creek because early revegetation efforts have not reached their riparian shading potential. However, the difference from existing conditions is smaller because the TSF area has a higher temperature under existing conditions than Meadow Creek as a whole.

East Fork Meadow Creek experiences an increase in summer and fall maximum water temperatures during mine operations and closure/reclamation activities (Mine Year 6 through Mine Year 18) and post-closure until Mine Year 52, at which point the temperatures decline compared to the baseline conditions (**Table 7-5**). Restoration activities on the East Fork Meadow Creek is slated to begin in mine year 1, with the construction of the rock drain starting in Mine Year 3. East Fork Meadow Creek flowing through the rock drain would reduce its exposure to solar radiation, thus resulting in a decrease in change in water temperatures between the meadow and the lower section of East Fork Meadow Creek during the summer and fall months. By Mine Year 112, the difference in water temperature between the meadow and the lower East Fork Meadow Creek is around 0.5°C for both the summer and fall maximums.

Water temperatures in the warmer summer and fall months in Meadow Creek downstream from East Fork Meadow Creek substantially decreases relative to the baseline conditions during mine operations and closure/reclamation activities (Mine Year 6 through Mine Year 18), though there is an increase at Mine Year 27, which then continues to decline until Mine Year 112 (**Table 7-5**). These decreases during mine operations are a result of decreased solar radiation upstream sources (upper Meadow Creek and East Fork Meadow Creek). The removal of the low-flow piping along the TSF in Mine Year 23 would result in water temperatures increasing, though not as high as baseline conditions, and subsequently decreasing as the revegetation efforts take effect. This section retains some connection to groundwater which helps maintain a lower temperature as well.

The East Fork SFSR between Meadow Creek and YPP experiences decreases in summer maximum water temperatures relative to baseline conditions. There is a slight increase in temperatures, still lower than baseline, after Mine Year 22 once the low-flow piping along the TSF is removed, and temperatures continue to decrease once the revegetation efforts take effect (**Table 7-5**). Fall maximum water temperature decrease throughout the operations, closure, and post-closure periods (**Table 7-5**).

Table 7-5 Maximum Weekly Water Temperatures during July (Summer) and September (Fall) for Modeled Mine Years for the 2021 Modified Mine Plan

Stream Drainage	Season	Baseline (°C)	Mine Year										
			6 (°C)	12 (°C)	18 (°C)	22 (°C)	27 (°C)	32 (°C)	52 (°C)	112 (°C)	Change from Baseline to 27 (°C)	Change from Baseline to 52 (°C)	Change from Baseline to 112 (°C)
East Fork SFSR Upstream from Meadow Creek	Summer	13.4	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	-0.1	-0.1	-0.1
	Fall	11.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	-0.1	-0.1	-0.1
Meadow Creek Upstream from East Fork Meadow Creek	Summer[1]	14.0	12.4	12.3	12.4	12.4	20.8	18.6	17.1	15.1	6.8	3.1	1.1
	Fall[1]	12.0	10.5	10.5	10.5	10.5	16.0	13.8	12.7	11.3	4.0	0.7	-0.7
	Summer[2]	16.8	13.5	13.0	13.1	13.1	21.7	20.2	18.5	16.0	4.9	1.7	-0.8
	Fall[2]	14.2	11.2	11.0	11.1	11.0	15.9	14.4	13.1	11.5	1.7	-1.1	-2.7
Meadow Creek Downstream from East Fork Meadow Creek	Summer	19.4	17.6	16.5	16.3	16.1	18.5	17.9	16.6	15.2	-1.4	-2.8	-4.2
	Fall	15.9	15.5	13.6	13.2	13.0	13.9	13.3	12.4	11.6	-2.0	-3.5	-4.3
East Fork Meadow Creek	Summer	14.6	15.8	15.4	15.3	15.2	14.9	14.8	14.4	14.2	0.3	-0.2	-0.4
	Fall	12.6	13.5	13.1	12.9	12.8	12.8	12.6	12.4	12.3	0.2	0.0	-0.3
East Fork SFSR between Meadow Creek and YPP	Summer	17.3	16.3	15.6	15.8	15.9	16.3	15.9	15.2	14.7	-1.0	-2.1	-2.6
	Fall	13.9	13.5	12.6	12.6	12.4	12.5	12.3	11.9	11.7	-1.4	-2.0	-2.2
East Fork SFSR between YPP and Sugar Creek	Summer	14.1	16.1	15.8	15.7	15.6	15.6	15.4	14.8	14.5	1.5	0.7	0.4
	Fall	11.2	13.0	12.4	12.0	11.8	11.8	11.6	11.3	11.1	0.6	0.1	-0.1
East Fork SFSR Downstream from Sugar Creek	Summer	14.9	16.0	15.0	15.1	15.1	15.0	14.9	14.7	14.5	0.1	-0.2	-0.4
	Fall	11.9	12.5	11.6	11.6	11.5	11.6	11.5	11.3	11.3	-0.3	-0.6	-0.6

Increased temperatures attributable to climate change are not incorporated in the reported predicted values.
Uncertainty in predicted temperature values increases over time due to assumptions made about the effects of stream restoration and riparian shading.
[1] Temperatures based on distance weighted average of all QUAL2K reaches
[2] Temperatures based on distance weighted average of the QUAL2K reaches along the TSF and TSF Buttress area
°C = degrees Celsius; East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit lake

East Fork SFSR between YPP and Sugar Creek, and similarly the East Fork SFSR roughly 1 km downstream from Sugar Creek, experiences an increase in summer and fall maximum water temperatures at Mine Year 6 because of the draining of the YPP lake followed by active mining and mine dewatering that removes cooling influences of upstream shading and groundwater discharge to surface water (**Table 7-5**). By Mine Year 112, summer maximum water temperatures in the East Fork SFSR between YPP and Sugar Creek are about 0.4°C higher than baseline conditions, but fall maximum temperatures, and summer maximum and fall maximum temperatures below Sugar Creek end up between 0.1 and 0.6°C below baseline conditions (**Table 7-5**).

The effects of the SGP on fish caused by changes to water temperature are expected to be minor to moderate, permanent, localized for the East Fork SFSR and upstream from Meadow Creek, Meadow Creek upstream from the East Fork Meadow Creek, East Fork Meadow Creek, and East Fork SFSR downstream from YPP, but major, permanent localized, and beneficial for Meadow Creek downstream from the East Fork Meadow Creek, and for the East Fork SFSR between Meadow Creek and YPP.

Sediment and Turbidity

Fish population abundance, distribution, and survival have been linked to levels of turbidity and silt deposition. Excess sediment can degrade spawning gravels, reduce embryo survival and emergence, impair growth and survival of juvenile salmonids, fill pool habitat, and reduce the productivity of aquatic macroinvertebrates and other prey items for fish (Bjornn et al. 1977; Suttle et al. 2004). Prolonged exposure to high levels of suspended sediment would create a loss of visual capability in fish in aquatic habitats within the analysis area, leading to reduced feeding and growth rates; a thickening of the gills, potentially causing the loss of respiratory function; clogging and abrasion of gills; and increases in stress levels, reducing the tolerance of fish to disease and toxicants (Waters 1995, Newcombe and Jensen 1996; Wilber and Clark 2001). It can also cause the movement and redistribution of fish populations.

<u>Outside the Mine Site Area</u>

Construction and use of roads can accelerate erosion and sediment delivery to streams and have been identified as the primary contributor of sediments to stream channels in managed watersheds (Trombulak and Frissell 2000). During the Burntlog Route construction, including bridge and culvert installations, the potential exists for increased runoff, erosion, and sedimentation resulting from localized vegetation removal and soil excavation which could result in increased sediment load in streams. Construction of and upgrades to access roads creates a potential for increased runoff, erosion, and sedimentation as a result of localized vegetation removal and excavation of soil, rock, and sediment, which could result in increased sediment load in streams. Expected permit stipulations from IDWR and IDEQ would ensure streambank vegetation would be protected except where its removal is necessary. New cut or fill slopes not protected with some form of stabilization measures would be seeded and planted with native vegetation to prevent erosion. Use of temporary erosion and sediment control BMPs also would be employed.

During the construction phase, the SGP would be accessed by routes that would cross 43 of the 71 streams listed in Table 7-19 of the SGP Water Quality Specialist Report (Forest Service 2022c). In addition to these stream crossings, approximately 6.5 miles (18 percent of its 36-mile length) of the Johnson Creek Route is located in close proximity to streams (i.e., within 100 feet). The number of vehicle trips per day also is used in this analysis as a metric for potential increases in erosion and sedimentation. A total of 65 vehicle trips per day would occur during the construction phase (Table 7-2 in the SGP Access and Transportation Specialist Report, Forest Service 2022e). During the mining and ore processing operations phase (approximately 15 years), a total of 50 vehicle trips per day are anticipated on average per day (year-round) during operations utilizing the Burntlog Route. During the closure and reclamation phase, traffic along the Burntlog Route would be reduced to a total of 27 vehicle trips per day (year-round).

For stream crossings, Perpetua would replace existing, or install new, culverts or bridges at crossings along the Johnson Creek (CR 10-579), McCall-Stibnite (CR 50-412), and Burnt Log (Forest Road 447) roads. Existing bridges and culverts along Warm Lake Road would remain. If not properly designed, constructed, and maintained, culverts and bridges could constrict natural stream flow leading to an increase in water velocity at the downstream end of the structure. This could lead to stream bank and/or streambed erosion, and/or excessive erosion at the structure. Erosion of the streambed and/or banks could result in downstream sedimentation, a change in the morphology of the stream, and/or a change to the aquatic habitat. If a structure does not allow for adequate flow, water could pool excessively on the upstream side. As such, stream crossings associated with access roads would be designed to minimize potential impacts on surface water hydrology, water quality, and fish passage. The Forest Service would require stream crossings to be designed to accommodate a 100-year flood recurrence interval, unless site-specific analysis using calculated risk tools, or another method determines a more appropriate recurrence interval.

During the Burntlog Route construction including bridge and culvert installations, the potential exists for increased runoff, erosion, and sedimentation as a result of localized vegetation removal and excavation of soil, rock, and sediment, which could result in increased sediment load in streams. Expected permit stipulations from the IDWR and IDEQ would ensure that streambank vegetation would be protected except where its removal is absolutely necessary; that new cut or fill slopes not protected with some form of riprap would be seeded and planted with native vegetation to prevent erosion; use of temporary erosion and sediment control BMPs associated with a stormwater pollution prevention plan; and that all activities would be conducted in accordance with Idaho environmental anti-degradation policies, including IDEQ water quality regulations and applicable federal regulations.

For the Burntlog Route, the potential for sedimentation would be minimized using standard erosion control measures, such as silt fencing, ditch checks, and other measures, which would be installed and maintained to minimize the potential for erosion and sedimentation. Numerous small (15- to 60-inch) drainage culverts would be installed along the Burntlog Route to reduce rutting and shunt water out of ditches and off the road prism, which would serve to reduce erosion from the road into streams. Perpetua would maintain a hardened road surface with gravel surfacing to promote an efficient and useable all-weather road while minimizing erosion (Perpetua 2021b).

Additionally, Perpetua would be required to comply with specific design requirements as part of the IDWR Stream Channel Alteration Permit, such as line of approach, minimum bridge clearance and minimum culvert size per length, and anchoring on steep slopes. Bridges and culverts would be maintained to allow proper drainage and limit sediment delivery to area streams.

Based on permit-related design requirements, use of BMPs, and required maintenance activities, the potential for access road-related erosion and sedimentation would be minimal (limited to periods of substantial overland flow, such as from very large rainfall events).

Utilities associated with the SGP (existing transmission line upgrades and structure work, right-of-way (ROW) clearing, new transmission line, and transmission line access roads) would cross 37 different streams, as identified in Table 7-20 in the SGP Water Quality Specialist Report (Forest Service 2022c). Of the 37 streams that would be crossed, 26 would be related to the upgrade of existing Idaho Power Company transmission lines, where the existing transmission line ROW crosses various streams. During transmission line upgrades and new transmission line construction, the potential exists for increased runoff, erosion, and sedimentation as a result of vegetation removal within the ROW, and the localized excavation of soil, rock, and sediment for structure work and/or ROW access roads. Expected permit stipulations from IDWR and IDEQ would be similar to the examples provided above for access roads and would ensure the use of erosion and sediment control BMPs associated with a stormwater pollution prevention plan. ROW vegetation clearing would retain vegetation root structure within soils thus reducing erosion concerns.

Surface water quality also could be impacted during construction by fugitive dust from vehicles and heavy equipment that settles into adjacent water bodies. Reduction of these potential impacts would be achieved through fugitive dust control at the SGP. In dry months, Perpetua would spray water on mine haul roads as necessary to mitigate dust emissions in compliance with state and Forest Service requirements.

The extent of sedimentation effects from fugitive dust would be concentrated at the SGP; however, due to the nature of sediment transport by streams, the geographic extent of the impact could extend farther downstream in the East Fork SFSR depending on site- and event-specific factors. The duration for traffic-related dust and erosion/sedimentation would last throughout the mine construction, operations, and post-closure periods; however, the potential for these effects would be incrementally reduced during closure and reclamation due to reduced activity at the SGP and stabilization of disturbed areas. Therefore, the effects of fugitive dust on fish would be minor, long-term and localized.

The effects of the SGP construction of temporary roads and transmission lines on sedimentation on fish and aquatic habitat are expected to be moderate, short-term, and localized.

<u>Within the Mine Site Area</u>

Construction and active mining would disturb, excavate, and move soil and overburden thereby raising the potential for sediment runoff and suspended sediment increases in surface waters. Total suspended solids (TSS) in surface water are generally correlated with turbidity (Nephelometric Turbidity unit (NTU)), which is a more visually apparent estimator of sediment contamination. Under baseline conditions, turbidity is generally low (less than 5 NTU) with occasional spikes of up to 70 NTU during snowmelt or rainfall events (Forest Service 2022c). The greatest potential for Project-related increases in stream sedimentation would come during storm events causing overland flow across exposed soil, excavated areas, and roads. BMPs would be employed for near-stream or instream work such as removal of legacy materials and stream restoration to minimize the potential for coarser sediment generation or mass wasting that would effect sediment transport and deposition. Under baseline conditions, sediment entering the East Fork SFSR primarily comes from Sugar Creek, Meadow Creek, and East Fork Meadow Creek. Applicable sediment control design techniques BMPs would be used to minimize sediment runoff and erosion along roads and excavated areas. On the mine site and along the Burntlog route, expected permit conditions from IDWR and IDEQ would protect streambank vegetation, require culvert maintenance, and require low impact snow removal techniques.

Surface water quality also could be impacted during operations, closure, and reclamation by fugitive dust from vehicles and heavy equipment that settles into adjacent water bodies, as described above, outside the mine site area.

Potential Project-related sediment impacts on fish would include temporary turbidity increases during runoff events and localized deposition of fine sediment in stream channels. Turbidity increases during runoff events have the potential to temporarily change fish behavior but are unlikely to be severe enough, relative to baseline fluctuations, to cause fish mortality or health impacts. Increases in fine sediment deposition within stream channels have the potential to decrease spawning gravel suitability and decrease benthic invertebrate production within gravel riffles. These impacts would impact spawning/incubation and rearing/feeding life stages, respectively, of Chinook salmon, steelhead, bull trout, and westslope cutthroat trout. With the application of sediment reduction BMP's and surface runoff minimizing design techniques, the impacts of sediment in surface water to fish are predicted to be measurable but not severe, limited to the mine area, and occur during the active mining period. However, the restoration efforts in the

East Fork Meadow Creek would result in a substantial decrease in sediment input into Meadow Creek and the East Fork SFSR.

The effects of the SGP on sediment and turbidity on Chinook salmon, steelhead, bull trout, and westslope cutthroat trout would be moderate, permanent, and localized.

Physical Barriers

Physical barriers can affect fish population dynamics by reducing or blocking access to fish habitat. These barriers can be natural (gradient, woody debris, etc.) or human-made (culverts, altered creek channels due to human activities). These barriers, both outside and within the mine site area, are discussed below.

<u>Outside the Mine Site Area</u>

During the construction of the Burntlog Route or of temporary roads, culverts would be constructed or replaced, which may affect fish access in different sections of streams. Surveys were conducted to identify fish bearing streams along the Burntlog Route (Rio ASE 2021). Any new or reconstructed crossing is required to be fish passable, which would increase or re-establish fish access where it had been reduced or blocked unless there is a risk of passing non-native fish species. The potential re-establishment of access upstream from these culverts could affect the composition of the aquatic community. Changes in types of fish present and the abundance of fish could increase the risk of injury and mortality for some species. For instance, additional habitat could benefit some species, while the presence of additional fish in previously inaccessible reaches would introduce competition for resources. These changes may affect the distribution and relative abundance of fish populations in affected streams.

Furthermore, establishing or increasing access could allow non-native species to access upstream habitat that is currently blocked, such as brook trout. Brook trout are known to compete with bull trout for resources and habitat (USFWS 2008). Brook trout also are known to hybridize with bull trout, which has the potential to negatively impact the genetic integrity, and/or result in negative changes to the local population of bull trout (USFWS 2008). According to the Forest Plan standard, no barrier will be removed if increasing access between non-native species to sensitive native species would occur. Additionally, brook trout presence is minimal in the Burntlog Route (MWH 2017, Stantec 2018 and 2019).

The effects of the SGP on fish access during construction of temporary roads and the culverts are expected to be minor, short-term, and localized.

<u>Within the Mine Site Area</u>

Fish passage barriers can negatively impact fish population dynamics by reducing, or completely blocking, available habitat during certain life stages. Existing fish passage barriers within the mine site were identified as either complete - no species can move upstream or downstream at any time of year; or partial - the barrier may not exist at high flows but at certain flows (i.e., low flows) some fish may not be able to pass. Passage barriers are further categorized by natural - not caused by human action, such as a rock dam, log jam, and steep slopes; or artificial - caused by human action, such as culverts, stream alteration, and surface water diversions (BioAnalysts 2019).

Existing and predicted fish passage barriers, as well as the removal of barriers resulting from SGP activities under the 2021 MMP are shown in **Figure 7-2**. **Table 7-6** presents a summary of the fish barriers conditions, as well as the length of stream channel changes post-closure, which includes both the new access as well as blocked access to stream channels into existing stream reaches in construction diversion and stream enhancements.

Species-specific impacts to fish habitat resulting from passage barriers were assessed for Chinook salmon and steelhead through the evaluation of the extent of both Critical Habitat and IP (**Sections 7.2.3.4** and **7.2.3.5**). Impacts to fish habitat from passage barriers for bull trout and westslope cutthroat trout were assessed by quantifying the extent of Critical Habitat (bull trout) and occupancy probability (for both) (**Sections 7.2.3.6** and **7.2.3.7**). Additional information is provided in ESS 2019b.

The greatest benefit to Chinook salmon and steelhead passage comes in Mine Year -1 with the construction of the fishway, which would allow these species to volitionally access habitat that they have not naturally accessed for decades. The fishway may be a partial barrier by discouraging migration of some fish, but the extent of this is unknown. By Mine Year 11, the East Fork SFSR, where the Yellow Pine Pit is located, would have been restored, providing natural conditions for volitional passage. Additionally, the box culvert, 2.88 km upstream from the YPP cascade barrier would be modified to provide full passage. This substantially increases the amount of habitat volitionally available to Chinook salmon and steelhead that are not currently accessible (**Table 7-6**).

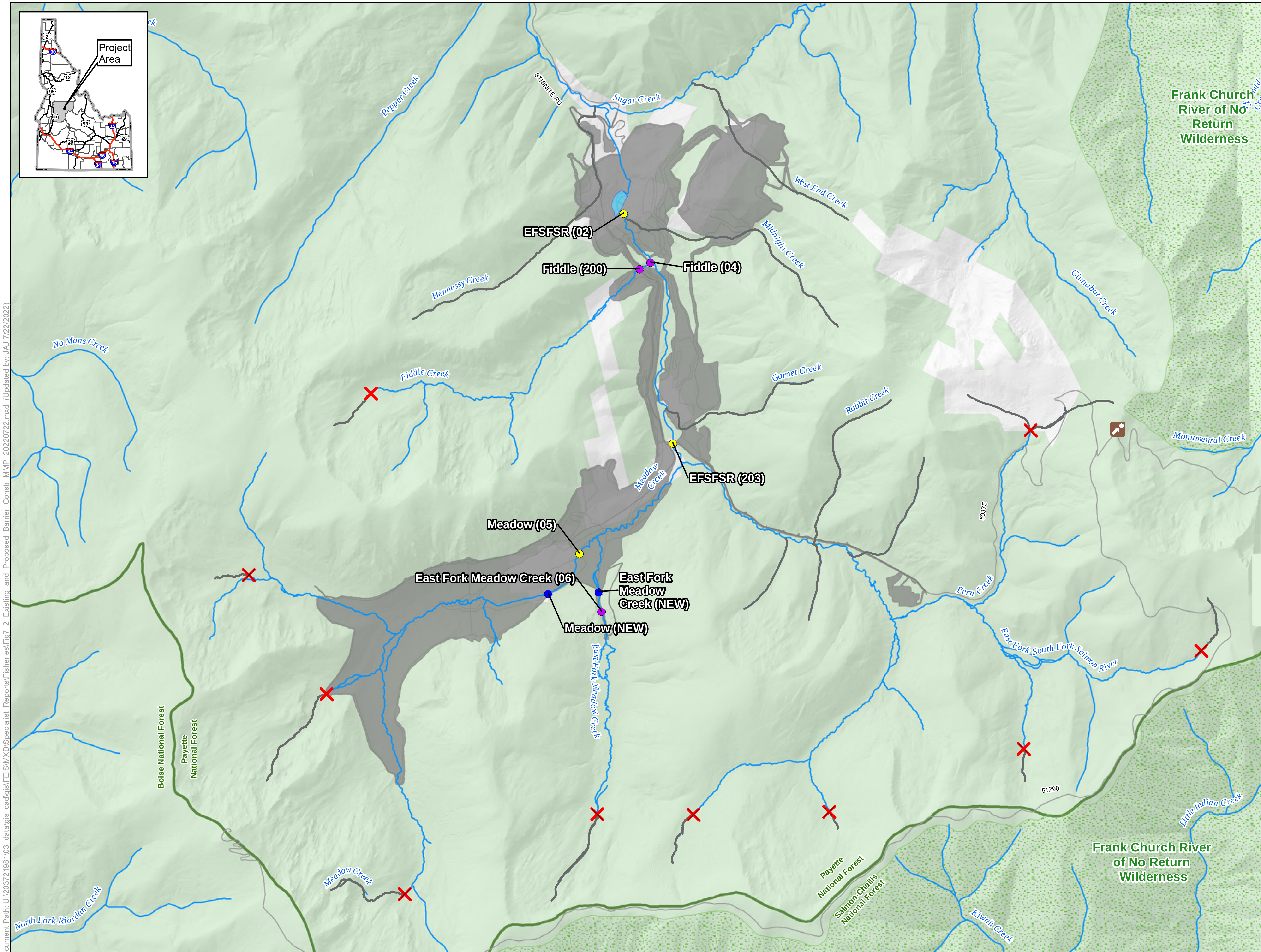
Based on the current known extent of bull trout occupancy, bull trout may be extirpated from the reaches upstream from the TSF when the reaches within the footprint would be dewatered and flow would be diverted into the diversions that route water around the facilities. With the gradient barrier that would be created along the TSF, there would be no mechanism by which bull trout would be able to volitionally (i.e., naturally) recolonize the reaches upstream from or on top of the TSF. Based on the current known extent westslope cutthroat trout occupancy, fish in the upper headwaters of Meadow Creek would remain isolated.

The effects of the SGP on fish access for Chinook salmon and steelhead, to upstream habitat are expected to be major, permanent, and localized benefits, but for bull trout and westslope cutthroat trout the effects are expected to be major, permanent, and localized impacts.

