# Stibnite Gold Project

## Water Quantity Specialist Report

**Prepared by:**
USDA Forest Service
Payette National Forest

**for:**
Payette and Boise National Forests

August 2022

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## List of Acronyms

| | |
|---|---|
| °F | degrees Fahrenheit |
| amsl | above mean sea level |
| ASAOC | Administrative Settlement Agreement and Order on Consent |
| BDAs | bedrock dominated areas |
| bgs | below ground surface |
| BMP | best management practice |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CWA | Clean Water Act |
| cfs | cubic feet per second |
| CR | County Road |

| | |
|---|---|
| East Fork SFSR | East Fork South Fork Salmon River |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| Forest Service | United States Forest Service |
| FCRNRW | Frank Church River of No Return Wilderness |
| FR | Forest Road |
| ft | feet |
| g/km2-yr | grams per square km per year |
| GDE | groundwater dependent ecosystem |
| gpm | gallons per minute |
| IDAPA | Idaho Administration Procedures Act |
| IDL | Idaho Department of Lands |
| IDEQ | Idaho Department of Environmental Quality |
| IDWR | Idaho Department of Water Resources |
| in. | inches |
| IWRB | Idaho Water Resource Board |
| kV | kilovolt |
| MCFZ | Meadow Creek Fault Zone |
| MMP | Modified Mine Plan |
| MWB | meteoric water balance |
| NEPA | National Environmental Policy Act |
| NM | not measured |
| OSV | over-snow vehicle |
| Perpetua | Perpetua Resources Idaho Inc. |
| PRISM | Parameter-elevation Regressions on Independent Slope Model |
| SFR | Surface Flow Routing |
| SGLF | Stibnite Gold Logistics Facility |
| SGP | Stibnite Gold Project |
| SHSM | Stibnite hydrologic site model |
| SNOTEL | Snow Telemetry |
| SODA | spent ore disposal area |

| | |
|---|---|
| SPF | SPF Water Engineering LLC |
| SWWB | site-wide water balance |
| TSF | Tailings storage facility |
| UDAs | unconsolidated dominated areas |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |
| USGS | United States Geological Survey |

# 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 2019). A further modified Plan, also known as ModPRO2,[2] was then submitted in October of 2021 (Perpetua 2021). 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 at three open pits 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. Post-closure monitoring and water treatment activities are expected to continue for an additional 20 years after the closure period to manage mine-impacted waters on site.

# 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. Site access would occur on existing roadways without road modifications. 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.