Table 7-6 Length of Habitat Gained or Lost under Post-Closure Conditions Relative to Baseline Conditions for Existing and Expected Future Fish Passage Barriers Constructed or Removed in Mine Site Area Streams

Stream/ Location	Mine Year Added/Removed	Length of Chinook Salmon Habitat (km)		Length of Steelhead Habitat (km)		Length of Bull Trout and Cutthroat Trout Habitat (km)	
		Change Attributed to Barrier [1,2]	Change in Total Available[1,2,3]	Change Attributed to Barrier[2]	Change in Total Available[2]	Change Attributed to Barrier[1,4]	Change in Total Available[1,4]
Existing Barriers							
East Fork SFSR above YPP (02) Artificial – Gradient	Removed: -1 (Fish Tunnel); 11 (Channel reconstruction)	+19.65[1] +8.87[2]	+1.44[1] +0.27[2]	+8.72[2]	+1.77[2]	+19.54[1] +32.82	+1.31[1] +1.96[4]
East Fork SFSR (203) Artificial – Box Culvert	Removed -1	+16.87[1] +6.29[2]	+1.44[1] +0.27[2]	+6.90[2]	+1.77[2]	+16.66[1] 26.43	+1.31[1] +1.96[4]
Fiddle Creek (04) Artificial – Gradient	Removed -4	NP	NP	NP	NP	NP[1] -0.72[4]	NP[1] +1.96[4]
Fiddle Creek (200) Artificial – Culvert	Removed -4	NP	NP	NP	NP	NP[1] 0.71[4]	NP[1]
Meadow Creek (05) Artificial – Gradient	Removed 3	NP	NP	NP	NP	NP	NP
East Fork Meadow Creek (06) Natural – Gradient	Removed -1	NP	NP	NP	NP	NP	NP
Created Barriers							
Meadow Creek Diversion Artificial – Gradient	New -2	NP	NP	NP	NP	NP	NP
Meadow Creek TSF Artificial – Gradient	New 18	0.58 -1.02[2]	+1.44[1] +0.27[2]	-0.14	+1.77	-0.61[1] +0.28[4]	+1.31[1] +1.96[4]
East Fork Meadow Creek Artificial – Rock Drain/Gradient	New -1	NP	NP	NP	NP	NP[1]	NP[1]
East Fork Meadow Creek Artificial – Gradient	New Mine Year 22	NP	NP	NP	NP	NP[1] -0.63[4]	NP[1] +1.96[4]

[1] Results based on potential Critical Habitat
[2] Results based on usable Intrinsic Potential habitat, but not always accessible
[3] Not all of the total habitat is accessible habitat under baseline conditions
[4] Results based on usable occupancy potential, but not always accessible
East Fork SFSR = East Fork South Fork Salmon River; km = kilometer; NP = not present, YPP = Yellow Pine pit



LEGEND

- Upstream Extent of Fish Presence
- Existing Barrier No Change
- Existing Barrier With Change
- New Barrier

Project Components*

- SGP Features

Other Features

- U.S. Forest Service
- Wilderness
- Monumental Summit
- County
- Road
- Non-fish-bearing Stream
- Stream/River
- Lake/Reservoir

*Project Components are associated with 2021 MMP

Note:
East Fork Meadow Creek is also known as Blowout Creek
The McCall – Stibnite Road (CR 50-412) consists of Lick Creek Road, East Fork South Fork Salmon River Road (East Fork Road) and Stibnite Road.

0 0.3 0.6 Miles
1 inch = 0.6 miles
when printed at 11x17

N

Figure 7-2
Existing and Proposed Barrier Construction or Removals for the Modified Mine Plan
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Midas Gold
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

Chemical Contaminants

<u>Outside the Mine Site Area</u>

There is the potential for spills to occur along access roads as fuel and other materials are trucked to and from the SGP. If a spill were to occur at a stream crossing or near a stream, surface water could be impacted. Discussion of very low probability scenarios for a large release (tanker truck or concentrate truck rollover), and more probable scenarios involving small releases, is provided in Forest Service 2022c. Overall, environmental design features required by the Forest Service (**Table 2-2**), design features proposed by Perpetua (**Table 2-3**), and permit stipulations and regulatory requirements from state and federal agencies (including use of U.S. Department of Transportation [USDOT]-certified containers and USDOT-registered transporters) would reduce the risk of spills and ensure that effective response is provided should a spill occur.

The most probable release scenario associated with truck transport on the access routes to the SGP would be relatively small amounts of fuel spilled from vehicles themselves and attributed to mechanical failure or human error. Under this scenario, immediate cleanup actions would include deployment of containment and spill recovery materials, and removal of impacted soil. Fuel spilled to soils/roadbed could be readily contained and recovered, while fuel which enters waterways via roadside drainages may be difficult or impossible to fully recover and there would be potential for migration beyond the immediate spill area. Spill response materials on the vehicles and pre-positioned along the access routes and in SGP response vehicle would include materials to contain and recover floating oil. Response actions would include notification to the appropriate regulatory agencies.

Small volume release scenarios would be temporary due to prompt response and cleanup actions; however, higher volume/lower probability spill scenarios could result in longer-term remedial actions and impacts. The risk of spills would last throughout the life of the SGP (long term). Effects would generally be local and in close proximity to the release source in most scenarios; however, if surface or groundwater were to be impacted with fuels or other hazardous materials, the potential for migration beyond the local area could occur.

A low probability release of liquid petroleum or hazardous material from a bulk truckload could potentially occur assuming the puncture of the bulk tanker in the accident. Under this scenario, spilled material would be released to the immediate roadbed area, and potentially impact physical resources and ecological receptors (e.g., vegetation or wildlife) and nearby surface water depending on the topography and location. Spill response and recovery measures such as containment, deployment of absorbent materials, removal of impacted roadbed material and vegetation, and deployment of water-based spill recovery materials and equipment (as needed) would help to limit impacts.

A release of large quantities of solid hazardous materials such as cyanide or antimony concentrate would also be unlikely. Breaches of the shipping containers for these materials in the case of an accident could release the solid materials to the ground where it would reside until response actions are taken to mechanically clean it up, along with any contaminated soil. Migration of these solid materials from the immediate release site would be less likely than for liquid materials but could be possible in wet weather conditions. Again, spill response and recovery measures would help to limit impacts.

The pilot vehicles that would accompany all transports of fuel or hazardous materials between the SGLF and the Operations Area Boundary would carry spill response tools and materials, communications equipment, and drivers trained in spill responses. Thus, response to a small to moderate spill of fuel or hazardous material during transit over the SGP access roads would essentially be immediate.

Spill containment and countermeasures equipment and materials would be pre-positioned at the SGP mine site, Burntlog Maintenance Facility, and SGLF. In the event of a major spill requiring assistance from any of these locations, the radio communications between the pilot vehicles and these facilities would enable a timely response which would take an estimated 45 minutes to mobilize and arrive at the spill site.

Close proximity of access roads to surface water resources increases the potential for spilled material on the roadways to enter water, thus increasing the potential consequences of a spill. The Burntlog Route crosses 37 streams and includes 9 miles of road that are within 0.5 mile of surface water resources. The Johnson Creek Route crosses 43 different streams and includes 27 miles of road that are within 0.5 mile of surface water resources, including several miles that parallel the fish-bearing East Fork SFSR and Johnson Creek waterways. Though the Burntlog Route includes a greater number of stream crossings, the Johnson Creek Route includes significantly greater proximity to water resources. The potential consequences from trucking spills would thus be greater along the Johnson Creek Route that would be utilized during construction of the Burntlog Route.

Of all the substances to be transported, fuel may pose the highest risk to fish and fish habitat with delivery of 5.8 million gallons of diesel and 0.5 million gallons of gasoline expected annually via tanker truck. This is because large quantities of diesel fuel are transported in each load, numerous trips are made each year, and the substance is a liquid that rapidly flows down gradient toward nearby streams. Most of the streams with segments in proximity to access roads support Chinook salmon, steelhead trout, bull trout, and cutthroat trout. The intensity of the impact of a hazardous materials spill on fish and fish habitat could be high; as a large diesel spill could kill 100 percent of the Chinook salmon juveniles, adults, alevins, and eggs for a considerable distance (several miles) downstream from the accident (NMFS 1995). In terms of toxicity to water-column organisms, diesel is one of the most acutely toxic oil types. Fish, invertebrates, and aquatic vegetation that come in direct contact with a diesel spill may be killed (EPA 2019). The severity of the impact would depend on the timing, size, and location of the spill. Small spills in deep open waters are expected to rapidly dilute; however, fish kills have been reported for small spills in confined, shallow water (EPA 2019).

As an example, schools of adult Chinook salmon (20 to 100 individuals) have been seen in the East Fork SFSR and Johnson Creek. Thus, a large spill could potentially kill a substantial number of adult salmon depending on various factors (NMFS 1995). A spill in the fall could kill all the 1-year old juveniles and zero age eggs/alevins, thus eliminating 2 years of Chinook salmon progeny. Diesel from a spill could mix with spawning gravels and sand and be retained in the stream substrate for a year or more, and thereby negatively affect salmon eggs, alevins, and juveniles for several years (Korn and Rice 1981; Moles et al. 1981).

It is expected the risk associated with a spill large enough to negatively affect fish or aquatic habitat would generally be low but possible. This varies depending on the substance that is spilled but considers typical substances that would be transported. An exception may be when materials are transported during inclement weather conditions, this could increase the risk to moderate. Spills during the winter would be easier to contain because spilled material would not penetrate frozen ground as readily as unfrozen ground, and snow could absorb the spilled material, in addition the visual contrast between snow and fuel could aid in cleanup. However, areas that are harder to access (e.g., remote or in a canyon) may increase the time it takes to access and cleanup a spill, creating the potential for fish or fish habitat to be in contact with a hazardous material longer and could impact more fish or fish habitat.

While the likelihood of a spill is negligible to moderate, the magnitude of impacts could be major to individuals exposed to harmful concentrations of hazardous materials making impacts of spills moderate, temporary and localized depending on the type of material releases, the location of the spill, and the presence of fish and aquatic species in the affected area.

Within the Mine Site Area

The West End pit lake, unlike other active mine and facility areas, would not be reclaimed or restored and would therefore have impacts on fish in perpetuity. Based on the pit lake geochemical model (Forest Service 2022c), predicted West End pit lake water chemistry exhibits circumneutral pH conditions with TDS concentrations below 130 mg/L. Antimony, arsenic, and mercury concentrations that exceed the strictest potentially applied water quality standards throughout the operating and closure period. Predicted concentrations of copper and lead are predicted to exceed the strictest potentially applied water quality standards during pit dewatering operations, when produced water is routed for consumptive use and water treatment but decrease below those levels during as the lake fills. Concentrations of arsenic, mercury, and antimony are predicted to slightly exceed the strictest potentially applied water quality standards permanently post-closure. The West End pit lake would be fishless given the absence of fish in West End Creek. Therefore, impacts to fish from contaminants in the West End pit lake would be limited to contaminants entering Sugar Creek via outlet spillage or seepage after the closure and reclamation of the mine. The volume of water entering Sugar Creek would be small relative to the flow of the creek and any contaminants from the West End pit lake would be further diluted at the confluence with the East Fork SFSR. Effects of the SGP to fish, including Chinook salmon, steelhead, bull trout, and west slope cutthroat trout, as well as other native fish species in Sugar Creek, from the West End pit lake contaminants would be minor, permanent, and localized.

Wastewater treatment plant effluent would be discharged to the East Fork SFSR at a location near the worker housing facility. Treatment residuals would be dewatered and transported to a permitted, off-site landfill for disposal. The sanitary wastewater treatment and discharge would occur at a single location during the active life of the mine and therefore impacts to fish would be minor, long-term, and localized.

Fuel storage and handling would be conducted in accordance with a Spill Prevention, Control, and Countermeasure Plan that would utilize surface storage tanks with primary and secondary containment. There would not be any uncontained or underground infrastructure associated with fuel storage. Therefore, releases from fuel storage would not be expected to contact the environment or affect fish and aquatic species, so effects would be none to negligible, long-term, and localized.

Long-term impacts from contaminants would include those during the active mine life and reclamation periods during which contact water would be treated to minimize multiple contaminants. Chemical contaminant loads were modeled under baseline, active mining, and post-reclamation conditions at multiple sites within the SGP area (**Table 7-7**) (Forest Service 2022c). Impact magnitudes for contaminants are measured relative to IDEQ criteria for protection of aquatic life.

Copper and Aluminum
Exceedances of criteria for copper and aluminum occur under baseline conditions at some sites near the TSF but not downstream below Sugar Creek under baseline conditions. No exceedances are expected to during active mining and post-closure (**Table 7-7**). The impacts of copper and aluminum are expected to be minimal relative to baseline conditions. Therefore, the effects of the SGP on fish are expected to be minor, long-term, and localized.

Arsenic and Antimony
Surface water concentrations of arsenic and antimony downstream from the mine site area would be reduced during the active mining period relative to baseline conditions due to water treatment (Forest Service 2022c). Permanent impacts to contaminant concentrations in downstream surface waters would extend post-closure. Model results (Forest Service 2022c) indicate antimony concentrations in the East Fork SFSR downstream from Sugar Creek would be reduced permanently post-closure but arsenic concentrations would return to at or near baseline levels over time. The effects the SGP on fish related to arsenic and antimony would be minor, long-term, localized, and beneficial.

Table 7-7 Exceedance of Analysis Criteria, Operations and Post Closure for Assessment Nodes

Constituent of Concern		Aluminum[1]	Copper[2]	Antimony[3]	Arsenic[4]	Mercury[5]
Analysis Criteria		**0.36 mg/L**	**0.0024 mg/L**	**0.0056 mg/L**	**0.010 mg/L**	**2 ng/L (total mercury)**
Nodes	**Stream**	**Exceedance During Operations (Highest Concentration)[6]**				
YP-T-27	Meadow Creek	None	None	Seasonal peaks lower than baseline seasonal peaks (0.007 mg/L versus 0.018 mg/L).	Seasonal peaks lower than baseline seasonal peaks (0.023 mg/L versus 0.083 mg/L).	Seasonal peaks above baseline seasonal peaks (5 ng/L versus 2 ng/L).
YP-T-22	Meadow Creek	None	None	Seasonal peaks lower than baseline seasonal peaks (0.014 mg/L versus 0.025 mg/L).	Seasonal peaks lower than baseline seasonal peaks (0.018 mg/L versus 0.075 mg/L).	Seasonal peaks above baseline seasonal peaks (5 ng/L versus 2 ng/L).
YP-SR-10	East Fork SFSR	None	None	Seasonal peaks lower than baseline seasonal peaks (0.018 mg/L versus 0.030 mg/L).	Seasonal peaks lower than baseline seasonal peaks (0.023 mg/L versus 0.051 mg/L).	Seasonal peaks higher than baseline seasonal peaks (4 ng/L versus 3 ng/L).
YP-SR-8	East Fork SFSR	None	None	Concentrations below baseline conditions (0.004 to 0.021 mg/L versus 0.006 to 0.031 mg/L) throughout mining.	Concentrations below baseline conditions (0.012 to 0.032 mg/L versus 0.018 to 0.052 mg/L) throughout mining.	Seasonal peaks higher than baseline seasonal peaks (4 ng/L versus 3 ng/L).
YP-SR-6	East Fork SFSR	None	None	Concentrations below baseline conditions (0.005 to 0.027 mg/L versus 0.006 to 0.030 mg/L) throughout mining.	Concentrations at or below baseline conditions (0.013 to 0.041 mg/L versus 0.017 to 0.041 mg/L) throughout mining.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L).
YP-SR-4	East Fork SFSR	None	None	Concentrations primarily below baseline conditions (0.005 to 0.063 mg/L versus 0.008 to 0.056 mg/L) throughout mining. Concentrations above baseline occur in Mine Year -2 at the transition from baseline to construction.	Concentrations below baseline conditions (0.013 to 0.097 mg/L versus 0.019 to 0.120 mg/L) throughout mining.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L).

Constituent of Concern		Aluminum[1]	Copper[2]	Antimony[3]	Arsenic[4]	Mercury[5]
Analysis Criteria		**0.36 mg/L**	**0.0024 mg/L**	**0.0056 mg/L**	**0.010 mg/L**	**2 ng/L (total mercury)**
YP-SR-2	East Fork SFSR	None	None	Concentrations primarily below baseline conditions (0.004 to 0.041 mg/L versus 0.005 to 0.037 mg/L) throughout mining. Concentrations above baseline occur in Mine Year -2 at the transition from baseline to construction.	Concentrations below baseline conditions (0.010 to 0.066 mg/L versus 0.014 to 0.076 mg/L) throughout mining.	Concentrations at or slightly above baseline conditions (4 to 10 ng/L versus 3 to 10 ng/L) throughout mining.
YP-T-6	West End Creek	None	None	None	None	Concentrations above baseline conditions 37 to 63 ng/L versus 4 to 6 ng/L) throughout mining.
YP-T-1	Sugar Creek	None	None	None	Concentrations at or slightly below baseline conditions (0.007 to 0.015 mg/L versus 0.007 to 0.016 mg/L) throughout mining.	Concentrations at or slightly above baseline conditions (6 to 9 ng/L versus 6 to 8 ng/L) throughout mining.
Node	**Stream**	**Exceedances Post-Closure (highest Concentration)[6]**				
YP-T-27	Meadow Creek	None	None	Seasonal peaks lower than baseline seasonal peaks (0.008 mg/L versus 0.018 mg/L) until Mine Year 20.	Seasonal peaks lower than baseline seasonal peaks (0.017 mg/L versus 0.083 mg/L) until Mine Year 20.	Seasonal peaks at baseline seasonal peaks (2 ng/L versus 2 ng/L) throughout post-closure period.
YP-T-22	Meadow Creek	None	None	Seasonal peaks lower than baseline seasonal peaks (0.006 mg/L versus 0.025 mg/L) until Mine Year 20.	Seasonal peaks lower than baseline seasonal peaks (0.013 mg/L versus 0.075 mg/L) until Mine Year 20.	Seasonal peaks at baseline seasonal peaks (2 ng/L versus 2 ng/L) throughout post-closure period.
YP-SR-10	East Fork SFSR	None	None	None	Seasonal peaks lower than baseline seasonal peaks (0.013 mg/L versus 0.075 mg/L) until Mine Year 20.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L) throughout post-closure period.

Constituent of Concern		Aluminum[1]	Copper[2]	Antimony[3]	Arsenic[4]	Mercury[5]
Analysis Criteria		**0.36 mg/L**	**0.0024 mg/L**	**0.0056 mg/L**	**0.010 mg/L**	**2 ng/L (total mercury)**
YP-SR-8	East Fork SFSR	None	None	Seasonal peaks lower than baseline seasonal peaks (0.011 mg/L versus 0.031 mg/L) throughout post-closure-period.	Concentrations below baseline conditions (0.012 to 0.025 mg/L versus 0.018 to 0.052 mg/L) throughout post-closure period.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L) throughout post-closure period.
YP-SR-6	East Fork SFSR	None	None	Concentrations below baseline conditions (0.005 to 0.020 mg/L versus 0.006 to 0.030 mg/L) throughout post-closure period.	Concentrations below baseline conditions (0.012 to 0.029 mg/L versus 0.017 to 0.041 mg/L) throughout post-closure period.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L) throughout post-closure period.
YP-SR-4	East Fork SFSR	None	None	Concentrations below baseline conditions (0.005 to 0.023 mg/L versus 0.008 to 0.056 mg/L) throughout post-closure period.	Concentrations below baseline conditions (0.013 to 0.063 mg/L versus 0.019 to 0.120 mg/L) throughout post-closure period.	Seasonal peaks at baseline seasonal peaks (3 ng/L versus 3 ng/L) throughout post-closure period.
YP-SR-2	East Fork SFSR	None	None	Concentrations below baseline conditions (0.003 to 0.016 mg/L versus 0.005 to 0.037 mg/L) throughout post-closure period.	Concentrations below baseline conditions (0.010 to 0.047 mg/L versus 0.014 to 0.076 mg/L) throughout post-closure period.	Concentrations at or slightly below baseline conditions (3 to 9 ng/L versus 3 to 10 ng/L) throughout post-closure period.
YP-T-6	West End Creek	None	None	Concentrations slightly above baseline conditions (0.008 to 0.014 mg/L versus 0.008 to 0.012 mg/L) throughout post-closure period.	Concentrations slightly above baseline conditions (0.064 to 0.094 mg/L versus 0.064 to 0.088 mg/L) throughout post-closure period.	Concentrations above baseline conditions (4 to 10 ng/L versus 4 to 6 ng/L) throughout post-closure period.

Constituent of Concern		Aluminum[1]	Copper[2]	Antimony[3]	Arsenic[4]	Mercury[5]
Analysis Criteria		**0.36 mg/L**	**0.0024 mg/L**	**0.0056 mg/L**	**0.010 mg/L**	**2 ng/L (total mercury)**
YP-T-1	Sugar Creek	None	None	None	Concentrations at or slightly above baseline conditions (0.007 to 0.017 mg/L versus 0.007 to 0.016 mg/L) throughout post-closure period.	Concentrations at baseline conditions (6 to 8 ng/L versus 6 to 8 ng/L) throughout post-closure period.

Source: SRK 2018, Brown and Caldwell 2020b

[1] Aluminum: Lowest predicted for the SGP area based on Recommended Aquatic Life Criteria (EPA 2018); The same water quality data as in the Biotic Ligand Model were used (Brown and Caldwell 2020b)

[2] Copper analysis criteria was derived using the Biotic Ligand Model per guidance contained in IDEQ (2017). A conservative chronic copper analysis criteria was estimated by applying the lowest of the 10th percentile chronic criteria based on regional classifications for the Salmon River Basin, Idaho Batholith, and third order streams. Per the SGP Water Quality Management Plan (Brown and Caldwell 2020b), preliminary calculations using the Biotic Ligand Model and site-specific data have produced similar values to the standard derived using these regional classifications.

[3] Antimony does not have a specified NMFS or USFWS standard and is based on EPA's human health chronic criterion for consumption of water and organisms is 0.0056 mg/L.

[4] Arsenic: NMFS (2014) and USFWS (2015) both determined jeopardy for the chronic criterion proposed by EPA for Idaho Water Quality Standards (0.150 mg/L). NMFS (2014) directed EPA to promulgate or approve new aquatic life criterion. In the interim, NMFS directed EPA to ensure the 0.010 mg/L human health criterion applied in all National Pollutant Discharge Elimination System permits. USFWS (2015) directed EPA to ensure that the 10 µg/L recreational use standard is applied in all Water Quality Based Effluent Limitations (WQBELs) and Reasonable Potential to Exceed Calculations using the human health criteria and the current methodology for developing WQBELs to protect human health.

[5] Mercury: NMFS (2014) and USFWS (2015) both determined jeopardy for the chronic criterion proposed by EPA for Idaho Water Quality Standards (0.000012 mg/L total mercury). NMFS (2014) directed EPA to promulgate or approve a new criterion. In the interim, implement the fish tissue criterion that IDEQ adopted in 2005. Where fish tissue is not readily available, then NMFS specified application of a 0.000002 mg/L criteria (as total mercury) in the interim. USFWS (2015) directed EPA to use the 2001 EPA/2005 Idaho human health fish tissue criterion of 0.3 milligram per kilogram wet weight for WQBELs and reasonable potential to exceed criterion calculations using the current methodology for developing WQBELs to protect human health.

[6] Predicted future concentrations are reported on a monthly basis. Concentrations in some locations vary naturally on a seasonal basis and, therefore, exceed baseline in certain months (usually Spring) and are lower than baseline in other months. Exceedances reported in this table are only those interpreted to be a result of mining activity, and not due to natural seasonal variability.

East Fork SFSR = East Fork SFSR; mg/L = milligrams per liter; ng/L = nanograms per liter

Mercury

Mercury concentrations in the East Fork SFSR downstream from Sugar Creek would be predicted to increase during active mining due to expanded excavation. Concentrations would then be predicted to decrease post-closure but remain slightly elevated relative to baseline conditions (Forest Service 2022c). Baseline, predicted active mine, and predicted post-closure mercury concentrations in the East Fork SFSR downstream from Sugar Creek would not exceed the aquatic life criterion. However, uncertainty remains whether incremental change in mercury concentrations beyond baseline would increase bioaccumulation of methylmercury in fish tissue at concentrations exceeding the tissue-based criterion. Methylation and bioaccumulation of mercury generally increases downstream in most watersheds. Through bioaccumulation and biomagnification, methylmercury reaches the highest concentrations in the tissues of longer lived, larger, or more piscivorous fish species. Therefore, the magnitude of potential permanent impacts to downstream fish from incremental changes in long-term or permanent mercury transport downstream from the mine area is unknown. Long-term, regional influences on downstream mercury methylation are not quantified.

Stream Flow

Changes in stream flow directly affects fish habitat. Changes to stream flow were evaluated using simulated monthly discharges for the August to March low-flow period for Mine Years -2 through post-closure. The SGP Water Quantity Specialist Report (Forest Service 2022d) provides additional descriptions of how much streamflow changes as a function of mine operations, including locations without gaging data (i.e., downstream from Sugar Creek). **Table 7-8** shows predicted (simulated) monthly stream flows during the August to March low flow period at five USGS gaging stations and one location in lower Meadow Creek in mine site streams (**Figure 6-10**) and predicted change from average baseline low flow period stream flows. **Figure 7-3** shows the percent change in simulated stream flows graphically.

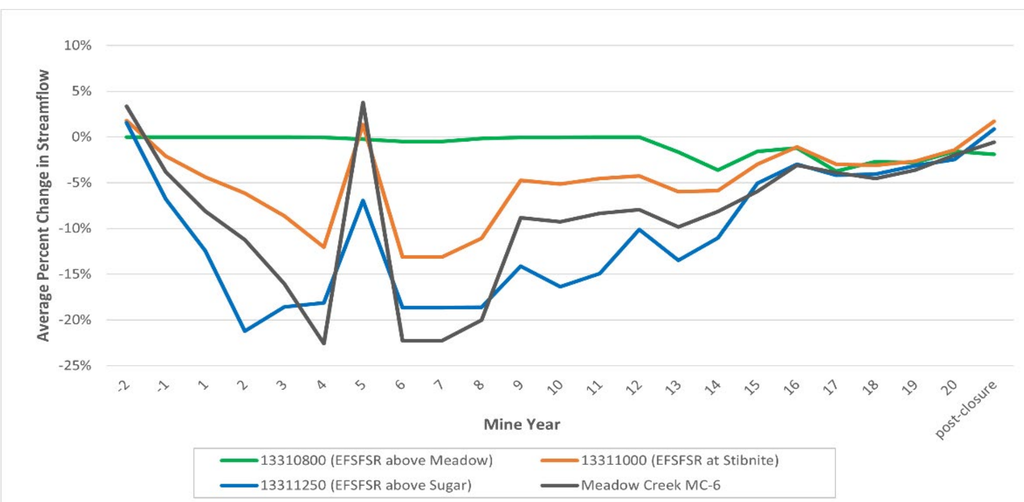


Figure 7-3 Average Percent Change in Stream Flow During the Low Flow Period (August to March)

The greatest predicted changes to stream flow under the 2021 MMP would be in the East Fork SFSR and in Meadow Creek in the vicinity of the TSF. While most of the streams would return to at or near baseline flows post-closure (post-closure flows represent an average of the predicted flows from Mine Years 21 through 112), Meadow Creek flows downstream from the TSF would be reduced by a maximum of 36.4 percent during mine operations. Flow increases in Mine Year 5 at some nodes are due to dewatering and subsequent filling of the Hangar Flats pit and dewatering of the YPP.

The effects of the SGP on changes in stream flow would be major, long-term (occurring during operations) and localized at the Meadow Creek, East Fork SFSR at Stibnite, and East Fork SFSR upstream from Sugar Creek sites, but minor, long-term (occurring during operations) and localized at the East Fork SFSR upstream from Meadow Creek. Permanent effects from changes in streamflow, that occur during the post-closure are negligible across all of the mine sites. The effects of reduced stream flow on habitat and productivity are described in the sections below.

Table 7-8 Percent Change in Streamflow from Baseline Streamflow for the Low-Flow Period over the Active Mine Years and Post-Closure Period

USGS Gage	13311250	1331100	13310800	MC-6
Mine Year	**East Fork SFSR Upstream from Sugar (%)**	**East Fork SFSR at Stibnite (%)**	**East Fork SFSR Upstream from Meadow Creek (%)**	**Meadow Creek (%)**
-2	1.5	1.8	0.0	3.4
-1	-6.8	-2.1	0.0	-3.8
1	-12.4	-4.4	0.0	-8.1
2	-21.2	-6.2	0.0	-11.2
3	-18.6	-8.6	0.0	-16.0
4	-18.1	-12.0	0.0	-22.6
5	-6.9	1.4	-0.2	3.7
6	-18.7	-13.1	-0.5	-22.3
7	-24.8	-20.4	-0.5	-36.4
8	-18.6	-11.1	-0.2	-20.0
9	-14.1	-4.8	0.0	-8.8
10	-16.4	-5.1	0.0	-9.3
11	-14.9	-4.5	0.0	-8.4
12	-10.1	-4.2	0.0	-7.9
13	-13.5	-6.0	-1.7	-9.8
14	-11.0	-5.9	-3.6	-8.2
15	-5.1	-3.0	-1.6	-5.9
16	-3.0	-1.1	-1.2	-3.1
17	-4.2	-3.0	-3.8	-3.9
18	-4.1	-3.1	-2.7	-4.5
19	-3.1	-2.6	-2.8	-3.6
20	-2.4	-1.4	-1.6	-2.0
Post-Closure	0.9	1.7	-1.9	-0.6

The Low-Flow Period for Post-closure is defined as average of Mine Years 21 through 112. Numbers represent percent change in stream flow; negative numbers indicate a reduction in stream flow while positive numbers indicate an increase in stream flow. Sugar Creek is summarized by itself because data were available for Sugar Creek. There is a relationship between percent change in flow and the amount of available habitat per species and life stage. MC-6 is located in the lower reaches of Meadow Creek

% = percent; East Fork SFSR = East Fork South Fork Salmon River

7.2.3.3 Summary of Effects to Watershed Condition Indicators

The WCIs evaluate stream function by measuring elements that reflect water quality, habitat access, channel conditions and dynamics, flow and hydrology, and watershed conditions. As discussed in **Section 6.1.3**, not all WCI indicators summarized for baseline conditions are of equal value in determining the potential impacts of the SGP within the analysis area. The impact analyses addressed the WCIs which are summarized in **Table 7-9**.

Table 7-9 Summary of Changes to Key Watershed Condition Indicators at the Mine Site

WCI	Stream Segment	Baseline	Change From Baseline		
			Construction (Mine Year -1 to 1)	Operation/ Closure (Mine Year 1 to 20)	Post-Closure (Mine Year 20+)
Water Temperature	East Fork SFSR Between Sugar Creek and YPP	FR	FR (*)	FR (*)	FR (+)
	East Fork SFSR Between YPP and Meadow Creek	FR	FR (*)	FR (*)	FR (+)
	Meadow Creek and East Fork Meadow Creek	FR	FR (+)	FR (+)	FR (+)
	East Fork SFSR Upstream from Meadow Creek	FR	FR(*)	FR(*)	FR(*)
Sediment and Turbidity	East Fork SFSR Between Sugar Creek and YPP	FUR	FUR (*)	FR (*)	FR (+)
	East Fork SFSR Between YPP and Meadow Creek	FUR	FUR (*)	FR (*)	FR (+)
	Meadow Creek and East Fork Meadow Creek	FUR	FUR (*)	FR (+)	FR (+)
	East Fork SFSR Upstream from Meadow Creek	FUR	FUR (*)	FUR (*)	FUR (*)
Physical Barriers	East Fork SFSR Between Sugar Creek and YPP	FUR	FA (+)	FA (+)	FA (+)
	East Fork SFSR Between YPP and Meadow Creek	FUR	FA (+)	FA (+)	FA (+)
	Meadow Creek and East Fork Meadow Creek	FUR	FUR (-)	FUR (-)	FUR (-)
	East Fork SFSR Upstream from Meadow Creek	FUR	FA (+)	FA (+)	FA (+)
Change in Peak/Base Flows	East Fork SFSR Between Sugar Creek and YPP	FA	FA (*)	FR (-) to Mine Year 6; FA (*) after Mine Year 6	FA (*)
	East Fork SFSR Between YPP and Meadow Creek	FA	FA (*)	FR (-) to Mine Year 6; FA (*) after Mine Year 6	FA (*)
	Meadow Creek and East Fork Meadow Creek	FA	FA (-)	FR (-) to Mine Year 6; FA (*) after	FA (*)

WCI	Stream Segment	Baseline	Change From Baseline		
			Construction (Mine Year -1 to 1)	Operation/ Closure (Mine Year 1 to 20)	Post-Closure (Mine Year 20+)
	East Fork SFSR Upstream from Meadow Creek	FA	FA (*)	FA (*)	FA (*)
Chemical Contaminants	East Fork SFSR Between Sugar Creek and YPP	FUR	FUR (*)	FR (+)	FR (+)
	East Fork SFSR Between YPP and Meadow Creek	FUR	FUR (*)	FR (+)	FR (+)
	Meadow Creek and East Fork Meadow Creek	FUR	FUR (*)	FR (+)	FR (+)
	East Fork SFSR Upstream from Meadow Creek	FA	FA (*)	FA (*)	FA (*)

Changes from baseline: (+) = increase from baseline functional index; (-) = decrease from baseline functional index; (*) = negligible or no change from baseline functional index

East Fork SFSR = East Fork South Fork Salmon River; FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; WCI = Watershed Condition Indicator; YPP = Yellow Pine pit

7.2.3.4 Impacts to Chinook Salmon

Chinook salmon would be affected by the 2021 MMP through changes in water temperature and flow, which affects other factors such as productivity, IP, and Critical Habitat. The effects to Chinook salmon are described below.

Water Temperature

As described in **Section 6.3.1.4**, water temperature is an important factor affecting the survival of each Chinook salmon life stage. The accepted stream temperature thresholds/ranges for life stages were compiled from regulatory standards and other relevant literature (ESS 2019a). ESS (2019a) presents quantification of baseline habitat availability (in relation to stream temperature) for Chinook salmon and analyzes the likely effects of changes to stream temperatures on available habitat as a result of implementation of the SGP. The following is a summary of the analysis and potential impacts from water temperature changes in streams at the mine site.

The highest modeled temperatures (i.e., maximum weekly summer temperatures) from SPLNT modeling (Brown and Caldwell 2019a) for a stream reach were compared to accepted stream temperature thresholds/ranges to determine the baseline length of available habitat. Predicted stream temperatures from SPLNT modeling were used to forecast the potential changes to the amount of available habitat for each life stage for multiple mine years. Note that the SPLNT model did not consider the effects of climate change; modeled temperature results would likely be higher if climate change had been a factor in the model.

Table 7-10 presents the length of usable IP habitat that fall within the temperature threshold categories for Chinook salmon adult migration and early life stages, and length of Critical Habitat for juvenile rearing. Length of habitat for Chinook salmon adult migration and juvenile rearing are based the amount of habitat with suitable thermal conditions using the summer maximum temperatures, which applied a maximum weekly ‘constant’ temperature for July (ESS 2019a). Spawning and incubation/emergence apply the fall maximum temperature, which applied a maximum weekly ‘constant’ temperature for September (ESS 2019a) while spawning and incubation/emergence apply the fall maximum temperature.

Detailed data for Chinook salmon under the 2021 MMP are presented in the update of ESS 2019a.

As shown in **Table 7-10**, the adult migration and spawning life stages experience a reduction in habitat that meets the thermal requirements for Chinook salmon. These reductions are either due to water temperatures that are too high or too low for the specific life stage, or due to limited access to suitable habitat (e.g., Meadow Creek). Juvenile rearing experience an increase in thermally-suitable habitat. Relative to baseline conditions:

- There would be a decrease in habitat conditions for migrating adults upstream from the YPP lake cascade barrier that meet the temperature criteria because water temperatures are lower than the thermal requirements. These habitats are not volitionally available to Chinook salmon under baseline conditions. The impacts shown are based on water temperatures that are mostly lower than the thermal criteria. While the temperatures are typically lower than the thermal criteria, migration would not be impaired.

- There would be a net decrease in thermally suitable spawning habitat both upstream and downstream from YPP lake cascade barrier during operations and post-closure due to a slightly warmer MWMT.

- There would be a net increase in thermally suitable habitat conditions for incubation and emergence during operations through post-closure both upstream and downstream from the YPP lake cascade barrier.

- There would be a net increase in thermally suitable juvenile rearing habitat during operations through post-closure.

It is important to note that the stream lengths identified in **Table 7-10** assume Chinook salmon already occur upstream from the YPP lake; however, unless they are released by IDFG, Chinook salmon do not naturally occur. Therefore, while there is a decrease in thermally suitable habitat, they currently only occur in approximately 2 km of modeled habitat downstream from YPP.

Creeks in the mine site area do experience significant seasonal and diurnal variations, and for mobile life stages (i.e., adults and juveniles), if MWMT are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges. Through stream restoration and enhancement actions, stream cover and instream structures may provide thermal refugia.

Based on modeled results, the effects of the SGP on Chinook salmon caused by changes to temperature-based suitable habitat are expected to be minor, permanent, and localized; however, given Chinook salmon would be able to volitionally access habitat upstream from YPP, the effects of the SGP on Chinook salmon are expected to be minor, permanent, and localized but beneficial.

Table 7-10 Length of Stream Habitat that Meets the Optimal Thermal Requirements for Chinook Salmon Under the 2021 Modified Mine Plan

Life Stage	Baseline (km)	Mine Year								Change from Baseline to 112 (km)
		6 (km)	12 (km)	18 (km)	22 (km)	27 (km)	32 (km)	52 (km)	112 (km)	
Below Yellow Pine Pit Cascade Barrier										
Adult Migration[1]	0	0	0	0	0	0	0	0	0	0
Adult Migration[2]	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Spawning[3]	0	0	0	0	0	0	0	0	0	0
Spawning[4]	2.01	1.48	1.66	0.73	0.73	1.66	1.66	1.66	1.66	-0.35
Incubation/Emergence	0	0	0	0	0	0	0	0.73	0.73	+0.73
Juvenile Rearing[5]	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Total Available Habitat	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Above Yellow Pine Pit Cascade Barrier										
Adult Migration[1]	2.43	0	0.25	0.69	0.25	2.93	2.68	1.07	0	-2.43
Adult Migration[2]	7.48	3.35	4.25	5.78	5.50	5.78	6.57	6.57	6.57	-0.91
Spawning[3]	1.51	0.28	0	0	0	0	0	0	0	-1.51
Spawning[4]	10.92	6.85	8.02	9.91	9.91	10.07	10.07	10.07	10.07	-0.85
Incubation/ Emergence	3.44	3.50	7.46	7.39	8.02	7.39	7.39	7.39	7.39	+3.95
Juvenile Rearing[5]	17.51	10.94	13.43	13.35	13.35	18.97	18.97	18.97	18.97	+1.46-
Total Available Habitat	10.92[6] 17.51[5]	6.85[6] 10.94[5]	8.02[6] 13.43[5]	9.91[6] 13.35[5]	9.91[6] 13.35[5]	10.07[6] 18.97[5]	10.07[6] 18.97[5]	10.07[6] 18.97[5]	10.07[6] 18.97[5]	-0.85[6] +1.46[5]

1 Results based in USEPA criteria for optimal swimming performance – 15-19°C
2 Results based on USEPA criteria for minimizing disease risk – 12-13°C and elevated disease risk 14-17°C
3 Results based on IDAPA criteria of 13°C maximum temperature for spawning
4 Results based on USEPA criteria of 4-14°C temperature for spawning
5 Results based on modeled Critical Habitat
6 Results based on usable Intrinsic Potential habitat
km = kilometer

Flow-Productivity

A flow-productivity model was developed to examine the effects of predicted flow changes associated with the 2021 MMP on Chinook salmon productivity (see **Section 6.3.1.1** for additional detail on the model). Annual flow productivity was determined as the long-term percent change from the existing or baseline conditions for each mine year. To analyze the altered stream flow across the mine area, flow-productivity outputs were used from three of the USGS stream flow gages (East Fork SFSR above Sugar, East Fork SFSR at Stibnite, East Fork SFSR above Meadow) and lower Meadow Creek (MC-6).

Table 7-11 and **Figure 7-4** show the average Chinook salmon flow-productivities for each stream flow site over pertinent periods throughout mine operations and post-closure. The greatest, reduction in flow-productivity averaged over the long-term period (Mine Years -2 to 20) are in the East Fork SFSR upstream from Sugar Creek (-10.5 percent) and in Meadow Creek (-8.9 percent). Most of the Chinook salmon productivity on the East Fork SFSR upstream from Sugar Creek is greatly impacted by mine operations that alter stream flow over the life of the mine. Similarly, most of the productivity in Meadow Creek is greatly impacted by changes in stream flow caused by mine operations in Meadow Creek. The East Fork SFSR above Meadow Creek is less impacted by changes in stream flow over the long-term. Similarly, most of the Chinook salmon productivity throughout the mine area is minimally affected by altered stream flow post-closure.

Table 7-11 Percent Change in Chinook Salmon Productivity Relative to Baseline Productivity by Mine Year and Location

Period	Mine Year	East Fork SFSR above Meadow Creek (USGS Gage 13310800)	East Fork SFSR at Stibnite (USGS Gage 13311000)	East Fork SFSR above Sugar Creek (USGS Gage 13311250)	Meadow Creek (MC-6)
Baseline Productivity		1.06	1.06	1.06	1.06
Mine Years -2 to 20 Percent Change from Baseline	-2	0%	2.0%	1.8%	3.9%
	-1	0%	-3.3%	-6.4%	-5.9%
	1	0%	-6.0%	-15.9%	-10.8%
	2	0%	-6.0%	-16.9%	-10.5%
	3	0%	-10.8%	-18.4%	-18.6%
	4	-0.1%	-7.2%	-13.7%	-12.2%
	5	-0.4%	-2.4%	-9.3%	-1.7%
	6	-0.6%	-15.7%	-19.5%	-23.4%
	7	-0.4%	-17.7%	-21.4%	-28.6%
	8	-0.1%	-7.4%	-15.1%	-12.7%
	9	0%	-4.5%	-13.1%	-8.0%
	10	0%	-4.9%	-15.1%	-8.6%
	11	0%	-4.9%	-14.5%	-8.6%
	12	-0.6%	-5.4%	-10.0%	-9.4%
	13	-2.5%	-6.2%	-12.7%	-9.4%
	14	-3.8%	-6.5%	-11.4%	-9.0%
	15	-0.2%	-1.8%	-3.5%	-4.7%
	16	-2.2%	-3.5%	-3.5%	-4.2%

Period	Mine Year	East Fork SFSR above Meadow Creek (USGS Gage 13310800)	East Fork SFSR at Stibnite (USGS Gage 13311000)	East Fork SFSR above Sugar Creek (USGS Gage 13311250)	Meadow Creek (MC-6)
	17	-3.9%	-4.4%	-4.4%	-5.3%
	18	-1.9%	-3.5%	-3.5%	-4.5%
	19	-3.2%	-3.1%	-3.1%	-3.4%
	20	-1.0%	-1.6%	-1.6%	-0.6%
Mine Years -2 to 20 Productivity (Percent Change from Baseline)	Minimum	1.02 (-3.9%)	0.87 (-17.7%)	0.83 (-21.4%)	0.78 (-28.6%)
	Mean	1.05 (-1.0%)	1.00 (-5.7%)	0.95 (-10.5%)	0.97 (-8.9%)
	Maximum	1.06 (0.0%)	1.08 (2.0%)	1.08 (1.8%)	1.10 (3.9%)
Mine Years 21 to 112 Productivity (Percent Change from Baseline)	Mean	1.04 (-1.8%)	1.08 (1.8%)	1.07 (1.1%)	1.05 (-0.6%)

Note: The Mine Years –2 to 20 were selected because stream flows equilibrate at year 20. Therefore, the average annual percent change in productivity for Mine Years 21 through 112 represents a post-closure condition.

Key: % = percent; East Fork SFSR = East Fork South Fork Salmon River; MC = Meadow Creek

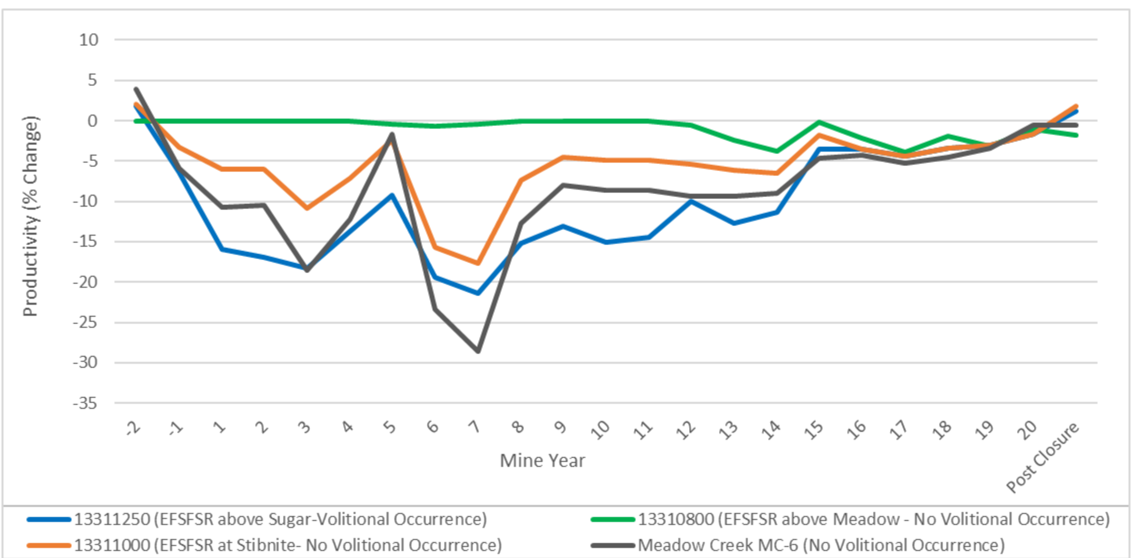


Figure 7-4 Percent Change in Chinook Salmon Productivity from Baseline Conditions by Mine Year and Location (USGS Gaging Stations and MC-6)

Changes in Chinook productivity also occur from Mine Years 3 to 8, where productivity fluctuates in the East Fork SFSR above Meadow Creek, East Fork SFSR above Sugar Creek, and Meadow Creek locations (**Table 7-11**; **Figure 7-4**). This decrease in productivity occur during periods of mine operations that results in dewatering. The increase in productivity in Mine Year 5 is due to reductions of water abstraction during operations from dewatering and subsequent filling of the Hangar Flats pit and dewatering of the YPP.

It is important to note that under baseline conditions, Chinook salmon do not volitionally occur upstream from the YPP lake cascade barrier. However, at mine year -1, the fish tunnel is constructed allowing for volitional passage. For the Meadow Creek, East Fork SFSR at Stibnite, and East Fork SFSR above Sugar Creek sites, the effects of the SGP on Chinook salmon productivity are expected to be moderate, long-term (occurring during operations), and localized. For the East Fork SFSR above Meadow Creek site, the effects of the SGP on Chinook salmon productivity are expected to be minor, long-term (occurring during operations) , and localized. Permanent effects from changes in productivity, that occur during the post-closure are negligible across the mine site.

Intrinsic Potential

An IP model was developed to evaluate segments of stream within the SGP area to determine the watershed's capacity to provide quality habitat for Chinook salmon (see **Section 6.3.1.1** and ESS 2019d for additional information).

For Chinook salmon, habitat assessed for IP was categorized into 1 of 4 rankings including high, medium, low, and negligible. Throughout the construction period and life of the mine, the stream length of each ranking of IP model habitat were determined. **Table 7-12** summarizes the years in which there is a large change in IP and includes total length of IP in the baseline conditions and at the end of the mine life. Additionally, **Figure 7-5** shows all Chinook salmon IP habitat within the analysis area broken down by year and includes key SGP events that effect the amount and quality of IP habitat.

Table 7-12 Stream Length with Intrinsic Potential Habitat for Chinook Salmon Throughout the Mine Life

IP Rating	Intrinsic Potential Habitat (km)							
	Baseline	Mine Year						Net Loss/Gain
		3	5	6	11	15	23 to 112	
East Fork SFSR and Tributaries Upstream from Yellow Pine Pit Cascade Barrier								
High	0	0	0	0	0	0	0	0
Medium	0.66	0.63	0.63	0.63	0.63	0.63	0.63	-0.03
Low	4.29	4.26	4.26	4.26	4.83	4.83	4.83	+0.54
Negligible	1.05	0.78	0.78	0.78	0.78	0.78	0.78	-0.27
Total IP Habitat	6.00	5.68	5.68	5.68	6.25	6.25	6.25	+0.25
Total Length of Habitat Evaluated	29.01	28.35	28.35	28.35	28.92	28.92	28.92	-0.09

IP Rating	Intrinsic Potential Habitat (km)							
	Baseline	Mine Year						Net Loss/Gain
		3	5	6	11	15	23 to 112	
Meadow Creek and East Fork Meadow Creek								
High	0.66	0	0	0	0	0	0	-0.66
Medium	0.9	0.31	1.66	0.31	0.31	1.66	2.45	+1.55
Low	1.21	0.24	0.24	0.24	0.24	0.24	0.24	-0.97
Negligible	0.1	0	0	0	0	0	0	-0.1
Total IP Habitat	2.86	0.55	1.89	0.55	0.55	1.89	2.68	-0.18
Total Length of Habitat Evaluated	16.93	15.53	15.53	15.53	15.53	15.53	15.69	-1.24
East Fork SFSR and Tributaries between Yellow Pine Pit and Sugar Creek								
High	0	0	0	0	0	0	0	0
Medium	0.18	0	0	0	0	0	0	-0.18
Low	0.84	0.35	0.35	0.35	1.26	1.26	1.26	+0.42
Negligible	0.15	0.12	0.12	0.12	0.12	0.12	0.12	-0.03
Total IP Habitat	1.17	0.47	0.47	0.47	1.38	1.38	1.38	+0.21
Total Length of Habitat Evaluated	4.34	4.47	4.47	4.47	3.45	3.45	3.45	-0.89
East Fork SFSR Downstream from Sugar Creek								
High	0	0	0	0	0	0	0	0
Medium	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0
Low	1.02	1.02	1.02	1.02	1.02	1.02	1.02	0
Negligible	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0
Total IP Habitat	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0
Total Length of Habitat Evaluated	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0
Headwaters East Fork SFSR Subwatershed								
Total IP Habitat Below YPP	2.28	1.58	1.58	1.58	2.49	2.49	2.49	+0.21
Total IP Habitat Above YPP	8.86	6.23	7.57	6.23	6.8	8.14	8.93	+0.07
Total IP Habitat	11.15	7.81	9.15	7.81	9.29	10.63	11.42	+0.28

East Fork SFSR = East Fork South Fork Salmon River; IP = Intrinsic Potential; km = kilometer

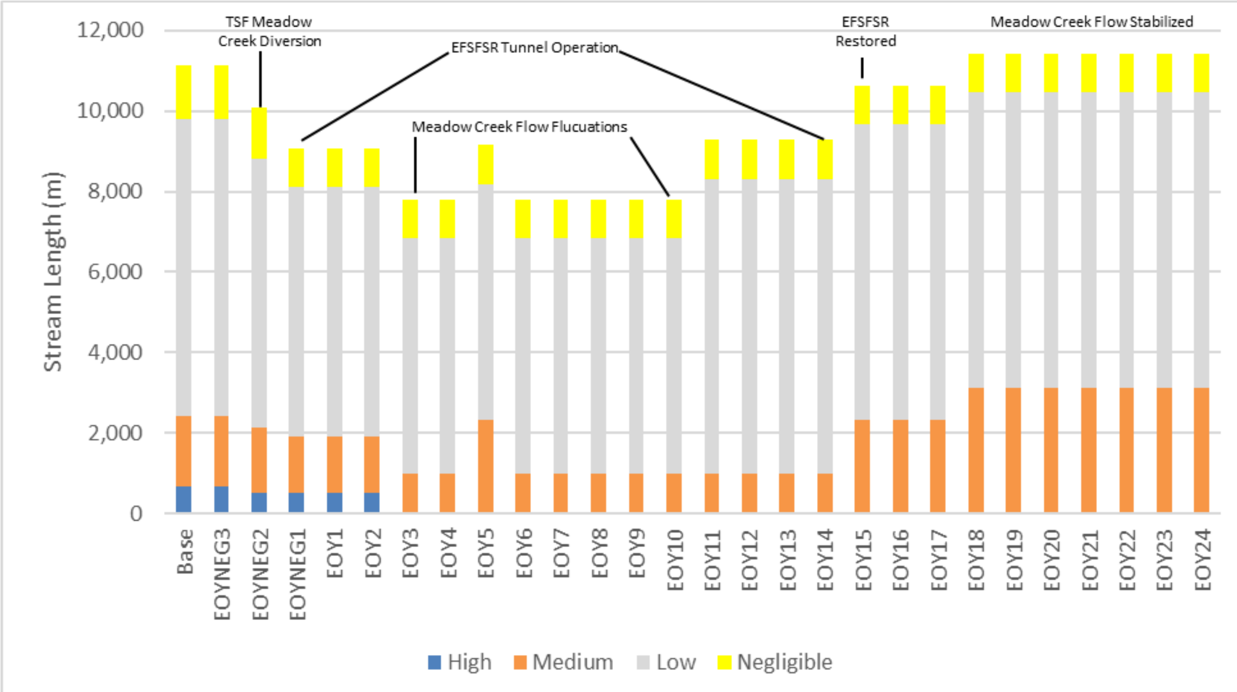


Figure 7-5 Chinook Salmon Intrinsic Potential Habitat in the Mine Site Area Over 28 Years (Mine Years -4 to 24)

Throughout the life of the mine, most of the changes to IP habitat for Chinook salmon cause major or moderate negative impacts. By Mine Year 3, Meadow Creek would lose all high and negligible and over half medium and low-quality IP habitat because the mining activities along the TSF would block fish access. Additionally, physical modification of ground surface in the vicinity of the East Fork SFSR causes a loss of medium, low, and negligible quality IP habitat just upstream from Midnight Creek. During Mine Year 5 operational changes at YPP cause flow increases in Meadow Creek drastically raising the medium quality IP habitat however in Year 6 flows return to similar to before reducing medium IP back down again in Mine Year 6. By Mine Year 11, the East Fork SFSR regains some low-quality IP habitat above Midnight Creek due to the start of reclamation and the end of physical modifications of ground surface in the vicinity of East Fork SFSR. By Mine Year 15 and Mine Year 18, Meadow Creek gains back a significant amount of medium quality IP habitat due to dewatering pumping stopping. Finally, by the end of the mine life, the IP habitat stays the same as year 18 due to presumed wetted widths in the restored stream channels (designed wetted width slightly less than 3.6 m compared to greater than or equal to 3.6 m wetted width required for Chinook salmon).