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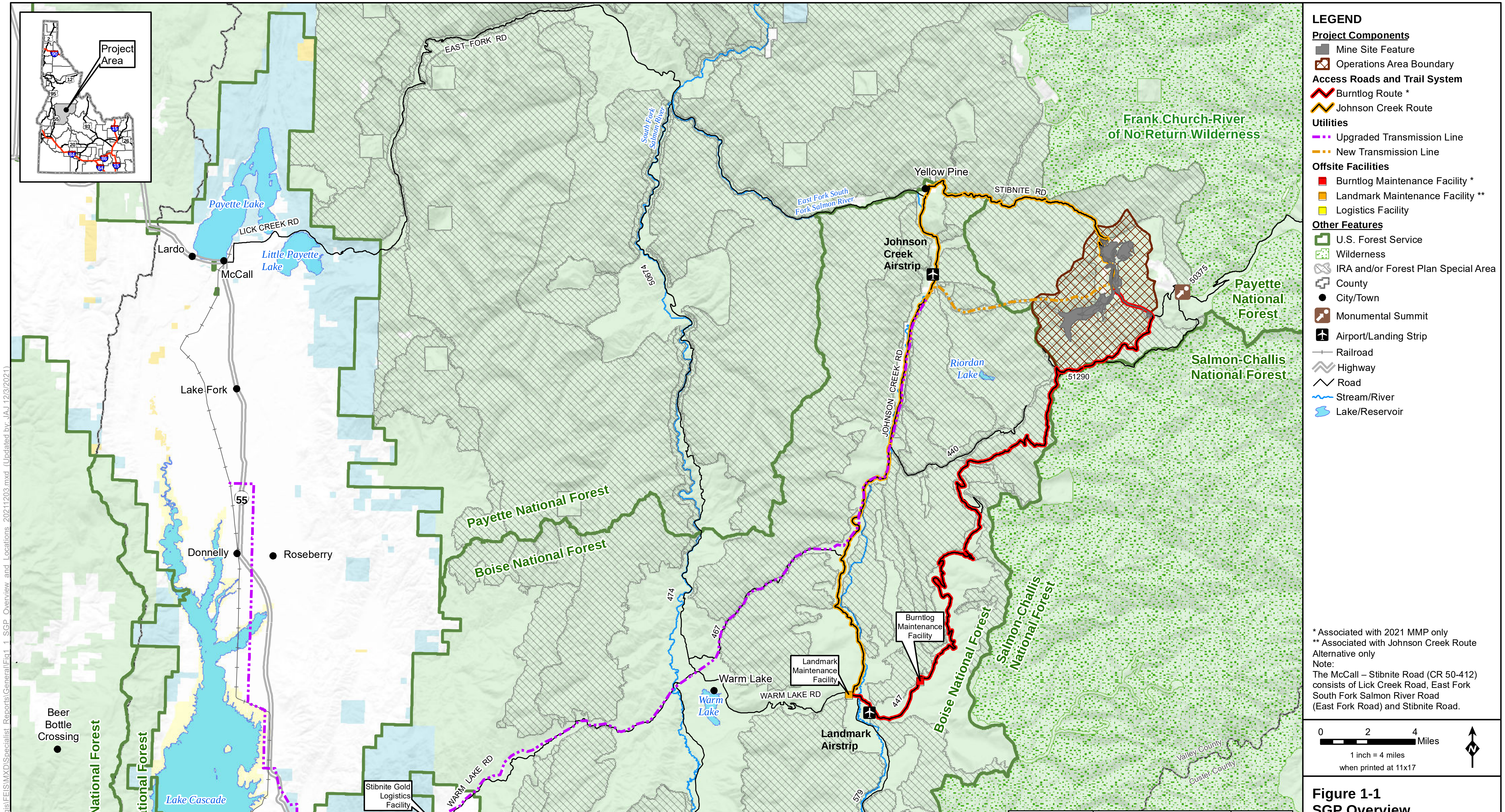
[1] Associated project documents may reference the Revised Plan as the ModPRO.

[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: 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); Boise National Forest; Payette National Forest*

## 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 (i.e., the 2021 MMP and Johnson Creek Route Alternative):

- 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

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. The Johnson Creek Route Alternative would require extensive upgrades to both Johnson Creek Road and Stibnite Road. Construction schedule for upgrading the roads and construction of the SGP would increase from 3 years to 5 years.