The IP model does not take current species presence or physical barriers into account, even if the evaluated stream segments are considered usable IP habitat. It is important to note that Chinook salmon do not naturally occur upstream from YPP; Chinook salmon have been periodically translocated upstream from YPP by the IDFG and the Nez Perce Tribe. While there is 11.15 km of usable IP habitat in baseline conditions, only 2.28 km or 20.4 percent of that IP habitat is in stream segments where Chinook salmon naturally occur. In addition, the only high IP habitat found in baseline conditions was in Meadow Creek, some of which is blocked by a physical barrier. By Mine Year 112, 0.21 km or 17.9 percent of the IP habitat downstream from YPP would be gained. Upstream from YPP, 0.07 km or an additional 0.79 percent of IP habitat would be gained and all high IP habitat would be lost. Notably, most of the medium IP that remains in Meadow Creek at Mine Year 23 is also blocked by a physical barrier to Chinook salmon so is not accessible (**Figure 7-6**).

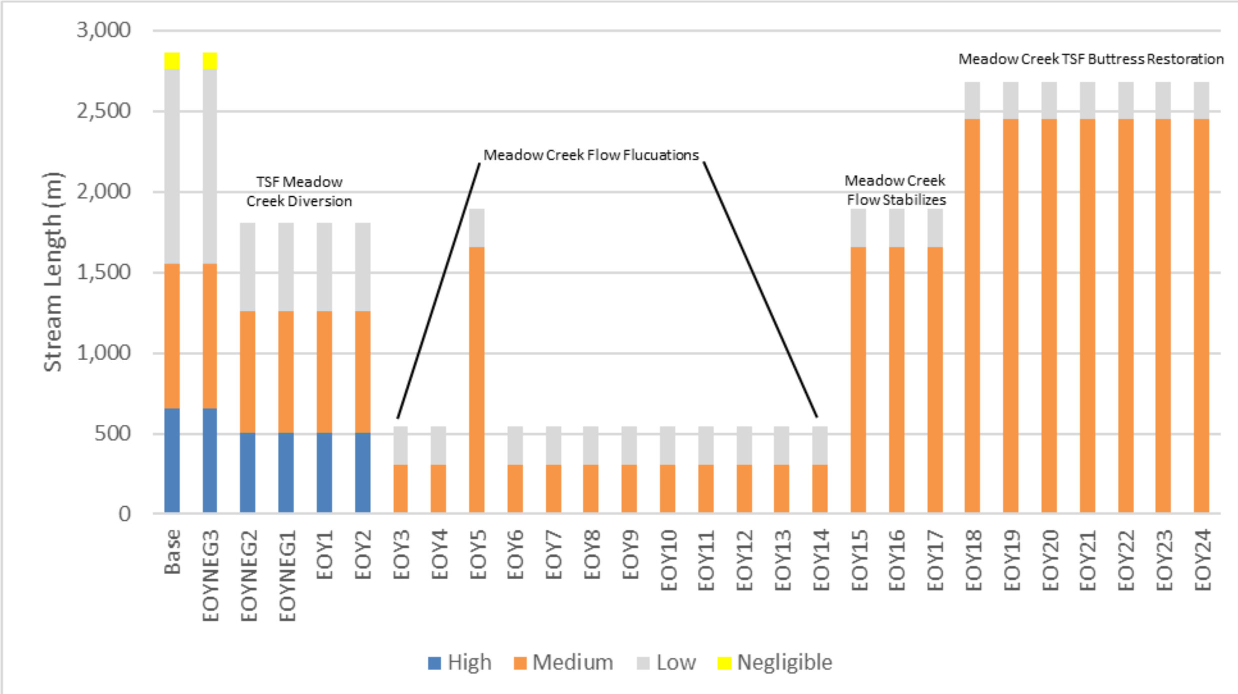


Figure 7-6 Chinook Salmon Intrinsic Potential Habitat in Meadow Creek for 28 Years (Mine Years - 4 to 24)

Overall, the SGP area gains a length of 0.28 km with Chinook salmon IP habitat by the end of the life of the mine. Meadow Creek has a net loss of 0.18 km while all other areas have no overall change or have a slight increase. The total changes to IP habitat are as follows: medium IP habitat is increased by 77 percent (1.34 km), less than 1 percent (0.01 km) of low IP habitat is lost, 100 percent (0.66 km) of high IP habitat is lost, and 31 percent (0.40 km) of negligible IP is lost. This equates to a 2 percent (0.28 km) gain of the total IP habitat for Chinook salmon. Although there is a loss of IP habitat in Meadow Creek, there is an overall long-term minor, permanent, increase in IP habitat and a small addition of new low IP habitat on the East Fork SFSR between the YPP and Sugar Creek.

It is important to note that under baseline conditions, Chinook salmon do not volitionally occur upstream from the YPP lake cascade barrier. The effects of the SGP on Chinook salmon IP habitat are expected to be moderate and localized impacts during the mining years, but minor, permanent, and localized benefits post-closure.

Critical Habitat

Critical Habitat for Chinook salmon in the active mine area would be impacted by various activities including active mining, diversions, barrier removal, and stream restoration. The impacts would be related to physical stream channel changes, accidental hazardous material spills, and changes in WCIs – most importantly barriers, stream flow, and water temperature. Chinook salmon Critical Habitat outside the mine site also would be directly affected by culvert installations and would be at risk of accidental hazardous materials spills in the streams adjacent to the access roads.

Access road culvert replacements and new culverts would cause temporary disturbances of Critical Habitat and increase the risk of erosion and sedimentation. The transportation of hazardous materials on access roads and throughout the mine site would increase the risk of spills adjacent to Critical Habitat or in streams/rivers that flow into Critical Habitat in the East Fork SFSR, Johnson Creek, and streams adjacent to Warm Lake Road (CR 10-579). A total of 18 km of Chinook salmon Critical Habitat along the Burntlog Route would be at risk. Impacts to Critical Habitat resulting from risks of erosion and sedimentation, hazardous materials, and risk of spills are described in **Section 7.2.3.2** in each respective topic area.

An analysis of modeled Critical Habitat currently blocked due to passage barriers indicates that the largest impacts to Critical Habitat for Chinook salmon would come from barrier removal. Nearly 26 km of modeled Critical Habitat are blocked above the YPP cascade barrier, with just over 23 km upstream from the box culvert in the East Fork SFSR under baseline conditions. These barriers would be removed by Mine Year -1 to provide upstream access for Chinook salmon. Activities on Meadow Creek would eliminate potential access to much of the stream, including over 6.6 km of modeled Critical Habitat.

The project activities would affect water temperatures in the mine site area, which are described in Impacts to Chinook Salmon – Water Temperature. These effects would be the same effects to Critical Habitat.

It is important to note that under baseline conditions, Chinook salmon do not volitionally occur upstream from the YPP lake cascade barrier. Overall, there would be a localized, permanent, major beneficial effect on access to Critical Habitat for Chinook salmon.

Integration of Effects

The combination of physical stream channel changes, direct effects to individuals, and changes to many of the WCIs (e.g., temperature, stream flow) would affect Chinook salmon and habitat in the analysis area under the 2021 MMP. SGP activities that would potentially cause these impacts include, but are not limited to, new road construction, transportation including hazardous materials, stream diversions, and construction and operation activities at the mine site. These effects may cause injury or mortality to individuals and temporarily or permanently displace Chinook salmon from several mine site streams during certain periods when habitat conditions become unsuitable. This would cause a temporal loss of habitat.

A summary of the overall net effects to Chinook salmon habitat and specific points regarding the impacts are provided below.

- Changes to water chemistry would primarily have minor effects but would have an unknown level of beneficial effects through the reduction of arsenic and antimony.

- Alterations of the physical structures of the East Fork SFSR and Meadow Creek would result in a net benefit to Chinook salmon. The construction of the fishway, with a later restoration of the East Fork SFSR, would provide volitional access to nearly 9 km of spawning habitat and nearly 20 km of rearing habitat that was only accessible when fish were transplanted by IDFG. Additional enhancements to the East Fork SFSR and Meadow Creek would provide additional habitat benefits.

- While there is a modeled loss of thermally suitable habitat for adult migration of Chinook salmon, this is primarily caused by water temperatures below the temperature criteria, which would not result in impaired movement. Spawning, both upstream and downstream from the YPP and juvenile rearing downstream from the YPP would experience a slight decrease in thermally-suitable habitat downstream from YPP. However, the expansion of habitat availability through the addition of the fishway and the subsequent stream channel restoration provides access to an additional 6 km of spawning habitat and nearly 17 km of rearing habitat.

- Changes in flows would result in a net decrease in productivity between baseline conditions and post-closure conditions. Activities during mine operations would result in major reductions in flows and in Chinook salmon flow-based productivity in the East Fork SFSR between Meadow Creek and Sugar Creek, and in Meadow Creek. The predicted average decreases in Chinook salmon productivity during mine operations compared to baseline conditions would be greater than 10 percent in the East Fork SFSR between YPP and Sugar Creek and nearly 9 percent in lower Meadow Creek, and over 5 percent in the East Fork SFSR near Stibnite. There would, as a result, be a net decrease in flow-productivity, particularly for the spawning life stage caused by a reduction in flow. In subsequent years, closure and post-closure periods, would have negligible to minor changes in productivity.

- The removal of barriers would provide access to upstream habitat not previously volitionally accessed. This would result in a net benefit to Chinook salmon. A new barrier would be constructed in Meadow Creek along the TSF; however, this is not a section of Meadow Creek in which Chinook salmon are able to volitionally reach.

- There would be a slight net increase in IP habitat for Chinook salmon. Post-closure, there would be a net increase of approximately 0.28 km (2 percent) of useable habitat in the headwaters of the East Fork SFSR. This is a change from approximately 11.15 km at baseline to 11.42 km in Mine Year 23. The majority of the usable IP habitat identified in the analysis area is habitat not previously volitionally accessed.

- There would be a net increase in access to Chinook salmon Critical Habitat. While construction and mining activities would affect individual fish and may affect the habitat through the introduction of sediment and contaminants, there would be an increase in access to upstream habitat that was not previously volitionally accessible.

Following closure and reclamation, the overall net effect from the SGP would be a net increase in available habitat, however, flows and temperatures make the additional habitat less optimal.

7.2.3.5 Impacts to Steelhead

Steelhead would be affected by the 2021 MMP through changes in water temperature and flow, which affects other factors such as productivity, intrinsic potential, and Critical Habitat. The effects to steelhead are described below.

Water Temperature

As described in **Section 6.3.2.4**, water temperature is an important factor affecting the survival of each steelhead life stage. The accepted stream temperature thresholds/ranges for life stages of steelhead were compiled from regulatory standards and other relevant literature (ESS 2019a). The technical memorandum presents quantification of baseline habitat availability (in relation to stream temperature) for steelhead and analyzes the likely effects of changes to stream temperatures on available habitat as a result of implementation of the SGP. The following is a summary of the analysis and potential impacts from water temperature changes in streams at the mine site.

Table 7-13 presents the length of intrinsic potential habitat that fall within the temperature threshold categories for steelhead life stages. Length of habitat for steelhead egg incubation/emergence and juvenile rearing are based the amount of habitat with suitable thermal conditions using the summer maximum temperatures. The other life stages are outside the summer – fall modeled parameters, and therefore are not included in the analysis. Detailed data for steelhead under the 2021 MMP are presented in the update of ESS 2019a.

As shown in **Table 7-13**, there would be no reduction in habitat that meets the thermal requirements for steelhead. Relative to baseline conditions:

- There would be no loss of suitable conditions for egg incubation/emergence.
- There would be a net increase in suitable rearing habitat during operations and post-closure, even with a loss of suitable rearing habitat conditions downstream from the YPP lake cascade barrier.

Creeks in the mine site area do experience significant seasonal and diurnal variations, and for mobile life stages (i.e., adults and juveniles), if MWMT are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges. Through stream restoration and enhancement actions, stream cover and instream structures may provide thermal refugia.

It is important to note that under baseline conditions, steelhead do not volitionally occur upstream from the YPP lake cascade barrier. Based on modeled results, the effects of the SGP on steelhead caused by changes to temperature-based suitable habitat are expected to be moderate, permanent, and localized, with beneficial effects resulting from increased access to habitats not previously accessible.

Flow Productivity

A flow-productivity model was developed to examine the effects of predicted flow changes associated with the 2021 MMP on steelhead productivity (see **Section 6.3.2.5** for additional detail on the model**)**. Annual flow productivity was determined as the long-term percent change from the existing or baseline conditions for each mine year. To analyze the altered stream flow across the project area, flow-productivity outputs were used from three of the USGS stream flow gages (East Fork SFSR above Sugar, East Fork SFSR at Stibnite, East Fork SFSR above Meadow) and the lower Meadow Creek (MC-6).

Table 7-14 and **Figure 7-7** shows the average steelhead productivities for each stream flow site over pertinent periods throughout mine operations and post-closure. The greatest, negative percent changes in flow-productivity averaged over the long-term period (Mine Years -2 to 20) are in the East Fork SFSR upstream from Sugar Creek (-11.2percent) and in Meadow Creek (-13.6 percent). Most of the steelhead productivity on the East Fork SFSR upstream from Sugar Creek is greatly impacted by mine operations that alter streamflow over the life of the mine. Similarly, most of the productivity in Meadow Creek is greatly impacted by changes in stream flow caused by mine operations in Meadow Creek. The East Fork SFSR above Meadow Creek is less impacted by changes in stream flow over the long-term. Similarly, most of the steelhead productivity throughout the mine area is minimally affected by altered stream flow post-closure.

Table 7-13 Length of Stream Habitat that Meets the Optimal Thermal Requirements for Steelhead Under the 2021 Modified Mine Plan

Life Stage	Baseline (km)	Mine Year 6 (km)	Mine Year 12 (km)	Mine Year18 (km)	Mine Year22 (km)	Mine Year27 (km)	Mine Year 32 (km)	Mine Year52 (km)	Mine Year 112 (km)	Change from Baseline to 112 (km)
Below Yellow Pine Pit Cascade Barrier										
Incubation/ Emergence	0	0	0	0	0	0	0	0	0	0
Juvenile Rearing	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Total Available Habitat	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Above Yellow Pine Pit Cascade Barrier										
Incubation/ Emergence	0	0	0	0	0	0	0	0	0	0
Juvenile Rearing	0	8.52	9.35	9.91	9.91	9.28	10.07	10.07	10.07	+10.07
Total Available Habitat	0	8.52	9.35	9.91	9.91	10.07	10.07	10.07	10.07	+10.07

km = kilometer

Table 7-14 Percent Change in Steelhead Productivity Relative to Baseline Productivity by Mine Year and Location

Period	Mine Year	East Fork SFSR above Meadow Creek (USGS Gage 13310800	East Fork SFSR at Stibnite (USGS Gage 13311000)	East Fork SFSR above Sugar Creek (USGS Gage 13311250)	Meadow Creek (MC-6)
Baseline Productivity		1.24	1.24	1.24	1.24
Mine Years -2 to 20 Percent Change from Baseline	-2	0%	0%	0.1%	0.0%
	-1	0%	-4.8%	-4.4%	-8.1%
	1	0%	-9.0%	-9.0%	-17.0%
	2	0%	-8.2%	-20.9%	-14.7%
	3	0%	-10.4%	-21.1%	-19.0%
	4	0%	-13.8%	-18.0%	-23.6%
	5	-0.2%	-7.5%	-11.2%	-12.6%
	6	-0.3%	-17.1%	-20.7%	-27.6%
	7	-0.3%	-17.6%	-18.5%	-29.5%
	8	-0.1%	-10.2%	-15.7%	-17.7%
	9	0%	-7.6%	-16.7%	-13.6%
	10	0%	-7.0%	-19.4%	-11.9%
	11	0%	-7.8%	-20.0%	-14.0%
	12	0%	-7.7%	-10.1%	-13.8%
	13	0%	-7.0%	-14.0%	-12.1%
	14	-0.8%	-7.9%	-13.8%	-12.7%
	15	0.2%	-4.6%	-4.8%	-8.6%
	16	1.0%	-4.0%	-1.4%	-9.6%
	17	-0.9%	-4.9%	-2.7%	-10.7%
	18	0.3%	-3.3%	-1.2%	-9.2%
	19	-1.8%	-3.2%	-3.4%	-4.6%
	20	2.4%	-2.6%	0.2%	-8.5%
Mine Years -2 to 20 Productivity (Percent Change from Baseline)	Minimum	1.21 (-1.8%)	1.02 (-17.6%)	0.98 (-21.1%)	0.88 (-29.5%)
	Mean	1.24 (0.0%)	1.14 (-7.6%)	1.10 (-11.2%)	1.02 (-13.6%)
	Maximum	1.26 (2.4%)	1.24 (0.0%)	1.24 (0.2%)	1.24 (0.0%)
Mine Years 21 to 112 Productivity (Percent Change from Baseline)	Mean	1.24 (0.7%)	1.27 (2.3%)	1.29 (4.2%)	1.24 (-0.2%)

The Mine Years–2 to 20 were selected because stream flows equilibrate at year 20. Therefore, the post-closure value represents an average annual percent change in productivity for Mine Years 21 through 112.

% = percent; East Fork SFSR = East Fork South Fork Salmon River; USGS = U.S. Geological Survey

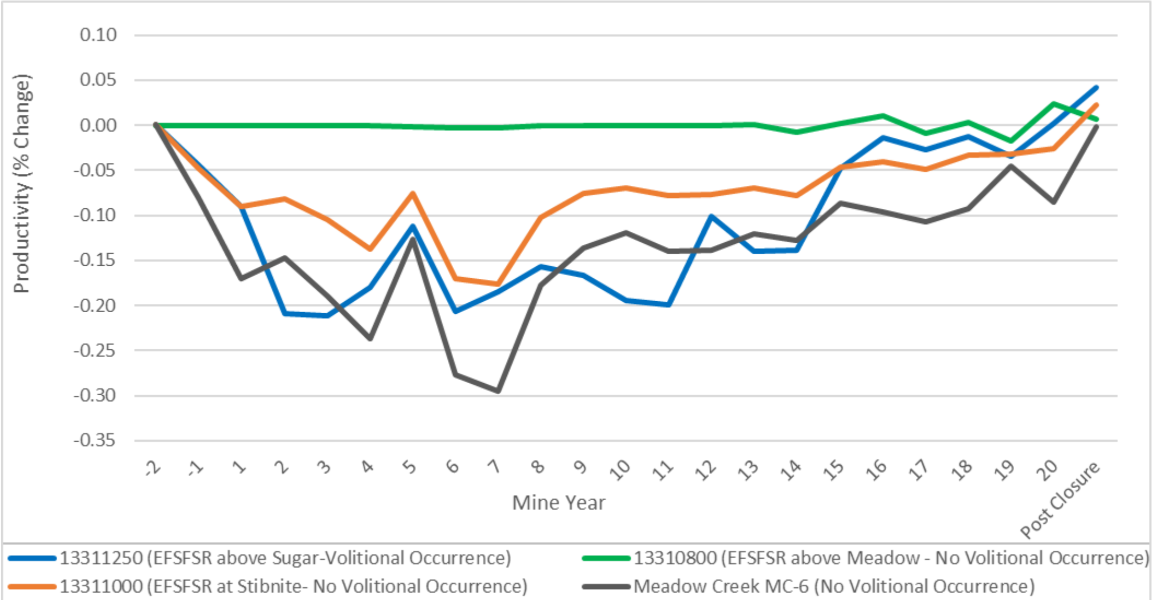


Figure 7-7 Percent Change in Steelhead Productivity from Baseline Conditions by Mine Year and Location (USGS Gaging Stations and MC-6)

Changes in steelhead productivity also occur from Mine Years 3 to 8, where productivity fluctuates in the East Fork SFSR above Meadow Creek, East Fork SFSR above Sugar Creek, and Meadow Creek locations (**Table 7-14**, **Figure 7-7**). The negative percent changes in productivity occur during periods of mine operations that results in dewatering. The increase in productivity in Mine Year 5 is due to reductions of water abstraction during operations from dewatering and subsequent filling of the Hangar Flats pit and dewatering of the YPP.

It is important to note that under baseline conditions, steelhead do not volitionally occur upstream from the YPP lake cascade barrier. However, at mine year -1, the fish tunnel is constructed allowing for volitional passage. At the Meadow Creek, East Fork SFSR at Stibnite, and East Fork SFSR above Sugar Creek sites, the effects of the SGP on steelhead productivity are expected to be moderate, long-term (occur during mine operations), and localized. For the East Fork SFSR above Meadow Creek site, the effects of the SGP on steelhead productivity are expected to be minor, long-term (occur during mine operations), and localized. Permanent effects from changes in productivity, that occur during the post-closure are negligible across the mine site.

Intrinsic Potential

An IP model was developed to evaluate segments of stream within the SGP area to determine the watershed's capacity to provide quality habitat for steelhead (see **Section 6.3.1.1** and ESS 2019d for additional information).

For steelhead, habitat assessed for IP was categorized into 1 of 3 rankings including high, medium, and low. Throughout the construction period and life of the mine, the length of each ranking of IP habitat were determined. **Table 7-15** summarizes the years in which there is a large change in IP and includes total IP habitat length in the baseline conditions and at the end of the mine life. Additionally, **Figure 7-8** shows all steelhead IP habitat within the analysis area broken down by year and includes key SGP events that effect the amount and quality of IP habitat.

Table 7-15 Stream Length with Intrinsic Potential Habitat for Steelhead Throughout the Mine Life

IP Rating	Intrinsic Potential Habitat (km)						
	Baseline	Mine Year					Net Loss/ Gain
		-2	3	11	18	23 to 112	
East Fork SFSR and Tributaries Upstream from the Yellow Pine Pit Cascade Barrier							
High	2.16	2.16	2.16	2.16	2.16	2.16	0
Medium	0	0	0	0	0	0	0
Low	2.91	2.88	2.88	3.45	3.45	3.45	+0.54
Total IP Habitat	5.07	5.04	5.04	5.61	5.61	5.61	+0.54
Total Length Habitat Evaluated	29.01	28.35	28.35	28.92	29.34	29.97	+0.96
Meadow Creek and East Fork Meadow Creek							
High	2.18	1.30	1.89	1.86	2.65	3.21	+1.03
Medium	0.60	0.46	0	0	0	1.27	+0.67
Low	0.87	0.09	0.03	0.03	0.03	0.03	-0.84
Total IP Habitat	3.65	1.85	1.89	1.89	2.68	4.51	+0.86
Total Length Habitat Evaluated	16.93	15.75	15.53	15.53	16.30	17.51	+0.58
East Fork SFSR and Tributaries between Yellow Pine Pit and Sugar Creek							
High	0.18	0.12	0.12	0.12	0.12	0.12	-0.06
Medium	0	0	0	0	0	0	0
Low	0.72	0.23	0.23	1.14	1.14	1.14	+0.42
Total IP Habitat	0.90	0.35	0.35	1.26	1.26	1.26	+0.36
Total Length Habitat Evaluated	4.34	4.47	4.47	3.45	3.45	3.45	-0.89
East Fork SFSR Downstream from Sugar Creek							
High	0.03	0.03	0.03	0.03	0.03	0.03	0
Medium	0	0	0	0	0	0	0
Low	1.02	1.02	1.02	1.02	1.02	1.02	0
Total IP Habitat	1.05	1.05	1.05	1.05	1.05	1.05	0
Total Length Habitat Evaluated	1.11	1.11	1.11	1.11	1.11	1.11	0
Headwaters East Fork SFSR Subwatershed							
Total IP Habitat Below YPP	1.95	1.40	1.40	2.31	2.31	2.31	+0.36
Total IP Habitat Above YPP	8.72	6.90	6.94	7.51	8.30	10.13	+1.51
Total IP Habitat	10.67	8.30	8.34	9.82	10.61	12.44	+1.77

East Fork SFSR = East Fork South Fork Salmon River; IP = Intrinsic Potential; km = kilometer

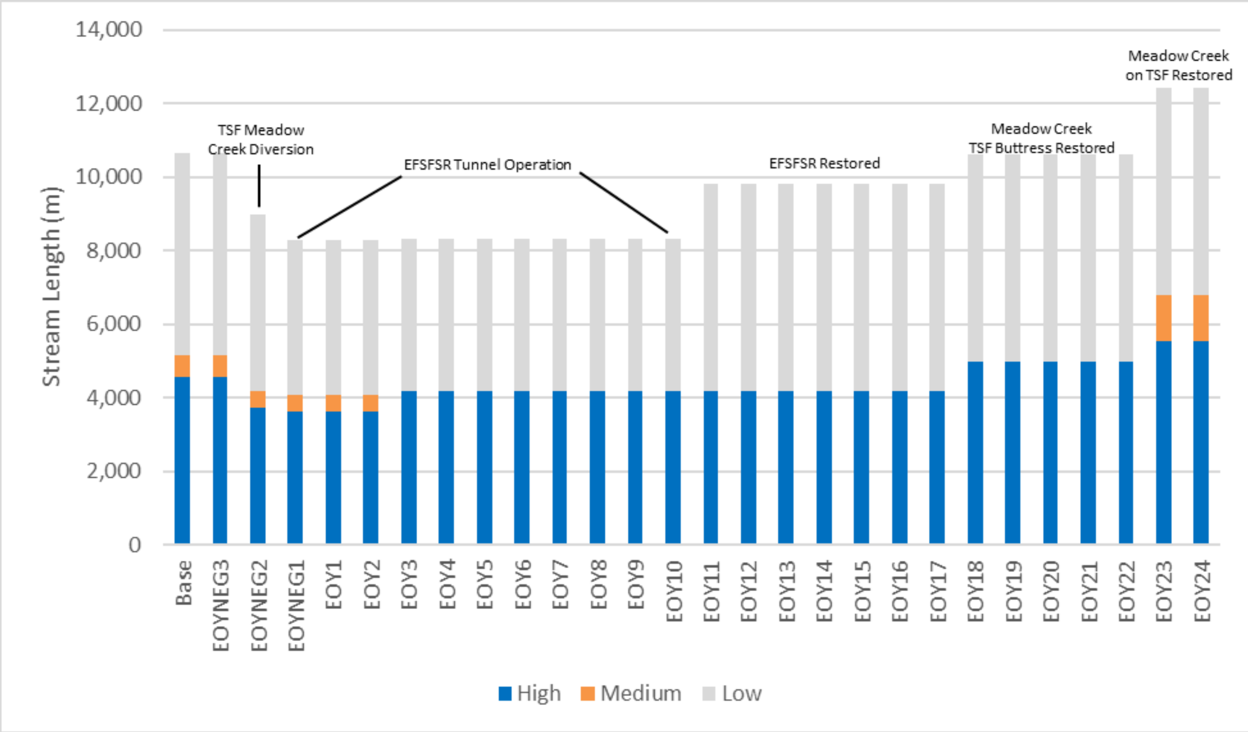


Figure 7-8 Steelhead Intrinsic Potential Habitat in the Mine Site Area Over 28 Years (Mine Years -4 to 24)

Throughout the life of the mine, most of the changes to IP habitat for steelhead result in moderate positive or negative impacts. In Mine Year -1 when the diversion of Meadow Creek occurs, Meadow Creek would lose some high, and most medium, and low-quality IP habitat. Additionally, in Mine Year -1, the YPP fish tunnel construction causes a slight decrease of IP habitat in the East Fork SFSR and tributaries between YPP and Sugar Creek. In Mine Year 3, all medium quality IP habitat is lost; however, 0.59 km of high IP habitat in lower Meadow Creek is added due to an increased bankfull width. Physical modification of ground surface in the vicinity of the East Fork SFSR causes a loss of low IP habitat just upstream from Midnight Creek. In Mine Year 11, the East Fork SFSR regains some low IP habitat above Midnight Creek due to reclamation starting and physical modifications of ground surface in the vicinity of East Fork SFSR end. By Mine Year 18, Meadow Creek gains back high IP habitat due to dewatering pumping stopping. Finally, at Mine Year 23, Meadow Creek regains additional medium and high-quality IP habitat.

As mentioned previously, IP does not factor in the actual species presence or physical barriers, but only whether the stream segments are considered usable IP habitat. It is important to note that under baseline conditions, steelhead do not occur upstream from YPP and there is a physical barrier to fish in Meadow Creek. While there is 10.67 km of IP habitat in baseline conditions, only 1.95 km or 18.2 percent of that is in stream habitat in which steelhead do currently occur. However, by Mine Year -1 the fishway construction would allow steelhead access to East Fork SFSR and its tributaries upstream from the YPP. By Mine Year 23, 1.77 km of IP habitat would be gained from baseline, providing 12.44 km of potential rearing and spawning habitat above and below YPP for steelhead. Within this 12.44 km of IP habitat, a physical barrier blocks 2.62 km of the 4.51 km of IP habitat in Meadow Creek so it would still be inaccessible to steelhead (**Figure 7-9**).

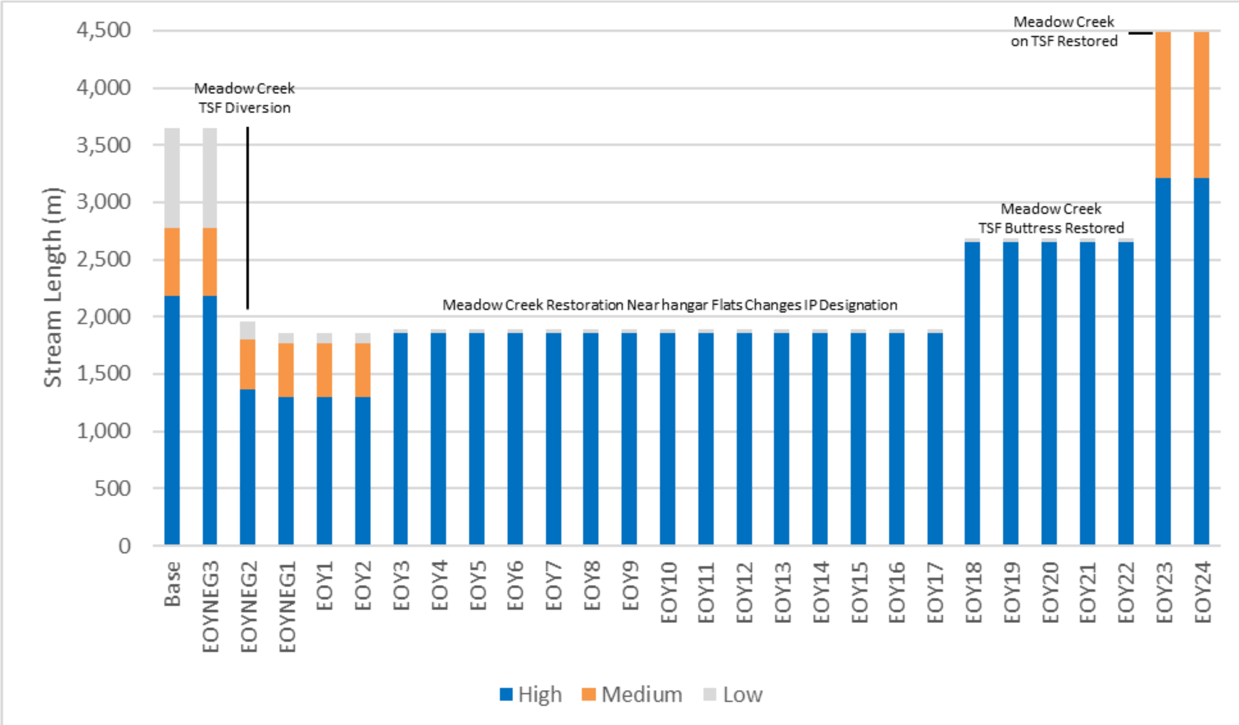


Figure 7-9 Steelhead Intrinsic Potential Habitat in Meadow Creek for 28 Years (Mine Years -4 to 24)

Overall, the SGP area gains 1.77 km of steelhead IP habitat by Mine Year 23. Within that gain of IP habitat, high quality IP habitat increased by 18 percent, medium quality IP habitat increased by 112 percent, and low-quality IP habitat increased by 2 percent relative to baseline conditions. This equates to an overall 16.5 percent gain in IP habitat for steelhead. The long-term changes in IP habitat for steelhead have a moderate positive impact in lower Meadow Creek and East Fork SFSR between Meadow Creek and YPP and a major negative impact in upper Meadow Creek and East Fork SFSR between YPP and Sugar Creek. The permanent changes in IP habitat for steelhead have a moderate positive impact. While permanent impacts are mostly positive due to IP habitat improvements in Meadow Creek, there is a moderate permanent impact in upper Meadow Creek.

It is important to note that under baseline conditions, steelhead do not volitionally occur upstream from the YPP lake cascade barrier. Once the fishway construction and subsequent channel restoration is completed, steelhead would be able to access habitat upstream from YPP except for part of Meadow Creek upstream from a barrier. Overall, the SGP is expected to result in moderate, permanent, and localized benefits to steelhead IP habitat.

Critical Habitat

There is no steelhead trout Critical Habitat upstream from the YPP cascade barrier, but there is Critical Habitat below the barrier. Impacts from SGP activities at the mine site and those caused by the access roads, transmission lines, or off-site facilities could impact steelhead Critical Habitat. Access road culvert replacements and new culverts would cause temporary disturbances of Critical Habitat and increase the risk of erosion and sedimentation. The transportation of hazardous materials on access roads and throughout the mine site would increase the risk of spills adjacent to Critical Habitat or in streams/rivers that flow into Critical Habitat in the East Fork SFSR, Johnson Creek, and streams adjacent to Warm Lake

Road (CR 10-579). A total of 18 km of steelhead Critical Habitat along the Burntlog Route could be affected.

The gradient barrier at the YPP lake cascade is currently restricting access for steelhead trout to habitat upstream. However, no Critical Habitat is identified for steelhead trout upstream from the barrier. The removal of the YPP barrier at Mine Year -1, would provide access to fish to naturally move upstream. This would create a gain in quantity and quality of available habitat regardless of the lack of identified Critical Habitat for steelhead trout upstream from the YPP barrier.

Overall, the effects of the SGP are expected to result in minor, long-term, and localized impacts to the steelhead Critical Habitat.

Integration of Effects

The combination of physical stream channel changes (e.g., diversions and new construction), direct effects to individuals, and changes to many of the WCIs (e.g., water temperature, streamflow) would affect steelhead and habitat in the mine area under the 2021 MMP. SGP activities that would potentially cause these impacts include, but are not limited to, new road construction, transportation including hazardous materials, stream diversions, and construction and operation activities at the mine site. These effects may cause injury or mortality to individuals and temporarily or permanently displace steelhead from several mine site streams during certain periods when habitat conditions become unsuitable. This would cause a temporal loss of habitat.

A summary of the overall net effects to steelhead habitat and specific points regarding the impacts are provided below.

- Changes to water chemistry would primarily have minor effects but would have an unknown level of beneficial effects through the reduction of arsenic and antimony.

- Alterations of the physical structures of the East Fork SFSR and Meadow Creek would result in a net benefit to steelhead. The construction of the fishway, with a later restoration of the East Fork SFSR, would provide volitional access to nearly 9 km habitat that was not previously accessible. Additional enhancements to the East Fork SFSR and Meadow Creek would provide additional habitat benefits.

- There is a modeled increase in thermally-suitable habitat for juvenile rearing. There is no thermally-suitable habitat for egg incubation and emergence under either baseline conditions or the 2021 MMP, so no net loss. Additionally, steelhead would have access to upstream spawning and rearing habitat, which were not previously accessible.

- Changes in flows would result in a net decrease in productivity between baseline conditions and post-closure conditions. Activities during mine operations would result in major reductions in flows and in steelhead flow-based productivity in the East Fork SFSR between Meadow Creek and Sugar Creek, and in Meadow Creek. There would be a net decrease in steelhead habitat in Meadow Creek, but most flows would return to near baseline conditions in the East Fork SFSR after mine closure and post-closure. In subsequent years, closure and post-closure periods, would have negligible to minor changes in productivity.

- The removal of barriers would provide access to upstream habitat not previously volitionally accessed. This would result in a net benefit to steelhead. A new barrier would be constructed in Meadow Creek along the TSF; however, this is not a section of Meadow Creek in which steelhead are able to volitionally reach.

- There would be a slight net increase in IP habitat for steelhead. Post-closure, there would be a net increase of approximately 1.77 km (16.5 percent) of useable habitat in the headwaters of the East Fork SFSR. This is a change from approximately 10.67 km at baseline to 12.44 km in Mine Year 23. The majority of the usable IP habitat identified in the analysis area is habitat not previously volitionally accessed.

- There would no change in access to steelhead Critical Habitat because there is no assumed Critical Habitat upstream from the YPP lake. Following the establishment of passage into the upper watershed, NMFS may designate Critical Habitat in the upper watershed.

Following closure and reclamation, the net effect would be an increase in both the quantity and quality of habitat for steelhead trout.

7.2.3.6 Impacts to Bull Trout

Bull trout would be affected by the 2021 MMP through changes in water temperature and flow, which affects other factors such as habitat through weighted usable area, occupancy probability, and Critical Habitat. The effects to bull trout are described below.

Water Temperature

As described in **Section 6.3.4.2**, water temperature is an important factor affecting the survival of each bull trout life stage. The accepted stream temperature thresholds/ranges for life stages of bull trout were compiled from regulatory standards and other relevant literature (ESS 2019a). The technical memorandum presents quantification of baseline habitat availability (in relation to stream temperature) for bull trout and analyzes the likely effects of changes to stream temperatures on available habitat as a result of implementation of the SGP. The following is a summary of the analysis and potential impacts from water temperature changes in streams at the mine site.

Table 7-16 presents the length of streams that have positive bull trout occupancy probability that fall within the temperature threshold categories for bull trout life stages. Length of habitat for bull trout juvenile rearing are based the amount of habitat with suitable thermal conditions using the summer maximum temperatures, while spawning and incubation/emergence apply the fall maximum temperature. Detailed data for bull trout under the 2021 MMP are presented in the update of ESS 2019a.

As shown in **Table 7-16**, all life stages experience a reduction in habitat that meets the thermal requirements for bull trout. These reductions are either due to water temperatures that are too high or too low for the specific life stage, or due to limited access to suitable habitat (e.g., Meadow Creek). Relative to baseline conditions:

- There would be a net decrease in thermally suitable conditions for spawning because water temperatures are higher than the thermal requirements. While there is a decrease in the amount of thermally suitable spawning habitat that is considered functioning at risk or functioning at unacceptable risk, there is also a decrease in spawning habitat functioning appropriately.

- There would be a net decrease in thermally suitable habitat functioning appropriately for egg incubation/emergence during operations and post-closure primarily due to the loss of access to the upper Meadow Creek.

- There would be a net decrease in thermally suitable juvenile rearing habitat functioning appropriately during operations through post-closure primarily due to the loss of access to the upper Meadow Creek.

Table 7-16 Length of Stream Habitat Under the Watershed Condition Indicator Categories for Water Temperatures for Bull Trout Under the 2021 Modified Mine Plan

Life Stage	Baseline (km)	Mine Year								Change from Baseline to 112 (km)
		Mine Year 6 (km)	Mine Year 12 (km)	Mine Year 18 (km)	Mine Year 22 (km)	Mine Year 27 (km)	Mine Year 32 (km)	Mine Year 52 (km)	Mine Year 112 (km)	
Below Yellow Pine Pit Cascade Barrier										
Spawning – FA	0	0	0	0	0	0	0	0	0	0
Spawning – FR	0	0	0	0	0	0	0	0.05	0.05	+0.05
Spawning - FUR	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.61	1.61	-0.35
Incubation/Emergence - FA	0	0	0	0	0	0	0	0	0	0
Incubation/Emergence - FUR	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Juvenile Rearing - FA	0	0	0	0	0	0	0	0	0	0
Juvenile Rearing - FR	0	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	+1.66
Juvenile Rearing - FUR	2.01	0	0	0	0	0	0	0	0	-2.01
Total Available Habitat	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Above Yellow Pine Pit Cascade Barrier										
Spawning – FA	1.62	1.42	2.61	1.42	1.42	1.42	1.42	1.42	1.42	-0.20
Spawning – FR	7.76	6.28	8.24	5.55	6.18	6.34	6.34	6.34	6.34	-1.42
Spawning - FUR	14.82	8.64	5.85	10.78	10.15	8.29	8.29	8.29	8.29	-6.52
Incubation/Emergence - FA	0	0	0	0	0	0	0	0	0	0
Incubation/Emergence - FUR	24.2	16.34	16.70	17.75	17.75	16.05	16.05	16.05	16.05	-8.15
Juvenile Rearing - FA	12.16	10.35	9.90	7.60	7.88	7.76	7.76	7.76	7.76	-4.4
Juvenile Rearing - FR	9.60	5.99	6.55	9.45	9.62	5.36	5.60	7.22	8.29	-1.31
Juvenile Rearing - FUR	2.43	0	0.25	0.69	0.25	2.93	2.68	1.07	0	-2.43
Total Available Habitat	24.2	16.34	16.70	17.75	17.75	16.05	16.05	16.05	16.05	-8.15

FA = functioning appropriately; FR = functioning at risk; FUR = functioning at unacceptable risk; km = kilometer;

Creeks in the mine site area do experience significant seasonal and diurnal variations, and for mobile life stages (i.e., adults and juveniles), if MWMT are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges. Through stream restoration and enhancement actions, stream cover and instream structures may provide thermal refugia.

Based on modeled results, the effects of the SGP on bull trout caused by changes to thermally suitable habitat are expected to be major, permanent, and localized.

Weighted Usable Area (PHABSIM)

A PHABSIM model was developed to predict how bull trout habitat changes based upon changes in stream flow associated with different stream reaches throughout the SGP (see **Section 6.3.3.5** for additional detail). The PHABSIM data are approximately 30 years old and originated from another project. They represent available data that provide reference information and should not be viewed as directly transferable to the project site. Although the PHABSIM results do not explicitly predict changes in habitat associated with changes in flow related to the proposed project, they do provide data on how the model predicted similar reductions in flow at similar-sized creeks in close proximity would affect habitat for the different life stages of bull trout. The general relationship between the predicted changes in streamflow and the impact to habitat (i.e., WUA) at the mine site is a general decrease in streamflow results in a general decrease in habitat for the adult and juvenile bull trout life stages.

Under the 2021 MMP, the largest impacts on low-flow discharge would be in Meadow Creek between Year 2 and Year 8. Over this time period, flows are predicted to decrease between 11 percent and 36 percent (**Table 7-8**; mean = 18 percent and median = 20 percent). Since Meadow Creek is a small stream, it is represented by Summit Creek (Stream Index 1; **Table 6-20**). For Summit Creek, the PHABSIM results indicated an 87 percent reduction in discharge from 7.8 cfs to 1.0 cfs which would result in a 90 percent reduction in adult bull trout habitat. Juvenile bull trout results were slightly lower with an 89 percent reduction in juvenile bull trout habitat. The predicted reduction in adult habitat at Summit Creek associated with a reduction in flow from 7.8 cfs to 4.4 cfs (44 percent) was predicted to equate with a 42 percent decline in adult bull trout habitat and similarly a 41 percent reduction in juvenile bull trout habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size. For Meadow Creek, the impacts on bull trout habitat are major, long-term, and localized.

For the East Fork SFSR above Sugar Creek site, which is represented by Sugar Creek (Stream Index 2; **Table 6-20**), flows are predicted to decrease between Mine Years 1 and 14 ranging from 7 percent to 25 percent (**Table 7-8**; mean = 16 percent and median = 16 percent). For Sugar Creek, the PHABSIM results indicated a 90 percent reduction in discharge from 9.9 cfs to 1.0 cfs which would result in an 88 percent reduction in adult bull trout habitat. Juvenile bull trout habitat reduction results were slightly lower with a –87 percent reduction. The predicted reduction in adult habitat at Sugar Creek associated with a decrease in flow from 7.8 cfs to 4.4 cfs (44 percent) was predicted to equate to a 37 percent decline in adult bull trout habitat and similarly a 33 percent reduction in juvenile bull trout habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size. For East Fork SFSR above Sugar Creek, the impacts on bull trout habitat are major, long-term and localized.

For the East Fork SFSR at Stibnite site, which is represented by East Fork SFSR downstream from Sugar Creek (Stream Index 3; **Table 6-20**), flows are predicted to decrease between Mine Years 2 and 8 ranging from 6 percent to 20 percent (**Table 7-8**; mean = 10 percent and median = 11 percent). For East Fork SFSR downstream from Sugar Creek, the PHABSIM results indicated a 60 percent reduction in discharge from 63 cfs to 25 cfs which would result in a 49 percent reduction in adult bull trout habitat. Juvenile bull trout habitat reduction results were slightly lower with a 45 percent reduction in juvenile bull trout habitat. The predicted reduction in adult habitat at Sugar Creek associated with a decrease in flow from 63 cfs to 44 cfs (30 percent) was predicted to equate to a 15 percent decline in adult bull trout habitat.

Juvenile bull trout habitat reduction results were slightly lower with an 11 percent reduction in habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size. For the East Fork SFSR at Stibnite site, the impacts on bull trout habitat are moderate, long-term and localized. Analysis of relevant PHABSIM modeling from the region indicates SGP discharge impacts on physical habitat would be major, long-term, and localized.

Occupancy Probability

The OM is a tool used to determine the probability of a fish species occupying a particular stream reach (occupancy probability) and to predict changes in the probability given changes to site physical characteristics (Isaak et al. 2015, 2017). An OM was developed to quantify potential occupancy probability for bull trout (See **Section 6.3.3.5** and ESS 2019f for additional information). The OM calculates occupancy probabilities based on the combination of three independent variables important to bull trout: stream flow, stream temperature, and channel slope. The continuous range of occupancy probabilities are represented as percentages, from 0 percent to 100 percent for each reach. **Table 7-17** presents the OM-derived distance-weighted average occupancy probabilities for bull trout by stream reach under the 2021 MMP for six different time periods: Baseline (existing conditions), Mine Year 6 (approximately halfway through mine operations), Mine Year 12 (near the end of mine operations), Mine Year 18 (beginning of the closure and reclamation), Mine Year 27 (post-closure where water temperatures are the highest) and Mine Year 112 (post-closure).

Stream channel alterations in the East Fork SFSR and Meadow Creek would impact occupancy probabilities for bull trout in the mine area. The largest increase in bull trout occupancy probability occurs in the East Fork SFSR between Sugar Creek and the YPP lake in Mine Year 6 but decrease in Mine Year 12 and Mine Year 18 and starts to increase to Mine Year 112 (**Table 7-17**). The increase in Mine Year 6 in the East Fork SFSR is primarily caused by a decrease in average water temperatures between mid-July and late September. Water temperatures have higher maximums, but also lower minimums during this period. During this time period, less water from Meadow Creek is flowing into the East Fork SFSR, which affects the daily temperature moderation. As a result, the lower average temperature results in a higher occupancy probability for bull trout in the East Fork SFSR between the YPP lake and Sugar Creek. The East Fork SFSR upstream from the YPP lake and the Meadow Creek drainage all have increased occupancy probabilities for bull trout over time.