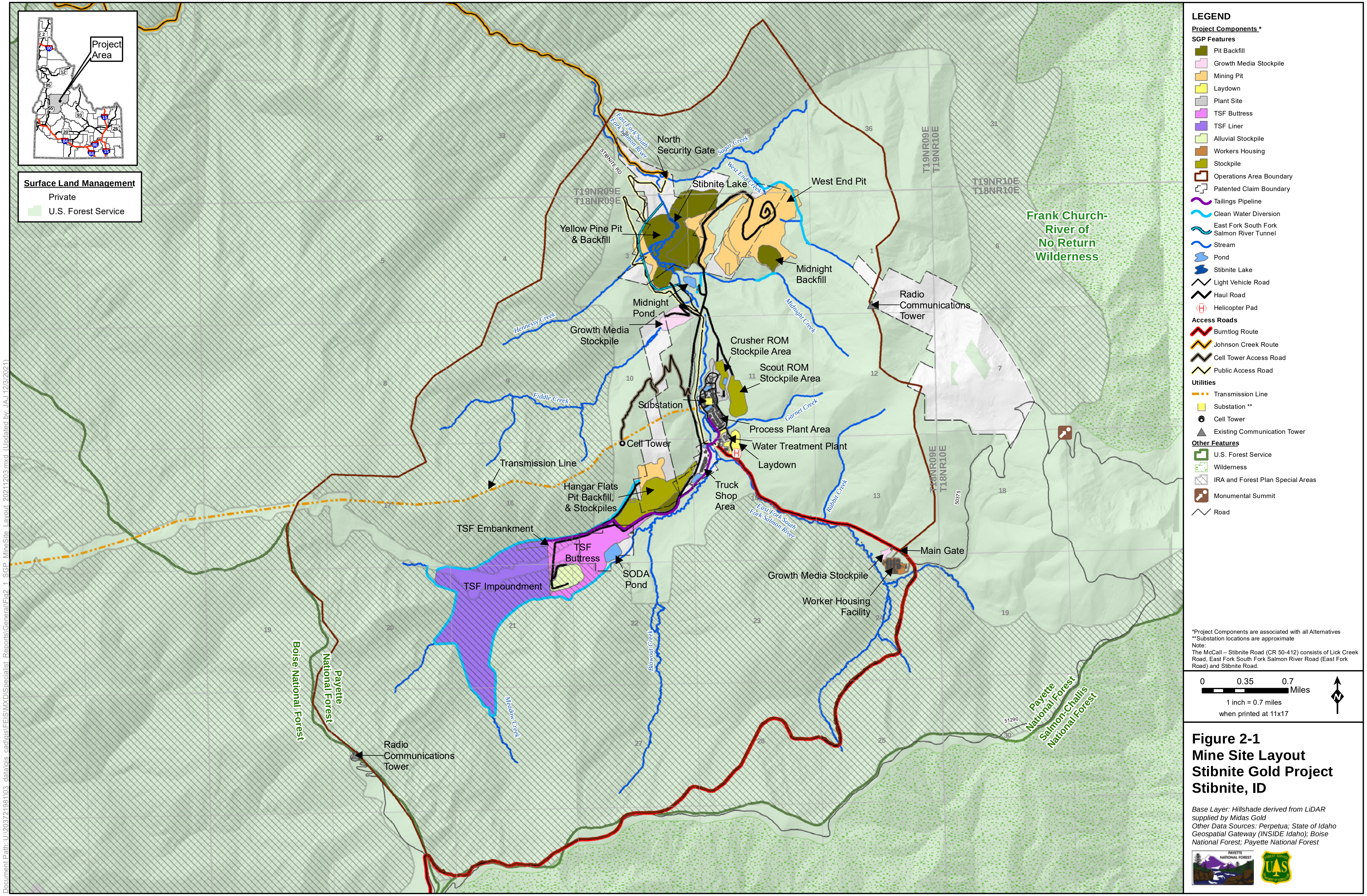



**Figure 2-1**
**Mine Site Layout**
**Stibnite Gold Project**
**Stibnite, ID**

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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.<br>• Operations: Approximately 15 years.<br>• Exploration: Approximately 17 years (during construction and operations).<br>• Reclamation: Approximately 5 years (except for the TSF which would require an additional 9 years for tailings dewatering and consolidation).<br>• Closure/Post-Closure Water Treatment: Approximately through Mine Year 40.<br>• Environmental Monitoring: As long as needed. | Same as 2021 MMP except:<br>• Construction: Approximately 5 years (upgrading the existing Johnson Creek and Stibnite Roads to provide permanent mine access). |
| All Phases | Access Roads | Construction/Operations:<br>• Warm lake road from State Highway (SH) 55 to Johnson Creek Route intersection (34 miles).<br>• Johnson Creek Route for SGP access during early construction with minor improvements within the road prism.<br>• Burntlog Route (38 miles) for SGP access during last year of construction, mining and ore processing operations, and closure and reclamation. Includes improvements of existing segments (23 miles) and road construction for new segments (15 miles).<br>• Up to eight borrow areas developed along Burntlog Route for materials needed for road improvements and maintenance.<br>• Access route around the Yellow Pine pit for public access.<br>Closure and Reclamation:<br>• New sections of Burntlog Route to be reclaimed after the closure and reclamation period. | • Warm lake road from SH 55 to Johnson Creek Route intersection (34 miles).<br>• 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.<br>• Access route around the Yellow Pine pit for public access, employee access, and deliveries of supplies and equipment to the processing, warehouse, worker housing facility, and administration areas.<br>• No improvements or construction of new segments for Burntlog Route.<br>• Up to seven borrow sources developed along the Johnson Creek Route for materials needed for road improvements and maintenance.<br>Closure and Reclamation:<br>• Improved Johnson Creek and Stibnite roads would not be reclaimed to pre-existing conditions. |