Table 7-17 Distance Weighted Average of Occupancy Probabilities (in Percent) for Bull Trout Under the 2021 Modified Mine Plan

Stream Reach	Baseline	Mine Year 6	Mine Year 12	Mine Year 18	Mine Year 27	Mine Year 112
East Fork SFSR upstream from Meadow Creek	8.4%	9.6%	9.5%	8.5%	9.8%	9.7%
Meadow Creek and East Fork Meadow Creek	5.7%	6.9%	6.7%	7.8%	5.7%	8.7%
East Fork SFSR between Meadow Creek and YPP	10.1%	12.4%	15.2%	13.8%	13.1%	14%
East Fork SFSR Between YPP and Sugar Creek	15.3%	22.6%	12.4%	12.3%	13.3%	16.1%

% = percent; East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit

A distance-weighted average method was used to represent the average occupancy probability for each stream segment. To produce the distance-weighted average, the occupancy probability of each OM reach was multiplied by the proportion of the reach's stream length to the total length of each stream segment that has some likelihood of being occupied by bull trout. The length of potential habitat available for bull trout are presented in **Table 7-18**.

Table 7-18 Length of Available Habitat for Potential Occupancy for Bull Trout Under the 2021 Modified Mine Plan

Stream Reach	Baseline (km)	Mine Year 6 (km)	Mine Year 12 (km)	Mine Year 18 (km)	Mine Year 27 (km)	Mine Year 112 (km)
East Fork SFSR upstream from Meadow Creek	13.1	13.9	13.1	13.1	13.9	13.1
Meadow Creek and East Fork Meadow Creek	13.1	7.1	6.8	7.4	15.2	14.0
East Fork SFSR between Meadow Creek and YPP	6.5	5.6	7.8	6.9	7.4	8.1
East Fork SFSR Between YPP and Sugar Creek	1.2	0.5	0.7	0.7	0.7	0.7

East Fork SFSR = East Fork South Fork Salmon River; km = kilometer; YPP = Yellow Pine pit

The largest decreases of available potential habitat for bull trout and westslope cutthroat trout relative to baseline conditions would occur in the Meadow Creek drainage. During this period, the main activities that contribute to the loss of potential habitat in these areas are the diversion of Meadow Creek around the TSF footprint; the construction of the rock drain on East Fork Meadow Creek and the East Fork SFSR fish tunnel; and dewatering of the YPP lake, all occurring in Mine Year -1. The length of available habitat in these areas would increase at Mine Year 18 following restoration of Meadow Creek along the TSF.

Mine actions, stream enhancement, and restoration implemented by Mine Year 18 would remove all major fish passage blockages. Any remaining available habitat blockages would occur only in non-enhanced reaches and the Meadow Creek TSF high-gradient areas where fish cannot naturally access the available habitat. The approximately upper 10 km of Meadow Creek would remain blocked in perpetuity due to the high-gradient stream segments flowing off the TSF, however, there is still potentially usable bull trout habitat with occupancy potential that does get factored into the modeled results.

Overall, the SGP is expected to result in minor, permanent, and localized benefits to occupancy probability and the available habitat for occupancy potential for bull trout.

Critical Habitat

Critical habitat for bull trout in the active mine area would be impacted by various activities including active mining, diversions, barrier removal, and stream restoration. An analysis of designated Critical Habitat currently blocked due to passage barriers indicates that the largest impacts to Critical Habitat for bull trout would come from barrier removal. Nearly 20 km of Critical Habitat are blocked for migratory bull trout above the YPP under baseline conditions but are occupied by non-migratory bull trout. This barrier would be removed before mine operations begin (Mine Year -1) to allow access for fluvial and adfluvial bull trout above these barriers. An existing barrier to bull trout in Meadow Creek upstream from East Fork Meadow Creek would be removed but would be replaced by a pipeline along the TSF during operations and then a gradient barrier post-closure. This barrier would block passage to the headwaters of Meadow Creek, but would not eliminate suitable habitat for any bull trout currently present. Overall, the effects of the SGP on bull trout access to Critical Habitat within the mine area would be major, permanent, and localized.

Integration of Effects

The combination of physical stream channel changes, direct effects to individuals, and changes to many of the WCIs would affect bull trout in the mine area. Some SGP activities may improve access to habitat from baseline conditions. Despite some improvement to access, there remain some potential effects associated with the 2021 MMP that may cause injury or mortality to individuals and permanent displace bull trout from the analysis area.

Post-closure, a net decrease in quality and quantity of bull trout habitat would occur despite removal of passage barriers and an increase of lake habitat for bull trout including:

- Changes to water chemistry would primarily have minor effects but would have an unknown level of beneficial effects through the reduction of arsenic and antimony.
- The loss of the YPP lake would result in a net long-term impact to bull trout, but a permanent negligible net change once the Stibnite Lake is constructed by Mine Year 11. The construction of the fishway, and subsequent channel restoration of the East Fork SFSR, would provide volitional access to habitat that was not previously accessible to the adfluvial population, which may provide additional spawning habitat. Additional enhancements to the East Fork SFSR and Meadow Creek would provide additional habitat benefits.
- There would be a net loss in bull trout thermally suitable habitat due to water temperatures exceeding the thermal requirements for spawning, incubation/emergence and rearing, primarily in Meadow Creek.
- Changes in flows would result in a net decrease in bull trout habitat in Meadow Creek and in the East Fork SFSR, but most flows would return to near baseline conditions, particularly in the East Fork SFSR after mine closure and post-closure.
- The removal of barriers would provide access to upstream habitat not previously volitionally accessed. This would result in a benefit to bull trout. A new barrier would be constructed in Meadow Creek along the TSF, which would result in blockage. Overall, there would be a net increase in accessibility to habitat for bull trout.
- There would be a minor net increase in occupancy potential for bull trout.
- There would be a net loss in Critical Habitat for bull trout in upper Meadow Creek because of the diversion around the TSF, and later by the completion of the TSF, which would become a gradient barrier to upstream and downstream fish passage.

7.2.3.7 Westslope Cutthroat Trout

Westslope cutthroat trout would be affected by the 2021 MMP through changes in water temperature and flow, which affects other factors such as habitat through weighted usable area and occupancy probability. The effects to westslope cutthroat trout are described below.

Water Temperature

As described in **Section 6.3.4.2**, water temperature is an important factor affecting the survival of each westslope cutthroat trout life stage. The accepted stream temperature thresholds/ranges for life stages of cutthroat trout were compiled from regulatory standards and other relevant literature (ESS 2019a). The technical memorandum presents quantification of baseline habitat availability (in relation to stream temperature) for westslope cutthroat trout and analyzes the likely effects of changes to stream temperatures on available habitat as a result of implementation of the SGP. The following is a summary of the analysis and potential impacts from water temperature changes in streams at the mine site.

Table 7-19 presents the length of streams that have positive westslope cutthroat trout occupancy probability that fall within the temperature threshold categories for westslope cutthroat trout life stages. Length of habitat for westslope cutthroat trout egg incubation/emergence and juvenile rearing are based the amount of habitat with suitable thermal conditions using the summer maximum temperatures. The other life stages are outside the summer – fall modeled parameters, and therefore are not included in the analysis. Detailed data for steelhead under the 2021 MMP are presented in the update of ESS 2019a.

As shown in **Table 7-19**, there are slight decreases in suitable habitat conditions for egg incubation/emergence during operations, but an increase for post-closure conditions. Relative to baseline conditions:

- There would be a decrease in thermally suitable condition for egg incubation/emergence due to higher water temperatures during operations and the early period of the post-closure, but after Mine Year 27, water temperatures begin to decrease, resulting in a net increase in thermally suitable conditions for egg incubation/emergence upstream from the YPP lake cascade barrier.

- There would be a decrease in thermally suitable rearing habitat during operations and early post-closure, but after Mine Year 22, water temperatures begin to decrease, resulting in a net increase in thermally suitable rearing habitat upstream from the YPP lake cascade barrier.

Based on modeled results, the effects of the SGP on westslope cutthroat trout caused by changes to thermally suitable habitat are expected to be minor, permanent, and localized.

Weighted Usable Area (PHABSIM)

A PHABSIM model was developed to predict how westslope cutthroat trout habitat changes based upon changes in streamflow associated with different stream reaches throughout the SGP (see **Sections 6. 3.3.5** and **6.3.4.3**). The limitations and functions of PHABSIM are described in **Section 7.2.3.6**.

Under the 2021 MMP, the largest impacts on low-flow discharge for the project site would be at Meadow Creek between Year 2 and Year 8. Over this time period, flows are predicted to decrease between 11 percent and 36 percent (**Table 7-8**; mean = 18 percent and median = 20 percent). Since Meadow Creek is a small stream, it is comparable to Summit Creek (Stream Index 1; **Table 6-20**). For Summit Creek, the PHABSIM results indicated an 87 percent reduction in discharge from 7.8 cfs to 1 cfs which would result in a 99 percent reduction in adult cutthroat trout habitat. Effects on the habitat for the cutthroat spawning life stage were about half as large. The predicted reduction in adult habitat at Summit Creek associated with a reduction in flow from 7.8 cfs to 4.4 cfs (44 percent) was predicted to equate to a 56 percent decline in adult cutthroat habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size. For Meadow Creek, the impacts on cutthroat trout habitat are major, long-term and localized.

Table 7-19 Length of Stream Habitat that Meets the Optimal Thermal Requirements for Westslope Cutthroat Trout Under the 2021 Modified Mine Plan

Life Stage	Baseline (km)	Mine Year 6 (km)	Mine Year 12 (km)	Mine Year 18 (km)	Mine Year 22 (km)	Mine Year 27 (km)	Mine Year 32 (km)	Mine Year 52 (km)	Mine Year 112 (km)	Change from Baseline to 112 (km)
Below Yellow Pine Pit Cascade Barrier										
Incubation/Emergence	0	0	0	0	0	0	0	0	0	0
Juvenile Rearing	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Total Available Habitat	2.01	1.48	1.66	1.66	1.66	1.66	1.66	1.66	1.66	-0.35
Above Yellow Pine Pit Cascade Barrier										
Incubation/Emergence	0.85	0.78	0.78	0.37	0.37	0.37	2.11	2.11	2.11	+1.26
Juvenile Rearing	20.91	17.33	17.69	18.74	19.15	23.40	21.65	21.65	21.65	+0.74
Total Available Habitat	24.20	18.11	18.47	19.52	19.52	23.77	23.77	23.77	23.77	-0.73

Key: km = kilometer

For the East Fork SFSR above Sugar Creek site, which is represented by Sugar Creek (Stream Index 2; **Table 6-20**), flows are predicted to decrease between Year 1 and Year 14 ranging from 7 percent to 25 percent (**Table 7-8**; mean = 16 percent and median = 16 percent). For Sugar Creek, the PHABSIM results indicated a 90 percent reduction in discharge from 9.9 cfs to 1.0 cfs which would result in a 99 percent reduction in adult cutthroat trout habitat. Juvenile cutthroat trout habitat loss results were slightly lower, while effects on cutthroat fry habitat were about half as large. The predicted reduction in adult habitat at Sugar Creek associated with a decrease in flow from 9.9 cfs to 5.4 cfs (46 percent) was predicted to equate to a 53 percent decline in adult cutthroat trout habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size. For the East Fork SFSR above Sugar Creek, the impacts on cutthroat trout habitat are major, long-term and localized.

For the East Fork SFSR at Stibnite site, which is represented by East Fork SFSR Downstream from Sugar Creek (Stream Index 3; **Table 6-20**), flows are predicted to decrease between Year 2 and Year 8 ranging from 6 percent to 20 percent (**Table 7-8**; mean = 10 percent, median = 11 percent). For East Fork SFSR Downstream from Sugar Creek, the PHABSIM results indicated a 60 percent reduction in discharge from 63 cfs to 25 cfs which would result in a 67 percent reduction in adult cutthroat trout habitat. No habitat data were available for juvenile cutthroat trout habitat, but the effects on cutthroat fry habitat were much lower with a 24 percent decrease. The predicted reduction in adult habitat at Sugar Creek associated with a decrease in flow from 63 cfs to 44 cfs (30 percent) was predicted to equate to a 32 percent decline in adult cutthroat trout habitat and only a 6 percent reduction in cutthroat fry habitat. There were no PHABSIM results provided for smaller decreases in discharge at low flows for this stream size or for the cutthroat trout juvenile life stage. For the East Fork SFSR at Stibnite site, the impacts on cutthroat trout habitat are moderate, permanent and localized.

Analysis of relevant PHABSIM modeling from the region indicates the effects of SGP discharge impacts on physical habitat could be moderate to major, long-term, and localized.

Occupancy Probability

Occupancy probability and stream length with occupancy probability was calculated in the same manner for westslope cutthroat trout as described for bull trout (see **Section 7.2.3.6**).

Stream channel alterations in the East Fork SFSR and Meadow Creek would impact occupancy probabilities for westslope cutthroat trout in the mine area. The largest increase in westslope cutthroat trout occupancy probability occurs in the East Fork SFSR between Sugar Creek and the YPP lake in Mine Year 6 but decrease in Mine Year 12 but increases again by Mine Year 112 (**Table 7-20**). The increase in Mine Year 6 in the East Fork SFSR is caused by a decrease in average water temperatures between mid-July and late September. Water temperatures have higher maximums, but also lower minimums during this period. During this time period, less water from Meadow Creek is flowing into the East Fork SFSR, which affects the daily temperature moderation. As a result, the lower average temperature results in a higher occupancy probability for westslope cutthroat trout in the East Fork SFSR between the YPP lake and Sugar Creek. The East Fork SFSR upstream from the YPP lake and the Meadow Creek drainage all have increased occupancy probabilities for westslope cutthroat trout over time.

Table 7-20 Distance Weighted Average Occupancy Probability (in Percent) of Westslope Cutthroat Trout under the 2021 Modified Mine Plan

Stream Reach	Baseline	Mine Year 6	Mine Year 12	Mine Year 18	Mine Year 27	Mine Year 112
East Fork SFSR upstream from Meadow Creek	64.3%	64.4%	64.8%	64.4%	64.4%	64.8%
Meadow Creek and East Fork Meadow Creek	63.9%	64.6%	64.6%	65.1%	64.5%	66.3%
East Fork SFSR between Meadow Creek and YPP	64.2%	65.0%	66.5%	65.7%	65.6%	65.4%
East Fork SFSR Between YPP and Sugar Creek	68.0%	70.2%	65.5%	65.7%	65.6%	67.7%

% = percent; East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit

With the occupancy probability identified in each system, the length of habitat that has an occupancy probability in each stream was calculated. The length of potential habitat available for westslope cutthroat trout are presented in **Table 7-21**.

Table 7-21 Length of Available Habitat for Potential Occupancy for Westslope Cutthroat Trout Under the 2021 Modified Mine Plan

Stream Reach	Baseline (km)	Mine Year 6 (km)	Mine Year 12 (km)	Mine Year 18 (km)	Mine Year 27 (km)	Mine Year 112 (km)
East Fork SFSR upstream from Meadow Creek	13.1	13.9	13.1	13.1	13.9	13.1
Meadow Creek and East Fork Meadow Creek	13.1	7.1	6.8	7.4	15.2	14.0
East Fork SFSR between Meadow Creek and YPP	6.7	5.6	7.8	6.9	7.4	8.1
East Fork SFSR Between YPP and Sugar Creek	1.2	0.5	0.7	0.7	0.7	0.7

EFMC = East Fork Meadow Creek; East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit

The largest decreases of available potential habitat for westslope cutthroat trout relative to baseline conditions would occur in the Meadow Creek drainage. During this period, the main activities that contribute to the loss of potential habitat in these areas are the diversion of Meadow Creek around the TSF footprint; the construction of the rock drain on East Fork Meadow Creek and the East Fork SFSR fish tunnel; and dewatering of the YPP lake, all occurring in Mine Year -1. The length of available habitat in these areas would increase at Mine Year 18 following restoration of Meadow Creek along the TSF.

Mine actions, stream enhancement, and restoration implemented by Mine Year 18 would remove all major fish passage blockages. Any remaining available habitat blockages would occur only in non-enhanced reaches and the Meadow Creek TSF high-gradient areas where fish cannot naturally access the available habitat. The approximately upper 10 km of Meadow Creek would remain blocked in perpetuity due to the high-gradient stream segments flowing off the TSF. Based on the current known extent westslope cutthroat trout occupancy, fish in the upper headwaters of Meadow Creek would remain isolated.

Overall, the SGP is expected to result in minor, permanent, and localized benefits to occupancy probability and the available habitat for occupancy potential for westslope cutthroat trout.

Integration of Effects

The combination of physical stream channel changes, direct effects to individuals, and changes to many of the WCIs would negatively affect westslope cutthroat trout in the analysis area through the loss of suitable habitat. Despite some improvement to access, there remain potential effects which may cause injury or mortality to individuals and/or displacement of westslope cutthroat trout.

Following reclamation, the net effect would be a minor loss of both quantity and quality of habitat for westslope cutthroat trout including:

- Changes to water chemistry would primarily have minor effects but would have an unknown level of beneficial effects through the reduction of arsenic and antimony.
- Habitat enhancements to the East Fork SFSR and Meadow Creek would provide benefits to westslope cutthroat trout habitat.
- The primarily net reduction in water temperatures in the East Fork SFSR and Meadow Creek would provide a net minor benefit for westslope cutthroat trout. There is a slight modeled decrease in temperature-suitable habitat for all life stages.
- Changes in flows would result in a net decrease in westslope cutthroat trout habitat in Meadow Creek, but most flows would return to near baseline conditions in the East Fork SFSR after mine closure and post-closure. Habitat quantified by WUA available to westslope cutthroat trout based on PHABSIM model results show low reductions in WUA post-closure, with a negligible net decrease in westslope cutthroat trout habitat.
- The removal of barriers would have negligible effects on westslope cutthroat trout. A new barrier would be constructed in Meadow Creek along the TSF, which would result in blockage, which may result in isolation of fish in the headwaters.
- There would be a minor net increase in occupancy potential for westslope cutthroat trout.

The 2021 MMP may indirectly impact westslope cutthroat trout individuals but would not likely contribute to a trend towards ESA listing or loss of viability of the species within the planning area.

7.2.4 Johnson Creek Route Alternative

7.2.4.1 Direct Impacts to Individuals

Spill Risk

The potential for surface water quality impacts from accidental fuel or chemical spills along the mine access roads would be comparable between the action alternatives. However, all vehicle trips would traverse the Johnson Creek Route under this alternative, resulting in greater use of the Johnson Creek Route access roads. The potential location and extent of accidental spills would therefore differ compared to the 2021 MMP. The Johnson Creek Route is located in close proximity to streams (i.e., within 100 feet) for 6.5 miles or 18 percent of its approximately 36-mile length, so the potential for fuel and hazardous chemical spills impacting surface water quality is higher than for travel on the Burntlog Route which is within 100 feet of a stream for 1.69 miles or four percent of its length. Overall design features proposed by Perpetua, design features required by the Forest Service, and permit stipulations and regulatory requirements from state and federal agencies (including use of USDOT-certified containers and USDOT-registered transporters) would reduce the risk of spills and promote effective response should a spill occur.

The effects of spills associated with the Johnson Creek Route alternative on surface water and potentially on fish and aquatic habitat would be minor to major, temporary, and localized depending on the spill location.

7.2.4.2 Impacts to Watershed Condition Indicators

Sediment and Turbidity

The number of streams crossed along the Johnson Creek Route (43) would be reduced compared to the 2021 MMP. However, the Johnson Creek Route would be widened and upgraded under this alternative to accommodate approximately 60 vehicle trips per day for the duration of the operating period. Therefore, surface water quality impacts from erosion and sedimentation during access road construction could increase during the construction activities and would require implementation of sediment and erosion BMPs.

Use of the Johnson Creek Route for site access would avoid construction-related impacts from sedimentation at 21 different streams compared to the 2021 MMP. These streams include Burntlog Creek, East Fork Burntlog Creek, the East Fork SFSR, Johnson Creek, Landmark Creek, Peanut Creek, Rabbit Creek, Riordan Creek, Trapper Creek, and 12 unnamed waterbodies.

During mine construction, the number of daily vehicle trips to the SGP would be comparable between the alternatives. The number of daily vehicle trips also would be the same during mine operations and reclamation; however, all vehicle trips would traverse the Johnson Creek Route under this alternative, resulting in greater use of the Johnson Creek Route access roads, and more fugitive dust generation and greater wear and tear on the road surface. In addition, use of the Johnson Creek Route would require two additional years of construction. The resulting surface water quality impacts from erosion and sedimentation would therefore differ in location and extent compared to the 2021 MMP but would be similar in magnitude because the number of vehicle trips to the SGP would remain the same.

Prevention of these types of impacts would be achieved through proper road design, construction, grade control, fugitive dust control and, in the winter months, snow removal and “sanding” using gravel and coarse sand with minimal fines to avert slippery conditions and reduce off-site sedimentation during the spring runoff season (**Tables 2-2** and **2-3**).

Overall, based on identified maintenance activities, design features proposed by Perpetua, design features required by the Forest Service, and permit stipulations from state and federal agencies, traffic-related dust and erosion/sedimentation would be within the normal range of properly maintained NFS roads. The duration for traffic-related dust and erosion/sedimentation would last throughout the entire period of use of the Johnson Creek Route (approximately 40 years); however, the potential for these effects would be incrementally reduced during closure and reclamation (when average annual daily traffic would be reduced). Due to the nature of airborne dust and sediment transport by streams, the geographic extent of the impact could be hundreds of feet to miles, depending on many site- and event-specific factors, but it is expected that effects would be limited to within the subwatersheds of the analysis area.

The effects of the Johnson Creek Route Alternative of sedimentation would be moderate, long-term, and localized.

Chemical Contaminants

The water quality effects of the Johnson Creek Route Alternative and 2021 MMP are comparable with regard to contact water, water treatment, groundwater chemistry, surface water chemistry, stream temperature, and impaired water bodies. The change in site access does result in some differences in effects of sedimentation and fuels and hazardous chemicals as noted above.

7.3 Mitigation and Monitoring

Mitigation measures required by the Forest Service would represent reasonable and effective means to reduce the impacts identified in the previous section or to reduce uncertainty regarding the forecasting of impacts into the future. These mitigation measures would be in addition to the Forest Service requirements and environmental design features (**Section 2.4**) accounted for in the preceding impact analysis.

Mitigation measures may be added, revised, or refined based on public comment, agency comment, or continued discussions with Perpetua regarding this specialist report or subsequent analysis under NEPA. The adopted mitigation measures will be finalized in the Final EIS.

7.4 Cumulative Effects

7.4.1 Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The cumulative effects analysis area for fish and aquatic habitat that could be directly or indirectly affected by the SGP is the same analysis area used to evaluate direct effects on fish and aquatic habitat, which consists of all of the watercourses and waterbodies in the Hydrologic Unit Code 6th field (10-digit code watersheds that overlap potential SGP disturbance areas (**Figure 5-1**).

Cumulative effects consider the range of existing and foreseeable activities and their potential effects with respect to fish and aquatic habitat when combined with the potential direct and indirect impacts of the SGP. Past and present actions that have, or are currently, affecting fish and aquatic habitat include past and current mining activities (including exploration), infrastructure projects, ongoing Forest Service management projects, recreation, fishing, transportation projects, water diversions, hydropower projects, and wildland fires.

Reasonably foreseeable future actions that could cumulatively contribute to fisheries and aquatic habitat impacts in the analysis area include:

- South Fork Restoration and Access Management Plan,
- East Fork Salmon River Restoration and Access Management Plan,
- Granite Meadows,
- Stallion Gold Horse Heaven Project,
- Burntlog Route Geophysical Investigation, and
- ASAOC signed January 15, 2021.

7.4.2 No Action Alternative

The existing baseline conditions of fish and aquatic habitat in and adjacent to the mine site are expected to improve due to the removal of legacy mining materials that are in contact with surface waters in Meadow Creek and the East Fork SFSR under the ASAOC Phase I. The ASAOC is a separate action and not tied to the permitting of the SGP. Although impacts would likely be reduced due to a reduction of mine waste available for contact with surface water, elevated arsenic and antimony concentrations would persist as a cumulative impact with inputs from other historical sources (e.g., SODA) and inputs from natural sources that would continue to cause contaminant loading to the environment and influence Meadow Creek and East Fork SFSR stream flow concentrations. These actions are consistent with standard EPA presumptive remedies for this type of site.

Cumulative impacts to fisheries also could occur at the SGP area due to continuing surface exploration for the Golden Meadows Exploration Project. These previously approved activities include construction of several temporary roads (approximately 0.32 mile of temporary roads) to access drill sites (total of 28 drill sites), drill pad construction (total of 182 drill pads), and drilling on both Forest Service and private lands at and in the vicinity of the SGP. The continuation of approved exploration activities at the SGP by Perpetua could cumulatively increase stream sediment levels resulting from surface disturbance and erosion. Exploration activities also could cause cumulative surface water quality impacts through accidental spills of diesel, gasoline, and jet fuel stored at the SGP in aboveground tanks.

7.4.3 2021 Modified Mine Plan

These actions would occur in the same watershed and are expected to have similar types of impacts to fish and aquatic habitat as described for the 2021 MMP, such as increases in sediment and stream temperatures, stream flow reductions, and stream channel changes. However, because these projects appear to be at a smaller scale than the SGP, their impacts also would be at a smaller scale. These projects also could have beneficial effects on fish and aquatic habitat in the long-term and are summarized below.

The South Fork Restoration and Access Management Plan and the East Fork Salmon River Restoration and Access Management Plan include numerous actions related to watershed reclamation within the SFSR watershed and is therefore expected to have a long-term beneficial effect on habitat conditions for fish.

The PNF’s Wildlife Conservation Strategy would affect fish because one of its objectives to actively reclaim or maintain conditions for sensitive fish and 303(d) listed waterbodies.