<table>
<tr><th>SGP Phase</th><th>Component/ Subcomponent</th><th>2021 MMP</th><th>Johnson Creek Route Alternative</th></tr>
<tr><td>All Phases</td><td>Public Access</td><td>Construction:<ul><li>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).</li><li>OSV trail on west side of Johnson Creek from Wapiti Meadows to Trout Creek campground closed during construction (9 miles).</li><li>OSV trail from Warm Lake to Landmark closed during construction through operations (8.5 miles).</li><li>Cabin Creek Road Groomed OSV trail (11 miles).</li><li>Public roads remain open through the SGP with temporary closures as needed to accommodate construction.</li></ul>Operations:<ul><li>Groomed OSV trail moves from west side of Johnson Creek Road to Johnson Creek Road from Landmark to Wapiti Meadows (16.7 miles).</li><li>Stibnite Road (County Road [CR] 50-412) / Thunder Mountain Road (FR 50375) closed through the SGP.</li><li>Seasonal public access through the Operations Area Boundary provided by constructing new road through Yellow Pine pit and below mine haul road to link Stibnite Road (FR 50412) to Thunder Mountain Road (FR 50375).</li><li>Public access allowed on Burntlog Route to Thunder Mountain Road (FR 50375).</li></ul>Closure and Reclamation:<ul><li>New road constructed over the Yellow Pine Backfill (backfilled Yellow Pine pit) connecting Stibnite Road (FR 50412) to Thunder Mountain Road (FR 50375).</li></ul></td><td>Construction and Operations:<br>Same as 2021 MMP except:<ul><li>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).</li><li>Groomed OSV trail on the west side of Johnson Creek from Trout Creek to Landmark lasting from construction through mine closure.</li></ul>Closure and Reclamation:<br>Same as 2021 MMP.</td></tr>
</table>

| SGP Phase | Component/ Subcomponent | 2021 MMP | Johnson Creek Route Alternative |
|---|---|---|---|
| Operations | Utilities – Transmission Lines | • Upgrade approximately63 miles of the existing 12.5 kilovolt (kV) and 69 kV transmission lines.<br>• New approximate 9-mile, 138 kV line would be constructed from the Johnson Creek substation to a new substation at the mine site.<br>• Upgrade the substations located at Oxbow Dam, Horse Flat, McCall, Lake Fork, and Warm Lake.<br>• Reroute approximately 5.4 miles of transmission line to avoid the Thunder Mountain Estates subdivision.<br>• Reroute approximately 0.9 miles of transmission line between Cascade and Donnelly to use an old railroad grade on private property.<br>• 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.<br>• Locations along Burntlog Route for very high frequency (VHF) repeater sites.<br>• Use existing access roads to repeater site locations along Burntlog Route.<br>• Communication site at the SGLF.<br>• Upgrades to existing communication site. | Same as 2021 MMP except:<br>• Cell tower sites constructed and maintained using helicopter (instead of constructing access roads) for sites within IRAs managed for Backcountry/Restoration.<br>• Locations along Johnson Creek route for repeater sites. |
| Operations | Off-site Maintenance Facility | • SGLF located along Warm Lake Road.<br>• 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<br>• 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.<br>• Return of previously existing road segments to pre-construction width and condition. | • No removal or reclamation of pre-existing access routes. |

Table Source: Perpetua 2021a

## 2.4 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, 2010) 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 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 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 Perpetua are listed in **Table 2-3**. All of these environmental design measures have been assumed to be implemented in conducting the environmental analysis presented in **Section 7.0**.

**Table 2-2 Prominent Regulatory and Forest Plan Requirements for Water Quantity**

| Description | Type | Reference |
|---|---|---|
| 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 |
| To accommodate floods, including associated bedload and debris, new culverts, replacement culverts, and other stream crossings would 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 |
| Section 6 of IDL's Best Management Practices for Mining in Idaho (IDL 1992) would be observed, including if water is encountered in exploration holes, water zones would be sealed off during abandonment to prevent crossflow. | Regulatory Requirement | Section 6 of IDL's Best Management Practices for Mining in Idaho (IDL 1992) |
| Drilling mud and hole plug products, if utilized, would conform to American Petroleum Institute guidelines for ensuring groundwater integrity. | Design Feature | American Petroleum Institute guidelines |
| The proponent 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 |
| All activities would 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 | |
| If additional water rights are applied for, the Forest Service would be informed to determine if additional analysis or consultation is necessary prior to use. | Design Feature | |

**Table 2-3 Proponent Proposed Design Features for Water Quantity**

| Description |
|---|
| 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. 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.<br>The effect of streamflow augmentation by discharge of treated water on flows in Meadow Creek were incorporated into the hydrologic modeling described in **Sections 5.0** and **7.0**. Treated water is most available during dewatering of the Hangar Flats pit which is contemporary with the largest effect on flows in Meadow Creek. The modeling anticipates that streamflow augmentation would occur when (1) Meadow Creek is at baseflow, (2) streamflow is being impacted, and (3) treated water is available. |
| Perpetua would stabilize and restore Blowout Creek. Blowout Creek wetland restoration would consist of restoring and enhancing palustrine aquatic bed (PAB), palustrine emergent (PEM), Palustrine scrub-scrub (PSS) wetlands that were impacted when a historical dam failed on Blowout 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 Blowout Creek as well as recharge the shallow groundwater system and reduce stream headcutting.<br>A coarse rock drain would be constructed within the chute downstream of the failed dam to isolate the flow of Blowout 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.<br>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), National Oceanic and Atmospheric Administration (NOAA) Fisheries, USFWS, the Forest Service, and other interested agencies, SGP partners, and stakeholders. |
| Pre-construction water management activities would include the installation of surface water management features and implementation of best management practices to reduce erosion and sediment delivery to streams. These water management features and best management practices could include sedimentation ponds; run-on water diversion ditches, trenches, and/or berms; runoff water collection ditches; silt fence; water bars; culverts; energy dissipation structures; terraces; and other features specified in construction permits. |
| Stormwater runoff from undisturbed areas upslope of mine features in the major drainages would be captured in the stream diversion channels described above or in other channels that would direct runoff away from disturbed areas. Smaller-scale diversion channels or earthen berms would be used, where necessary, to divert stormwater around other mine infrastructure. |
| Stormwater drains, ditches, and stream channels would be protected against erosion through a combination of adequate dimension, appropriate gradient, riprap, fabric- encapsulated soil lifts, or other stabilization materials. Diversions would be sized for a peak flow recurrence interval appropriate to the risk level of the facility, in recognition of other water management measures and fail-safes in place (excess flood storage and freeboard in the TSF, etc.), and in accordance with regulatory standards. |
| Existing streams that run through areas proposed for mining related disturbance would be diverted to prevent generation of contact water or commingling of contact and non-contact water, keeping clean water clean; and to prevent flooding of mine facilities by runoff generated off site. |
| Contact water which exceeds discharge water quality limits and that cannot be used during operations would be disposed of through a variety of methods including forced evaporation using sprayers located within the TSF or other managed areas, or active water treatment. Water would be treated to meet IPDES permit limits and treated water would then be discharged to IPDES permitted outfalls. |