Cumulative effects from large-scale management of Forest vegetation could include short-term disturbance of fish habitats and increases in sediment; but would be beneficial in the long-term. **Table 7-22** provides a general description of effects on fish and aquatic resources from the other types of projects that are expected to occur in the analysis area.

The impacts from the specific reasonably foreseeable future projects and other future projects or activities would likely be short duration and are planned at a smaller scale. However, when combined with the potential impacts and duration of the 2021 MMP, the duration and scale of cumulative impacts on fish and aquatic habitat would be larger because all these projects would occur during the same time period. The resulting cumulative effect on fish and aquatic habitat in the analysis area would be temporal losses or degradation of habitat and behavioral disturbances, along with some long-term beneficial effects from habitat improvements.

Table 7-22 Cumulative Effects on Fish and Aquatic Habitat from Other Future Projects or Activities

Cumulative Project Type	Effects on Fish and Aquatic Habitat
Mineral exploration and mining activities	Currently planned or future mine development would affect fish and habitat during development through direct disturbance of habitat, increase sediment, changes in stream flow and temperature.
Closure and reclamation projects	Projects within fish habitat that are currently, or in the future, undergoing reclamation would likely improve fish habitat because these projects involve the removal of some infrastructure and reclamation of native habitats.
Transportation projects	Road maintenance, bridge or culvert replacement, and improvement projects are likely in the analysis area. Installation or improvement of culverts or bridges may impact fish habitat due to construction-related effects such as erosion and sediment in streams. Maintenance of existing roadways and culverts/bridges would create short-term impacts, while new roadways and culverts/bridges could have impacts for a longer period.
Recreation and tourism effects	Recreational activities such as fishing would continue to affect fish in the future. Fishing activities could decrease localized fish populations. These are regulated by the IDFG and would not lead to cumulative impacts when combined with impacts from the SGP.
Private Development Projects	Private residential developments are likely to have minor temporary impacts on fish and fish habitat, such as culvert installations or replacements, and increases in sediment related to construction and vehicle use in the future.

7.4.4 Johnson Creek Route Alternative

The effects discussed for the 2021 MMP for the SGP and reasonably foreseeable future actions would also occur under the Johnson Creek Route Alternative. The use of the Johnson Creek Road rather than the construction of the Burntlog Route would increase the risk of spills and sedimentation in Johnson Creek. Therefore, the cumulative effects from the Johnson Creek Route Alternative would be greater in degree with regards to spills and sediment compared to the 2021 MMP but would be comparable with regard to other effects.

7.5 Short-term Uses and Long-term Productivity

7.5.1 No Action Alternative

Under the No Action Alternative, there would be no open pit mining or removal of legacy waste material at the SGP. Consequently, no short-term use would occur that would affect fisheries resources, and no change in long-term productivity would occur.

7.5.2 2021 Modified Mine Plan

Mining by its nature is a short-term land use with its effects on long-term productivity dependent on the success of its closure and reclamation activities. Construction and operation of the proposed mine would result in short-term impacts to fish and associated habitat. During construction and operations, some sections of fish habitat would be removed from the footprint of the proposed mine site. Changes to fish habitat include diverting the East Fork SFSR around YPP and subsequently backfilling and constructing a stream channel atop the pit at closure. In the long-term restoring fish passage upstream from the YPP would result in an increase in available habitat for anadromous and resident fish in the analysis area.

Short-term changes to fish habitat in Meadow Creek include diverting a portion of the creek just south of the proposed Hangar Flats open pit, and the loss of habitat where the TSF and TSF Buttress would be located. The short-term loss of habitat would negatively affect fish populations in Meadow Creek over the life of the mine. Closure and reclamation would restore habitat over time.

7.5.3 Johnson Creek Route Alternative

Under the Johnson Creek Route Alternative, the effects of short-term use and long-term productivity would be the same as that described for the 2021 MMP because the impacts to fish and aquatic habitat are primarily associated with activity at the mine site.

7.6 Irreversible and Irretrievable Commitments of Resources

7.6.1 No Action Alternative

Under the No Action Alternative there would be no irreversible or irretrievable commitment of fish and aquatic habitat resources.

7.6.2 2021 Modified Mine Plan

Irreversible Commitments – A commitment of resources is irreversible when the impacts of the proposed action or alternatives would limit the future options for use of the resource. This applies primarily to non-renewable resources or to processes or resources that are renewable over long periods of time.

The direct mortality of fish would be an irreversible impact that could occur under the 2021 MMP. Although fish exclusion barriers and trap and transfer activities would be incorporated to minimize fish mortality, incidental injury or mortality is expected to occur. These “takes” of fish in the mine site would be considered irreversible. Species subject to potential irreversible losses include Chinook salmon, steelhead trout, bull trout, and cutthroat trout.

Irretrievable Commitments – A commitment of resources is irretrievable when the impacts of the action alternatives would result in a loss of production, harvest, or use of renewable resources. An irretrievable commitment of resources occurs when a resource that is renewable over a relatively short period of time is consumed during the life of the SGP and is therefore unavailable for other uses until the use ceases and it is renewed and once again available. It is the temporal loss of resources that is considered irretrievable.

This includes resources that are renewable over a short time, such as riparian vegetation and streams. While the loss of the resource itself is reversible (through mitigation), the temporal loss of the use of the resource or habitat is irretrievable. The SGP would cause a temporal loss of fish habitat for fish species inhabiting certain stream reaches.

Portions of Meadow Creek upstream from the southern extent of the TSF would be irretrievable and unavailable to downstream fish within Meadow Creek during construction and operations. During construction and operations, the presence of the TSF and TSF Buttress would essentially isolate any populations of bull trout and westslope cutthroat trout which are known to inhabit the upper reaches of Meadow Creek. After closure and reclamation, restoration of Meadow Creek over the TSF/TSF Buttress would restore habitat, but a fish barrier would remain in place and access to upstream habitat would keep the upstream populations isolated.

The loss of existing fish habitat in the YPP lake may constitute as an irretrievable commitment of resources.

7.6.3 Johnson Creek Route Alternative

Under the Johnson Creek Route Alternative, the irreversible and irretrievable commitment of fish and aquatic resources would be the same as that described for the 2021 MMP because the impacts to fish and aquatic habitat are primarily associated with activity at the mine site.

7.7 Summary

For fish and aquatic habitat, the important factors involve the removal and placement of barriers such as the Yellow Pine Pit and TSF/TSF Buttress (which affect species differently), the modifications in surface water management and flows at the mine site, fish access through the East Fork SFSR fishway, and stream channel restoration effects on stream temperature. The principal difference between alternatives is associated with the risk of transportation-related spills along access routes. Reclamation and stream restoration activities post-closure generally improve habitat conditions compared to the operational period as flows and channels are re-established. However, stream temperatures are increased in restored stream channels until revegetation establishes to provide riparian shading for the streams.

Table 7-23 provides a summary comparison of fish and aquatic resource impacts by issues.

Table 7-23 Comparison of Fisheries and Aquatic Habitat Impacts by Alternative

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
The SGP may cause changes in fish habitat in the analysis area that may affect aquatic species, including federally listed fish species and aquatic habitat (e.g., Critical Habitat within and downstream from the SGP area.	Direct Impacts to Individuals	No mining related activities.	No change from Baseline.	Individuals would be affected by dewatering, salvage, and relocation due to modification of stream channels and the dewatering of the Yellow Pine Pit lake.	Same as 2021 MMP.
	Altered Physical Stream Structure	No mining related activities.	No change from Baseline.	Diversion of stream channels, elimination of the Yellow Pine Pit lake, the fish tunnel, and new barriers would affect fish occupancy and habitat during construction and operations.	Same as 2021 MMP.
	Changes to Water Temperature WCI	No mining related activities.	No change from Baseline.	During operations summer maximum stream water temperatures in Meadow Creek and the East Fork South Fork would decrease by up to 3.7°C due to diversion of Meadow Creek around the TSF and TSF Buttress. Upon closure and routing of Meadow Creek to the restored stream channel on top of the reclaimed TSF, summer maximum stream temperatures would increase by up to 6.8°C due to the time needed for revegetation to result in riparian shading of the stream. Over time, summer maximum stream temperatures would decline to near or below baseline conditions except for the Meadow Creek upstream from East Fork Meadow Creek which would remain 1.1°C above existing conditions.	Same as 2021 MMP.

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Sediment and turbidity from construction of temporary roads and transmission lines	No mine-related traffic on existing Forest Service Roads	No change from Baseline	Access road roads would cross 43 streams and transmission lines would cross 37 streams. **Construction:** 6.5 miles (18% of routes) would be within 100 feet of streams. **Operations:** 1.56 miles (4% of routes) would be within 100 feet of streams. Sedimentation and fugitive dust predicted to be within normal range of properly maintained Forest Service roads.	Same as 2021 MMP except 6.5 miles of stream would be within 100 feet of streams during operations.
	Change in Access to fish habitat through culverts from road construction	Use of existing roads and culverts	No change from Baseline	Culvert replacements on the Burntlog Route may increase or re-establish habitat access for native and non-native species.	No change from Baseline
	Change in amount of stream habitat by barrier removal and new barriers	Existing barriers in place	No change from Baseline	Removal of the box culvert in the East Fork SRSR would provide additional access to around 6 km of IP habitat for Chinook salmon and steelhead, with the removal of the barrier at the YPP lake cascade adding more than an additional 2.5 km for Chinook salmon. Removal of these barriers will provide access to nearly 33 km of habitat for bull trout and westslope cutthroat trout. Removal of barriers in the downstream end of Fiddle Creek would provide an additional 2 km of habitat for bull trout and westslope cutthroat trout. Creation of a partial gradient barrier in East Fork Meadow Creek would provide additional access to habitat for bull trout and westslope cutthroat trout. The removal and addition of barriers in Meadow Creek would ultimately result in a reduction in access to the Meadow Creek headwaters.	Same as 2021 MMP.

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Changes to Chemical Contaminants Associated with Spills	No mining related activities.	No change from Baseline.	Effects of spills would be managed via application of Forest Service requirements and project design features to minimize effects.	Same as 2021 MMP. Effects from spills would be potentially more significant because 6.5 miles of the permanent access road would be within 100 feet of streams during operations.

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Changes to Chemical Contaminants Associated with Mining Activity	**TSF Area** Aluminum: No exceedance Copper: No exceedance Antimony: 0.001 mg/L to 0.025 mg/L Arsenic: 0.004 mg/L to 0.075 mg/L Mercury: 1 ng/L to 2 ng/L **East Fork SFSR Downstream from SGP** Aluminum: No exceedance Copper: No exceedance Antimony: 0.0052 mg/L to 0.025 mg/L Arsenic: 0.014 mg/L to 0.076 mg/L Mercury: 3.2 ng/L to 9.6 ng/L	No change from Baseline.	**TSF Area** Aluminum: No exceedance Copper: No exceedance Antimony: 0.001 mg/L to 0.014 mg/L Arsenic: 0.001 mg/L to 0.018 mg/L Mercury: 1 ng/L to 2 ng/L **East Fork SFSR Downstream from SGP** Aluminum: No exceedance Copper: No exceedance Antimony: 0.003 mg/L to 0.016 mg/L Arsenic: 0.010 mg/L to 0.066 mg/L Mercury: 3.0 ng/L to 10.0 ng/L Increased seasonal peaks in mercury concentrations would be 1 to 3 ng/L above existing conditions in the mine area but below applicable water quality standards (12 ng/L). The effects of mercury concentrations on methylated mercury concentrations in the mine site area are comparable to existing conditions based on site-specific ratios of methylmercury to mercury concentrations (up to 2%). Effects of differences in peak mercury concentrations on downstream mercury methylation have not been quantified.	Same as 2021 MMP.

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Changes in Stream Flow	No mining related activities.	No change from Baseline.	East Fork SFSR Upstream from Sugar Creek: Up to 24.8% reduction in flow during operations. No reduction in flow post-closure. East Fork SFSR at Stibnite: Up to 20.4% reduction in flow during operations. No reduction in flow post-closure. East Fork SFSR Upstream from Meadow Creek: Up to 3.8% reduction in flow during operations. Up to 2% reduction in flow post-closure. Meadow Creek: Up to 36.4% reduction in flow during operations. Less than 1% reduction in flow post-closure.	Same as 2021 MMP
	Suitable Habitat Based on Optimal Thermal Requirements for Chinook Salmon	Below Yellow Pine Pit: Adult Migration (15-19˚C): 0 km Adult Migration (12-17˚C): 2.01 km Spawning (13˚C): 0 km Spawning (4-14˚C): 2.01 km Incubation: 0 km Juvenile Rearing: 2.01 km Total Available: 2.01 km Above Yellow Pine Pit: Adult Migration (15-19˚C): 2.43 km	No Change from Baseline	**Middle of Operations:** Below Yellow Pine Pit: Adult Migration (15-19˚C): 0 km Adult Migration (12-17˚C): 1.48 km Spawning (13˚C): 0 km Spawning (4-14˚C): 1.48 km Incubation: 0 km Juvenile Rearing: 1.48 km Total Available: 1.48 km Above Yellow Pine Pit: Adult Migration (15-19˚C): 0.25 km Adult Migration (12-17˚C): 3.35 km Spawning (13˚C): 0.28 km Spawning (4-14˚C): 6.85 km Incubation: 3.50 km Juvenile Rearing: 10.94 km Total Available: 10.94 km **Post-Closure:** Below Yellow Pine Pit:	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
		Adult Migration (12-17˚C): 7.48 km Spawning (13˚C): 1.51 km Spawning (4-14˚C): 10.92 km Incubation: 3.44 km Juvenile Rearing: 10.92 km Total Available: 10.92 km		Adult Migration (15-19˚C): 0 km Adult Migration (12-17˚C): 1.66 km Spawning (13˚C): 0 km Spawning (4-14˚C): 1.66 km Incubation: 0.73 km Juvenile Rearing: 1.66 km Total Available: 1.66 km Above Yellow Pine Pit: Adult Migration (15-19˚C): 0 km Adult Migration (12-17˚C): 6.57 km Spawning (13ºC): 0 km Spawning (4-14ºC): 10.07 km Incubation: 7.39 km Juvenile Rearing: 18.97 km Total Available: 18.97 km	
	Chinook Salmon Flow Productivity	East Fork SFSR Upstream from Sugar Creek: 1.06 East Fork SFSR at Stibnite: 1.06 East Fork SFSR Upstream from Meadow Creek: 1.06 Meadow Creek: 1.06	No change from Baseline.	East Fork SFSR Upstream from Sugar Creek: Up to 21.4% reduction during operations. No reduction post-closure. East Fork SFSR at Stibnite: Up to 17.7% reduction during operations. No reduction post-closure. East Fork SFSR Upstream from Meadow Creek: Up to 3.9% reduction during operations. Up to 1.8% reduction post-closure. Meadow Creek: Up to 28.6% reduction during operations. Less than 1% reduction post-closure.	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Chinook Salmon Intrinsic Potential	11.15 km	No change from Baseline	**Operations:** Loss of 3.34 km (30 percent). **Closure:** Gain of 0.28 km (2 percent).	Same as 2021 MMP.
	Chinook Salmon Critical Habitat	East Fork SFSR above Yellow Pine Pit: 25.88 km Meadow Creek: 6.81 km	No change from Baseline	**Operations:** Above Yellow Pine Pit: 25.9 km **Closure:** Above Yellow Pine Pit: 25.9 km	Same as 2021 MMP.
	Suitable Habitat Based on Optimal Thermal Requirements for Steelhead	Below Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 2.01 km Total Available: 2.01 km Above Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 0 km Total Available: 0 km	No Change from Baseline	**Middle of Operations:** Incubation: 0 km Juvenile Rearing: 1.66 km Total Available: 1.66 km Above Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 8.52 km Total Available: 8.52 km **Post-Closure:** Incubation: 0 km Juvenile Rearing: 1.66 km Total Available: 1.66 km Above Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 10.07 km Total Available: 10.07 km	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Steelhead Flow Productivity	East Fork SFSR Upstream from Sugar Creek: 1.24 East Fork SFSR at Stibnite: 1.24 East Fork SFSR Upstream from Meadow Creek: 1.24 Meadow Creek: 1.24	No change from Baseline.	East Fork SFSR Upstream from Sugar Creek: Up to 21.1% reduction during operations. No reduction post-closure. East Fork SFSR at Stibnite: Up to 17.6% reduction during operations. No reduction post-closure. East Fork SFSR Upstream from Meadow Creek: Up to 1.8% reduction during operations. No reduction post-closure. Meadow Creek: Up to 29.5% reduction during operations. Less than 1% reduction post-closure.	Same as 2021 MMP
	Steelhead Intrinsic Potential	10.67 km	No change from Baseline	**Operations:** Loss of 2.33 km (22 percent) **Closure:** Gain of 1.77 km (17 percent).	Same as 2021 MMP.
	Steelhead Critical Habitat	No Critical Habitat at mine site. Critical Habitat in proximity to access routes could be affected by spills.	No change from Baseline	No change from Baseline for mine site area. See above for spills summary.	Same as 2021 MMP. See above for spills summary.

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Suitable Habitat Based on Optimal Thermal Requirements for Bull Trout	Below Yellow Pine Pit: Spawning - FA: 0 km Spawning - FR: 0 km Spawning - FUR: 2.01 km Incubation - FA: 0 km Incubation - FUR: 0 km Juvenile Rearing - FA: 2.01 km Juvenile Rearing - FR: 0 km Juvenile Rearing - FUR: 2.01 km Total Available: 2.01 km Above Yellow Pine Pit: Spawning - FA: 1.62 km Spawning - FR: 7.76 km Spawning - FUR: 14.82 km Incubation - FA: 0 km Incubation - FUR: 24.20 km	No Change from Baseline	**Middle of Operations:** Below Yellow Pine Pit: Spawning - FA: 0 km Spawning - FR: 0 km Spawning - FUR: 1.48 km Incubation - FA: 0 km Incubation - FUR: 1.48 km Juvenile Rearing - FA: 0 km Juvenile Rearing - FR: 1.48 km Juvenile Rearing - FUR: 0 km Total Available: 1.48 km Above Yellow Pine Pit: Spawning - FA: 1.42 km Spawning - FR: 6.28 km Spawning - FUR: 8.64 km Incubation - FA: 0 km Incubation - FUR: 16.34 km Juvenile Rearing - FA: 10.35 km Juvenile Rearing - FR: 5.99 km Juvenile Rearing - FUR: 0 km Total Available: 16.34 km **Post-Closure:** Below Yellow Pine Pit: Spawning - FA: 0 km Spawning - FR: 0.05 km Spawning - FUR: 1.61 km Incubation - FA: 0 km	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
		Juvenile Rearing - FA: 12.16 km Juvenile Rearing - FR: 9.60 km Juvenile Rearing - FUR: 2.43 km Total Available: 24.20 km		Incubation - FUR: 1.66 km Juvenile Rearing - FA: 0 km Juvenile Rearing - FR: 1.66 km Juvenile Rearing - FUR: 0 km Total Available: 1.66 km Above Yellow Pine Pit: Spawning - FA: 1.42 km Spawning - FR: 6.34 km Spawning - FUR: 8.29 km Incubation - FA: 0 km Incubation - FUR: 16.05 km Juvenile Rearing - FA: 7.76 km Juvenile Rearing - FR: 8.29 km Juvenile Rearing - FUR: 0 km Total Available: 16.05 km	
	Bull Trout Distance Weighted Average Occupancy Probabilities	East Fork SFSR between YPP and Sugar Creek: 15.3% East Fork SFSR between Meadow Creek and YPP: 10.0% East Fork SFSR Upstream from Meadow Creek: 8.4% Meadow Creek: 5.7%	No change from Baseline.	East Fork SFSR between YPP and Sugar Creek: 12.4% - 22.6% during operations. 16.1% post-closure. East Fork SFSR between Meadow Creek and YPP: 12.4% - 15.2% during operations. 14% post-closure. East Fork SFSR Upstream from Meadow Creek: 8.5% - 9.6% during operations. 9.7% post-closure. Meadow Creek: 6.7% - 7.8% during operations. 8.7% post-closure.	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Bull Trout Length of Available Habitat for Potential Occupancy	East Fork SFSR between YPP and Sugar Creek: 1.2 km East Fork SFSR between Meadow Creek and YPP: 6.5 km East Fork SFSR Upstream from Meadow Creek: 13.1 km Meadow Creek: 13.1 km	No change from Baseline.	East Fork SFSR between YPP and Sugar Creek: 0.5 – 0.7 km during operations. 0.7 km post-closure. East Fork SFSR between Meadow Creek and YPP: 5.6 – 7.8 km during operations. 8.1 km post-closure. East Fork SFSR Upstream from Meadow Creek: 13.1 – 13.9 km during operations. 13.1 km post-closure. Meadow Creek: 6.8 - 7.4 km during operations. 14.0 km post-closure.	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Suitable Habitat Based on Optimal Thermal Requirements for Westslope Cutthroat Trout	Below Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 2.01 km Total Available: 2.01 km Above Yellow Pine Pit: Incubation: 0.85 km Juvenile Rearing: 20.91 km Total Available: 24.20 km	No Change from Baseline	**Middle of Operations:** Below Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 1.48 km Total Available: 1.48 km Above Yellow Pine Pit: Incubation: 0.78 km Juvenile Rearing: 17.33 km Total Available: 18.11 km **Post-Closure:** Below Yellow Pine Pit: Incubation: 0 km Juvenile Rearing: 1.66 km Total Available: 1.66 km Above Yellow Pine Pit: Incubation: 2.11 km Juvenile Rearing: 21.65 km Total Available: 23.77 km	Same as 2021 MMP

Issue	Indicator	Baseline Conditions	No Action	2021 MMP	Johnson Creek Route Alternative
	Westslope Cutthroat Trout Distance Weighted Average Occupancy Probabilities	East Fork SFSR Upstream from between YPP and Sugar Creek: 68.0% East Fork SFSR between Meadow Creek and YPP: 64.2% East Fork SFSR Upstream from Meadow Creek: 64.3% Meadow Creek: 63.9%	No change from Baseline.	East Fork SFSR Upstream from between YPP and Sugar Creek: 65.5% - 70.2% during operations. 67.7% post-closure. East Fork SFSR at Stibnite: 65.0% - 66.5% during operations. 65.4% post-closure. East Fork SFSR between Meadow Creek and YPP: 64.4% - 64.8% during operations. 64.8% post-closure. Meadow Creek: 64.6% - 65.1% during operations. 66.3% post-closure.	Same as 2021 MMP
	Westslope Cutthroat Trout Length of Available Habitat for Potential Occupancy	East Fork SFSR between YPP and Sugar Creek: 1.2 km East Fork SFSR between Meadow Creek and YPP: 6.7 km East Fork SFSR Upstream from Meadow Creek: 13.1 km Meadow Creek: 13.1 km	No change from Baseline.	East Fork SFSR between YPP and Sugar Creek: 0.5 – 0.7 km during operations. 0.8 km post-closure. East Fork SFSR between Meadow Creek and YPP: 5.6 – 7.8 km during operations. 8.1 km post-closure. East Fork SFSR Upstream from Meadow Creek: 13.1 – 13.9 km during operations. 13.1 km post-closure. Meadow Creek: 6.8 - 7.4 km during operations. 14.0 km post-closure.	Same as 2021 MMP

8.0 References

Adams, Susan B., Christopher A. Frissell, Bruce E. Rieman. 2002. Changes in Distribution of Nonnative Brook Trout in an Idaho Drainage over Two Decades. Transactions of the American Fisheries Society 131:561–568.

AECOM (2020a) Fish and Aquatic Resources Supplemental Information. Appendix J-1 of the Stibnite Gold Project Draft Environmental Impact Statement. August 2020.

AECOM (2020b) Fish Relative Species Abundance and Density. Appendix J-10 of the Stibnite Gold Project Draft Environmental Impact Statement. August 2020.

Alaska Department of Fish and Game. 1991. Blasting Standards for the Protection of Fish. Alaska Department of Fish and Game, Division of Habitat, Douglas, AK. Available at: https://www.adfg.alaska.gov/static/license/uselicense/pdfs/adfg_blasting_standards.pdf

ATS Consulting. 2013. Final Construction Noise and Vibration Report SR 520, West Connection Bridge Report. Prepared for Washington State Department of Transportation. 38 pp.

Bjornn, T.C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of Granitic Sediment in Streams and its Effects on Insects and Fish. Bulletin No. 17. College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, Idaho, USA.

BioAnalysts, Inc. (BioAnalysts). 2019. Fish Biology Report. Stibnite Gold Project. Appendix A to Draft Stream Design Report. Prepared for: Midas Gold Idaho, Inc. Prepared by BioAnalysts, Boise, ID.

BioAnalysts, Inc. (BioAnalysts). 2020. Evaluation of Upper EFSFSR Fish Passage Barriers – Technical Memorandum. Stibnite Gold Project. January 30, 2020 Brown and Caldwell. 2018a. Final Stibnite Gold Project Hydrologic Model Existing Conditions Report. Prepared for Midas Gold Idaho, Inc. Valley County, Idaho. April 2018.

Bradford, M.J., and J.S. Heinonen. 2008. Low Flows Instream Flow Needs and Fish Ecology in Small Streams. Fisheries and Oceans Canada and Cooperative Resource Management Institute, School of Resource and Environmental Management, Simon Fraser University. Vancouver, Canada. P165 – 180.