| Description |
|---|
| Groundwater pumped from the dewatering wells would be considered to be contact water and would be managed through forced evaporation or active water treatment when the volume of pumped water exceeds the ore processing facility demand. |
| One or two IPDES-permitted surface water outfalls (specific number and locations of outfalls to be determined via IPDES permitting through IDEQ) would be used to discharge treated contact water from active mine pits, the TSF Buttress, and the ore processing facility. An outfall located near the ore processing facility would discharge to the East Fork SFSR, and a second outfall, if needed, would discharge to Meadow Creek to augment streamflow during pit dewatering. |
| Channel segments constructed over fill or excavated in permeable materials would additionally be lined with a geosynthetic liner to minimize seepage. A transition layer of sand/gravel followed by riprap or similar would be placed over the liner for erosion protection. |
| A lined tailings pipeline maintenance pond would be located at the ore processing facility, to which tailings and process water in the tailings distribution or water reclaim pipelines would drain by gravity during maintenance shutdowns or if there is a leak in either pipeline. The pond would typically be empty except during maintenance or unforeseen problems with the tailings pipeline, pumping system, or TSF. The pond is designed to contain the contents of the pipelines and the runoff from the pond and lined pipeline corridor from a 100-year, 24-hour storm event plus snowmelt. |
| Underdrain collection sumps and downgradient monitoring wells would be used for TSF leak detection. |
| During mine operations, summer low flows in perennial diversion channels around the TSF impoundment and buttress (Meadow Creek), Yellow Pine pit (Hennessy Creek and East Fork SFSR tunnel), and West End pit (West End Creek) would be piped underground as a mitigation measure to maintain cold stream temperatures. |
| Hennessy Creek flow would be disconnected from the current unlined ditch passing alongside the Northwest Bradley dumps to divert flow around the west side of the Yellow Pine Pit. This diversion would be separate from any activity conducted under the Administrative Settlement Agreement and Order on Consent (ASAOC). |
| A liner would be installed under the Meadow Creek stream/floodplain corridor to minimize water seepage into the Hangar Flats pit or the pit dewatering well system, and to avoid potential pit wall instability or loss of stream habitat as a result of stream dewatering. |
| The underdrain system would convey spring and seep flows beneath both facilities to a collection sump at the buttress toe where the flows would be monitored for water quality prior to release into the stream system or capture for use in the processing circuit or treatment prior to discharge, depending on water quality. |
| Runoff generated from direct precipitation on the TSF would be retained in the TSF water pool for reclaim to the ore processing circuit. |

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

- Water Management Plan (Perpetua 2021b)
- Water Resources Monitoring Plan (Perpetua 2021c)

# 3.0 Relevant Laws, Regulations, and Policy

## 3.1 Land and Resource Management Plan

Physical, social, and biological resources on National Forest System 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 National Forest System 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 2010) provide management prescriptions designed to realize goals for achieving desired condition for surface water and groundwater quantity and include various objectives, guidelines, and standards for this purpose."

## 3.2 Federal Laws, Regulations, and Policy

The U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged, and/or fill material within waters of the United States pursuant to Section 404 of the Clean Water Act. The USACE does not regulate water rights in Idaho, but SGP activities that could alter surface water quantity may be regulated and require a USACE authorization.

There also are several federal regulations related to water-resource use (including for water acquired through a water right). However, these federal regulations do not have a direct application to the water rights process in Idaho. The exception is the Wild and Scenic Rivers Act of 1968. In 2004, the Main Salmon, Middle Fork Salmon, Rapid, Selway, Lochsa, and Middle Fork Clearwater rivers were designated as Wild and Scenic Rivers under the Wild and Scenic Rivers Act (16 United States Code 1271-1287), which reserves instream water rights for designated rivers, and requires additional administration of existing and new water rights pursuant to state law. The relevant instream flow rights and "detailed administration" are primarily established and delineated in the Snake River Basin Adjudication.