Brown and Caldwell. 2017. Stibnite Gold Project Water Resources Summary Report. Prepared for Midas Gold Idaho, Inc. June 30, 2017.

Brown and Caldwell. 2018. Final Stibnite Gold Project Stream and Pit Lake Network Temperature (SPLNT) Model Existing Conditions Report. Prepared for Midas Gold Idaho, Inc. Valley County, Idaho. March 6, 2018.

Brown and Caldwell. 2019a. Stibnite Gold Project Modified PRO Alternative Modeling Report. September.

Brown and Caldwell. 2019b. Final 2018 Yellow Pine Pit Lake Fish Sampling Summary Report. Prepared for Midas Gold Idaho, Inc. Valley County, Idaho. March 29, 2019.

Brown and Caldwell. 2020a. Final 2019 Yellow Pine Pit Lake Fish Sampling Summary Report. Prepared for Midas Gold Idaho, Inc. Valley County, Idaho. April 2020.

Brown and Caldwell. 2020b. Draft Technical Memorandum: Evaluation of Aquatic Life Criteria for Copper Using the Biotic Ligand Model for the Stibnite Gold Project. March 13, 2020.

Brown and Caldwell. 2021a. Stream and Pit Lake Network Temperature Model Refined Modified Proposed Action (ModPRO2) Report. Prepared for Perpetua Resources Idaho, Inc. July 2021.

Brown and Caldwell. 2021b. Stibnite Gold Project Stibnite Hydrologic Site Model Refined Modified Proposed Action (ModPRO2) Report. Prepared for Perpetua Resources Idaho, Inc. August 2021.

Brown and Caldwell, McMillen Jacobs, and BioAnalysts. 2021a. Fishway Operations and Management Plan. Prepared for Perpetua Resources Idaho, Inc. October 2021.

Brown and Caldwell, McMillen Jacobs, and BioAnalysts. 2021b. Fisheries and Aquatic Resources Mitigation Plan. Prepared for Perpetua Resources Idaho, Inc. October 2021.

Burns, D.C., M. Faurot, D. Hogen, M. McGee, R. Nelson, D. Olson, L. Wagoner, and C. Zurstadt. 2005. Bull Trout Populations on the Payette National Forest. Unpublished report EF.15.0043. McCall, ID: U.S. Department of Agriculture, Forest Service, Payette National Forest. 97p.

Carim, K.J., M.K. Young, K.J. Leder, T.W. Franklin, and M.K. Schwartz. 2017. Investigation into Fish Presence and Distribution in Upper East Fork of the South Fork of the Salmon River Basin and Meadow Creek Lake by the Payette National Forest. USFS Rocky Mountain Research Station, Missoula, MT. Prepared for Payette National Forest. May 20, 2017.

Columbia River Inter-Tribal Fish Commission (CRITFC). 2018. Johnson Creek Summer Chinook. Available at: https://www.critfc.org/fish-and-watersheds/fish-and-habitat-restoration/restoration-successes/johnson-creek-summer-chinook/.

Cooney, T., and D.M. Holzer. 2006. Appendix C: Interior Columbia Basin Stream Type Chinook Salmon and Steelhead Populations: Habitat Intrinsic Potential Analysis. Preliminary draft of the viability criteria for Interior Columbia domain.

Dunlap, K.N. 2009. Blasting Bridges and Culverts: Water Overpressure and Vibration Effects on Fish and Habitat. Master's Thesis, University of Alaska Fairbanks, Juneau, AK.

Ecosystem Sciences (ESS). 2019a. Technical Memorandum Stream Temperature on Fish: Chinook Salmon, Steelhead Trout, Westslope Cutthroat Trout and Bull Trout. December 2019. Updated in February 2022.

Ecosystem Sciences (ESS). 2019b. Fish Passage Barriers, Critical Habitat, Intrinsic Potential and Occupancy Model Impacts. December 2019. Updated in February 2022.

Ecosystem Sciences (ESS). 2019c. Technical Memorandum Intrinsic Potential Model Chinook Salmon and Steelhead. December 2019. Updated in February 2022.

Ecosystem Sciences (ESS). 2019d. Technical Memorandum Chinook Salmon Flow-Productivity Analysis. December 2019. Updated in February 2022.

Ecosystem Sciences (ESS). 2019e. Technical Memorandum Chinook Salmon Critical Habitat. November 2019. Updated in February 2022.

Ecosystem Sciences (ESS). 2019f. Technical Memorandum Habitat Occupancy Model Westslope Cutthroat Trout and Bull Trout Existing Conditions. Updated in February 2022. December 2019.

Ecosystem Sciences (ESS). 2019g. Technical Memorandum Summary of Existing PHABSIM Data to Inform Impacts on Westslope Cutthroat Trout and Bull Trout. Updated in February 2022. December 2019.

Ecosystem Sciences (ESS). 2019h. Technical Memorandum Bull Trout Use of Lake Habitat. November 2019. Updated in February 2022.

Eisler, R. 1991. Cyanide Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85, 55 pp.

Eisler, R. 2000. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants and Animals. Volume 1: Metals, Lewis Publishers, New York.

Faulkner, S.G., M. Welz, W.M. Tonn, D.R. Schmitt. 2008. Effects of Simulated Blasting on Mortality of Rainbow Trout Eggs. Transactions of the American Fisheries Society. 127:1-12.

Fisheries Hydroacoustic Working Group 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities. Available at: http://www.dot.ca.gov/hq/env/bio/files/fhwgcriteria_agree.pdf

Foust, J., and C. Nalder. 2010. Biological Assessment of the Effects on Endangered, Threatened, or Proposed Wildlife, Fish, and Plant Species for the Johnson Creek Watershed Improvement Project. Cascade Ranger District, Boise National Forest, Intermountain Region Forest Service. August 23, 2010.

Fulton, L.A. 1968. Spawning Areas and Abundance of Chinook Salmon in the Columbia River Basin – Past and Present. Special Scientific Report – Fisheries No. 571. U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington D.C., October 1, 1968.

Gowans, A.R.D., J.D. Armstrong, I.G. Priede, and S. Mckelvey. 2003. Movements of Atlantic Salmon Migrating Upstream Through a Fish-pass Complex in Scotland. Ecology of Freshwater Fish 12:177-189.

GeoEngineers, Inc. (GeoEngineers). 2017. Aquatic Resources 2016 Baseline Study – Addendum Report.

Great Ecology, Inc. (Great Ecology). 2018. Revised Stream Functional Assessment Methodology Report for the Stibnite Gold Project. Submitted to Midas Gold Idaho, Inc. May 2018.

Halofsky, J.E., D.L. Peterson, J.J. Ho, N.J. Little, L.A. Joyce (eds). 2018. Climate Change Vulnerability and Adaptation in the Intermountain Region. General Technical Report RMRS-GTR-375. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Part 1. pp. 1-97.

Hamilton, J., and K. Buhl. 1990. Acute Toxicity of Boron, Molybdenum, and Selenium to Fry of Chinook Salmon and Coho Salmon. Environmental Contamination and Toxicology 19(3). May 1990.

Hastings, M.C., and A.N. Popper. 2005. Effects of Sound on Fish. Prepared for California Department of Transportation. Sacramento, CA. 82 pp.

HDR, Inc. (HDR). 2013. Wetland Resources Baseline Study, Stibnite Gold Project. Prepared for Midas Gold Idaho, Inc. July.

HDR, Inc. (HDR). 2016. Stream Functional Assessment, Stibnite Gold Project. Prepared for Midas Gold Idaho, Inc. September 2016. 257 pp.

HDR, Inc. (HDR). 2017. Surface Water Quality Baseline Study, Stibnite Gold Project. Prepared for Midas Gold Idaho, Inc. December 2016, revised May 2017.

Hogen, D.L. 2002. Spatial and Temporal Distribution of Bull Trout, *Salvelinus confluentus*, in the Upper East Fork South Fork Salmon River Watershed, Idaho. Master's Thesis, University of Idaho. March 26, 2002.

Hogen D.M., and D.L. Scarnecchia. 2006. Distinct Fluvial and Adfluvial Migration Patterns of a Relict Charr, *Salvelinus confluentus*, Stock in a Mountainous Watershed, Idaho, USA. Ecology of Freshwater Fish. 15:376-387.

HydroGeo, Inc. (HydroGeo). 2012. Draft Surface Water Hydrology Baseline Study Work Plan for Golden Meadows Project. June 2012.

Idaho Department of Environmental Quality (IDEQ). 2002. South Fork Salmon River Subbasin Assessment. Prepared by: Boise Regional Office, Idaho Department of Environmental Quality. 145 p.

Idaho Department of Environmental Quality (IDEQ). 2005. Implementation Guide for the Idaho Mercury Water Quality Criteria. Negotiated Rulemaking Committee. April 2005. Available at: https://www.deq.idaho.gov/media/639808-idaho_mercury_wq_guidance.pdf.

Idaho Department of Environmental Quality (IDEQ). 2017. Implementation Guidance for the Idaho Copper Criteria for Aquatic Life Using the Biotic Ligand Model, November 2017.

Idaho Department of Environmental Quality (IDEQ). 2018. Idaho's Final 2016 Integrated Report, State of Idaho Department of Environmental Quality, November 2018.

Idaho Department of Fish and Game (IDFG). 2005. Bull Trout Status Review and Assessment in the State of Idaho. Grant # F-73-R-27. Report Period July 2004 to June 2005. IDFG Report Number 05-24.

Idaho Department of Fish and Game (IDFG). 2019a. Fisheries Management Plan 2019 – 2024, A Comprehensive Guide to Managing Idaho's Fisheries Resources. Boise, Idaho. 388 pp.

Idaho Department of Fish and Game (IDFG). 2019b. Meadow Creek Lake Fish Stocking Records. Accessed online at https://idfg.idaho.gov/ifwis/fishingPlanner/stocking/?region=8,3&search=meadow%20creek%20lake on 10/29/2019.

Idaho Department of Lands. 1992. Best Management Practices for Mining in Idaho. Boise, Idaho.

Interior Columbia Technical Recovery Team (ICTRT). 2008. Current Status Reviews: Interior Columbia River Basin Salmon ESUs and Steelhead DPSs. Volume I: Snake River Basin ESUs/DPS, Snake River Spring/Summer Chinook Salmon ESU, Snake River Steelhead DPS, Snake River Fall Chinook Salmon ESU, Snake River Sockeye Salmon ESU. July 2009, (final edits February 2010).

Isaak, D.J., M.K. Young, D.E. Nagel, D.L. Horan, and M.C. Groce. 2015. The Cold-water Climate Shield: Delineating Refugia for Preserving Salmonid Fishes Through the 21st Century. Global Change Biology 21 (7):2465-2828.

Isaak, D.J., S.J. Wenger, E.E. Peterson, J.M. Ver Hoef, S.W. Hostetler, C.H. Luce, J.B. Dunham, J.L. Kershner, B.B. Roper, D.E. Nagel, G.L. Chandler, S.P. Wollrab, S.L. Parkes, and D.L. Horan. 2016. NorWeST Modeled Summer Stream Temperature Scenarios for the Western U.S. Fort Collins, CO: Forest Service Research Data Archive. Available at: https://doi.org/10.2737/RDS-2016-0033.

Isaak, D.J., S.J. Wenger, and M.K. Young. 2017. Big Biology Meets Microclimatology: Defining Thermal Niches of Aquatic Ectotherms at Landscape Scales for Conservation Planning. Ecological Applications 27. January 3, 2017. Available at: https://doi.org/10.5061/dryad.d0s7k.

Jensen, N.R., and K.C. Collins. 2003. Time Required for Yolk Coagulation in Pink Salmon and Steelhead Eggs Exposed to Mechanical Shock. North American Journal of Aquaculture 65:339–343.

Kolden, K.D. and C. Aimone-Martin. 2013. Blasting Effects on Salmonids. Final report June 2013 (IHP-13-051). Prepared for the Alaska Department of Fish and Game, Division of Habitat, Douglas, AK.

Korn, S. and S. Rice. 1981. Sensitivity to, and Accumulation and Depuration of, Aromatic Petroleum Components by Early Life Stages of Coho Salmon (*Oncorhynchus kisutch*). Rapports et Proces-verbaux des Réunions. Conseil International pour l'Éxploration de la Mer, 178:87-92. 1981.

Kumari, B., V. Kumar, A.K. Sinha, J.A. Ahsan, A.K. Gosh, H. Wang, and G. De Boeck. 2017. Toxicology of Arsenic in Fish and Aquatic Systems. Environmental Chemistry Letters - ISSN 1610-3653 - Heidelberg, Springer heidelberg, 15:1(2017), p. 43-6. Full text (Publisher's DOI): https://doi.org/10.1007/S10311-016-0588-9.

Kuzis, K. 1997. Watershed Analysis of the Upper East Fork South Fork of the Salmon River. Prepared through the cooperation of: Stibnite Mine Inc. & Krassel Ranger District, Payette National Forest. Submitted by: Karen Kuzis, KK Consulting August 7, 1997.

Maret, T.R., J.E. Hortness, and D.S. Ott. 2006. Instream flow Characterization of Upper Salmon River Basin Streams, Central Idaho, 2005: U.S. Geological Survey Scientific Investigations Report 200-5230, 110 p.

McIntyre, J.K., D.H. Baldwin, D.A. Beauchamp, and N.L. Scholz. 2012. Low-level Copper Exposures Increase Visibility and Vulnerability of Juvenile Coho Salmon to Cutthroat Trout Predators. Ecological Applications 22:1460-1471.

Midas Gold Idaho, Inc. (Midas Gold). 2016. Golden Meadows Exploration Project Revised Plan of Operations for 3-Year Exploration Drilling Program, 2016. Prepared by: HDR Engineering, Inc. 412 E. Parkcenter Blvd., Suite 100 Boise, ID 83706 March 2016.

Midas Gold Idaho, Inc. (Midas Gold). 2019a. Stibnite Gold Project Water Quality Summary Report. 2012-2017.

Midas Gold Idaho, Inc. (Midas Gold). 2019b. An Important Update on Stibnite Road. Update: June 11, 2019.

Moles, A., S. Bates, S. Rice, and S. Korn. 1981. Reduced Growth of Coho Salmon Fry Exposed to Two Petroleum Components, Toluene and Naphthalene, in Fresh Water. Transactions of the American Fisheries Society 110:430-436.

Morrow, J. 2018. Johnson Creek Chinook Salmon and Flow Data for Quantifying Effects of Altering Streamflow. Memorandum for Johnna Sandow. October 9, 2018.

MWH Americas, Inc. (MWH). 2017. Aquatic Resources 2016 Baseline Study. Stibnite Gold Project, Midas Gold Idaho, Inc. April 2017.

National Marine Fisheries Service (NMFS). 1995. Biological Opinion. U.S. Forest Service and U.S. Army Corps of Engineers Authorizations for Stibnite Mining Inc. Commercial Road Use Permits and Garnet Pit Mining.

National Marine Fisheries Service (NMFS). 2013. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Big Creek Water Diversion Project, Tributaries of Big Creek in the Upper Big Creek (1706020605) and Lower Big Creek (1706020609) Watersheds, Valley County, Idaho (One Project). NMFS Consultation Number: 2012-9526.

National Marine Fisheries Service (NMFS). 2014. Final Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Water Quality Toxics Standards for Idaho. NMFS Consultation Number: 2000-1484.

National Marine Fisheries Service (NMFS). 2016. Proposed ESA Recovery Plan for Snake River Spring/Summer Chinook Salmon (Oncorhynchus tshawytscha) and Snake River Basin Steelhead (*Oncorhynchus mykiss*). October 2016.

National Marine Fisheries Service (NMFS). 2017. ESA Recovery Plan for Snake River Idaho Spring/Summer Chinook Salmon and Steelhead Populations. Chapter 6 Idaho Snake River Steelhead Status and Recovery. NMFS West Coast Region. November 2017.

Nelson, R.L. 2009. Biological Assessment for the Potential Effects of Managing the Payette National Forest in the South Fork Salmon River Section 7 Watershed on Snake River Spring/Summer and Fall Chinook Salmon, Snake River Steelhead, and Columbia River Bull Trout and Biological Evaluation for Westslope Cutthroat Trout. Volume 31. East Fork South Fork Salmon River Bridge Repair.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management, 16:693-727.

Nez Perce Tribe. 2010. Nez Perce Tribe Nacó'x (Chinook Salmon) and Héeyey (Steelhead) Adult Escapement and Spawning Ground Survey 2009 Summary Report. Department of Fisheries Resources Management, Fisheries Research Division. Lapwai, ID.

Nez Perce Tribe. 2011. Nez Perce Tribe Nacó'x (Chinook Salmon) and Héeyey (Steelhead) Adult Escapement and Spawning Ground Survey 2010 Summary Report. Department of Fisheries Resources Management, Fisheries Research Division. Lapwai, ID.

Nez Perce Tribe. 2018. Unpublished Data Regarding Chinook Salmon Spawning Survey Results. [Confidential; not available to the public].

Northwest Power Conservation Council (NPCC). 2004. Salmon Subbasin Assessment Prepared for the Northwest Power and Conservation Council. May 28, 2004.

Obiakor, M.O., M. Tighe, L. Pereg, and S.C. Wilson. 2017. Bioaccumulation, Trophodynamics and Ecotoxicity of Antimony in Environmental Freshwater Food Webs. Critical Reviews in Environmental Science and Technology, Volume 47. p. 2208 – 2258. DOI: 10.1080/10643389.2017.1419790.

Perpetua Resources Idaho Inc. (Perpetua). 2021a. Stibnite Gold Project: Refined Proposed action ModPRO2. October 2021.

Perpetua Resources Idaho Inc. (Perpetua). 2021b. Stibnite Gold Project Transportation Management Plan. October 2021.

Poole, G., J. Dunham, M. Hicks, D. Keenan, J. Lockwood, E. Materna, D. McCullough, C. Mebane, J. Risley, S. Sauter, and S. Spaulding. 2001. Scientific Issues Relating to Temperature Criteria for Salmon, Trout, Char Native to the Pacific Northwest. Environmental Policy Agency.

Rabe, C.D., D.D. Nelson, and T. Hodsdon. 2018. Status and Monitoring of Natural and Supplemented Chinook Salmon in Johnson Creek, Idaho Annual Progress Report Project Number 199604300. Report covers work performed from: March 2016 – December 2017.

Rio Applied Science and Engineering (Rio ASE). 2019. Stream Functional Assessment Report – Stibnite Gold Project. February 2019.

Rio Applied Science and Engineering (Rio ASE). 2021. Stream Design Report – Stibnite Gold Project. September 2021.

Rogers, A., and A. Cane. 1979. Upstream Passage of Adult Salmon Through an Unlit Tunnel. Fisheries Management. Volume 10-2: 87-92.

SRK Consulting (SRK). 2021. Stibnite Gold Project ModPRO2 Site-Wide Water Chemistry (SWWC) Modeling Report. Prepared for Perpetua Resources Idaho, Inc. November 2021.

Stantec. 2018. 2017 Aquatic Baseline Study Technical Memo, Appendix 1. Watershed Condition Indicators and Monitoring Results – Water Temperature. Stibnite Gold Project. Prepared for Midas Gold Idaho, Inc. April 2018.

Stantec. 2019. 2018 Aquatic Baseline Study for the Stibnite Gold Project Technical Memo. Prepared for Midas Gold Idaho, Inc. May 2018.

Stantec. 2020. 2019 Aquatic Baseline Study for the Stibnite Gold Project Technical Memo. Prepared for Midas Gold Idaho, Inc. April 2018.

StreamNet. 2020. Fish Data for the Pacific Northwest. Interactive Web Database. Available at: https://www.streamnet.org/. Accessed July 2020.

Suttle, K.B., M.E. Power, J.M. Levine, and C. McNeely. 2004. How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids. Ecological Applications. 14:969-974.

TetraTech. 2021. Conceptual Stream and Wetland Mitigation Plan Stibnite Gold Project. Prepared for Perpetua Resources Idaho, Inc. December 2021.

Timothy, J. 2013. Alaska Blasting Standard for the Proper Protection of Fish. Alaska Department of Fish and Game, Technical Report No. 13-03, Douglas, Alaska.

Trombulak, S.C., and C.A. Frissel. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology. 14(1):18-30.

URS Corporation. 2000. Stibnite Area Site Characterization Report, Volumes I, II, and III. Project No. 6800024343.00. Denver Colorado. September 12, 2000.

U.S. Environmental Protection Agency (EPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water. Seattle, WA.

U.S. Environmental Protection Agency (EPA). 2018. Final Aquatic Life Ambient Water Quality Criteria for Aluminum 2018. EPA-822-R-18-001. December 2018.

U.S. Environmental Protection Agency (EPA). 2019. Small Diesel Spills. Accessed on 5/28/2019 at https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html.

U.S. Fish and Wildlife Service (USFWS). 2008. Bull Trout 5-Year Review: Summary and Evaluation. Portland, Oregon.

U.S. Fish and Wildlife Service (USFWS). 2012. Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards. Prepared in Cooperation with the National Marine Fisheries Service and Washington State Department of Transportation. Lacey, Washington. June 19, 2002.

U.S. Fish and Wildlife Service (USFWS). 2015a. Recovery Plan for Conterminous United States Populations of Bull Trout (*Salvelinus confluentus*). Portland, Oregon.

U.S. Fish and Wildlife Service (USFWS). 2015b. Upper Snake Recovery Unit Implementation Plan for Bull Trout (*Salvelinus confluentus*). Prepared by U.S. Fish and Wildlife Service Idaho Fish and Wildlife Office Boise, Idaho. September 2015.

U.S. Fish and Wildlife Service (USFWS). 2019. Letter dated October 3, 2019 from Christopher Swanson, Acting State Supervisor, USFWS, to Tawnya Brummett, Acting Forest Supervisor, Payette National Forest, and Alan Haslam, Vice President of Permitting, Midas Gold Idaho. Subject: Comments on the Proposed Stibnite Gold Project – Tunnel Design, Operation and Maintenance.

U.S. Forest Service (Forest Service). 1991. Forest Service Manual. Title 2600 – Wildlife, Fish, and Sensitive Plant Management; Amendment No. 2600-91-5 Effective July 19,1991.

U.S. Forest Service (Forest Service). 2003. Record of Decision for the Final Environmental Impact Statement and Revised Payette National Forest Land and Resource Management Plan. Revised July 2003.

U.S. Forest Service (Forest Service). 2010a. Boise National Forest Land and Resource Management Plan. 2003-2010 Integration.

U.S. Forest Service (Forest Service). 2010b. Biological Assessment for the Potential Effects of Managing the Payette National Forest in the South Fork Salmon River Section 7 Watershed on Snake River Spring/Summer Chinook Salmon, Snake River Steelhead, and Columbia River Bull Trout and Biological Evaluation for Westslope Cutthroat Trout. Volume 33. Golden Meadows Core Drilling – Plan of Operations April 29, 2010.

U.S. Forest Service (Forest Service). 2012. Fisheries Specialist Report for the Idaho Power Company Transmission Line 328 Project. Cascade Ranger District, Boise National Forest. April, 2012.

U.S. Forest Service (Forest Service). 2015. Golden Meadows Golden Meadows Exploration Environmental Assessment.

U.S. Forest Service (Forest Service). 2017. Region 4 Boise National Forest Aquatic Database. Available at Cascade Idaho.

U.S. Forest Service (Forest Service). 2019. Region 4 Payette National Forest Aquatic Database. Available at McCall, Idaho.

U.S. Forest Service (Forest Service). 2022a. Stibnite Gold Project 2021 Modified Mine Plan Alternatives Specialist Report. Payette National Forest.

U.S. Forest Service (Forest Service). 2022b. Stibnite Gold Project Wetlands and Riparian Resources Specialist Report.

U.S. Forest Service (Forest Service). 2022c. Stibnite Gold Project Water Quality Specialist Report. Payette National Forest.

U.S. Forest Service (Forest Service). 2022d. Stibnite Gold Project Water Quantity Specialist Report. Payette National Forest.

U.S. Forest Service (Forest Service). 2022e. Stibnite Gold Project Access and Transportation Specialist Report. Payette National Forest.

Wagoner L. and D.C. Burns. 2001. Biological Assessment for the Potential Effects of Managing the Payette National Forest in the South Fork Salmon River Section 7 Watershed on Snake River Summer/Spring and Fall Chinook Salmon, Snake River Steelhead, and Columbia River Bull Trout and Biological Evaluation for Westslope Cutthroat Trout – Volume 24: Ongoing and New Actions. June 2001. Payette National Forest, McCall, Idaho. File Reference: EM.11.0016.

Waters, T.F. 1995. Sediment in Streams. Sources, Biological Effects and Control. American Fisheries Society Monograph 7. Bethesda, MD: American Fisheries Society Monograph 7. 251p. PNF Fisheries Program Library Reference BH.02.0001.

Watershed Solutions Inc. 2021. 2020 Aquatic Resources Baseline Study, Stibnite Gold Project. Prepared for Perpetua Resources Idaho. Inc. April, 2021.

Wilber, D.H. and D.G. Clark. 2001. Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management 21(4):855-875.

Wollebaek, J., J. Heggenes, and K.H. Roed. 2011. Population Connectivity: Dam Migration Mitigations and Contemporary Site Fidelity in Arctic Char. Evolutionary Biology 11: 207-222.

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries Aquatic Sciences. 2107: iv + 34p.