## 3.3 Executive Orders

There are no Executive Orders directly applicable to the water quantity effects of the SGP.

## 3.4 State and Local Policy

The Idaho Department of Water Resources (IDWR) regulates mine tailings impoundments with dams higher than 30 feet and administers regulations that may have to be considered when a tailings impoundment affects surface water hydrology.

The IDWR also is responsible for administration of water rights, well construction standards, dam safety, and stream channel alteration. Any water right to implement the SGP would need to be granted to the applicant by the State of Idaho through IDWR. The constitution and statutes of the State of Idaho declare all waters of the state to be public but provide the right to divert public waters to put them to beneficial use, which includes mining activities (IDWR 2019; Idaho Const. art. XV, § 1).

The State of Idaho adheres to the prior appropriation doctrine, according to which the first person or entity to appropriate water for beneficial use has the right to continue to use that water for that purpose and is the first to receive the water in times of shortage. A water right is obtained through an application to IDWR. The agency must ensure enough water is available for the water right and that the oldest (senior) water rights are satisfied first (IDWR 2019). Appropriative rights must be used to be retained; surface water and groundwater rights are forfeited by a failure, for the term of 5 years, to apply it to the beneficial use for which it was appropriated (Idaho Code 42-222 and 42-237). Water rights associated with mining projects are protected from forfeiture under Idaho Code 42-223(11).

Valley County reviews development proposals for consistency with the County's Land Use Development Ordinance. When permits are required by other agencies for all or parts of the application, evidence of the permit and compliance with the provisions of the permit are to be a condition of the land use approval. This includes permits to alter wetlands; permits to construct in flood prone areas; and in other situations where the review and issuance of the permit would ensure that the proposal would be technically feasible.

# 4.0 Issues and Resource Indicators

## 4.1 Significant Issues

Significant issues are those which are used to formulate alternatives to the Proposed Action and to develop mitigation measures. Construction, operation, and closure of mine infrastructure may impact water quantity within the analysis area.

## 4.2 Resource Issues and Indicators

The following indicators are applied for the analysis of water quantity:

- Stream flow characteristics (daily, seasonal, annual).
- The extent, magnitude, and duration of changes in groundwater levels.

Analysis of surface water and groundwater quantity effects is guided by the following issues and indicators:

**Issue**: The SGP may cause changes in the quantity of surface water and groundwater in all drainages within the analysis area.

**Indicators:**

- Stream flow characteristics (daily, seasonal, annual).
- The extent, magnitude, and duration of changes in groundwater levels.

**Issue**: The SGP may affect water rights.

**Indicators:**

- Change in water rights availability in the SGP area.
- New water rights needed.
- Impacts to other water rights.

# 5.0 Methodology

This section describes the methodology related to surface water quantity, groundwater quantity, and water rights. The analysis area (defined further below) encompasses the drainages, watercourses, and groundwater systems where stream flows or the quantity of groundwater storage and transmission may be impacted by the SGP, as shown in **Figure 5-1**. The following sections describe the scope of analysis completed to characterize the existing conditions, and provide the relevant laws, regulations, and policies that apply to the analysis.

## 5.1 Analysis Area

The analysis area for surface water and groundwater quantity encompasses the land where activities associated with the action alternatives could affect stream flows, groundwater levels, groundwater flow directions, groundwater-dependent ecosystems, and water rights. Such actions would be concentrated at the SGP and include groundwater withdrawal, streambed alteration/diversion, and surface water management. Open pit mining projects involve the excavation of pits to access and remove subsurface ore and development rock. Open pits excavated below the water table require lowering of the water table via removal of groundwater that would otherwise fill the pit. This is typically achieved by pumping from wells installed around the pit or sumps within the pit. Such pumping can affect surface waters that are to some degree in hydraulic communication with a groundwater system.

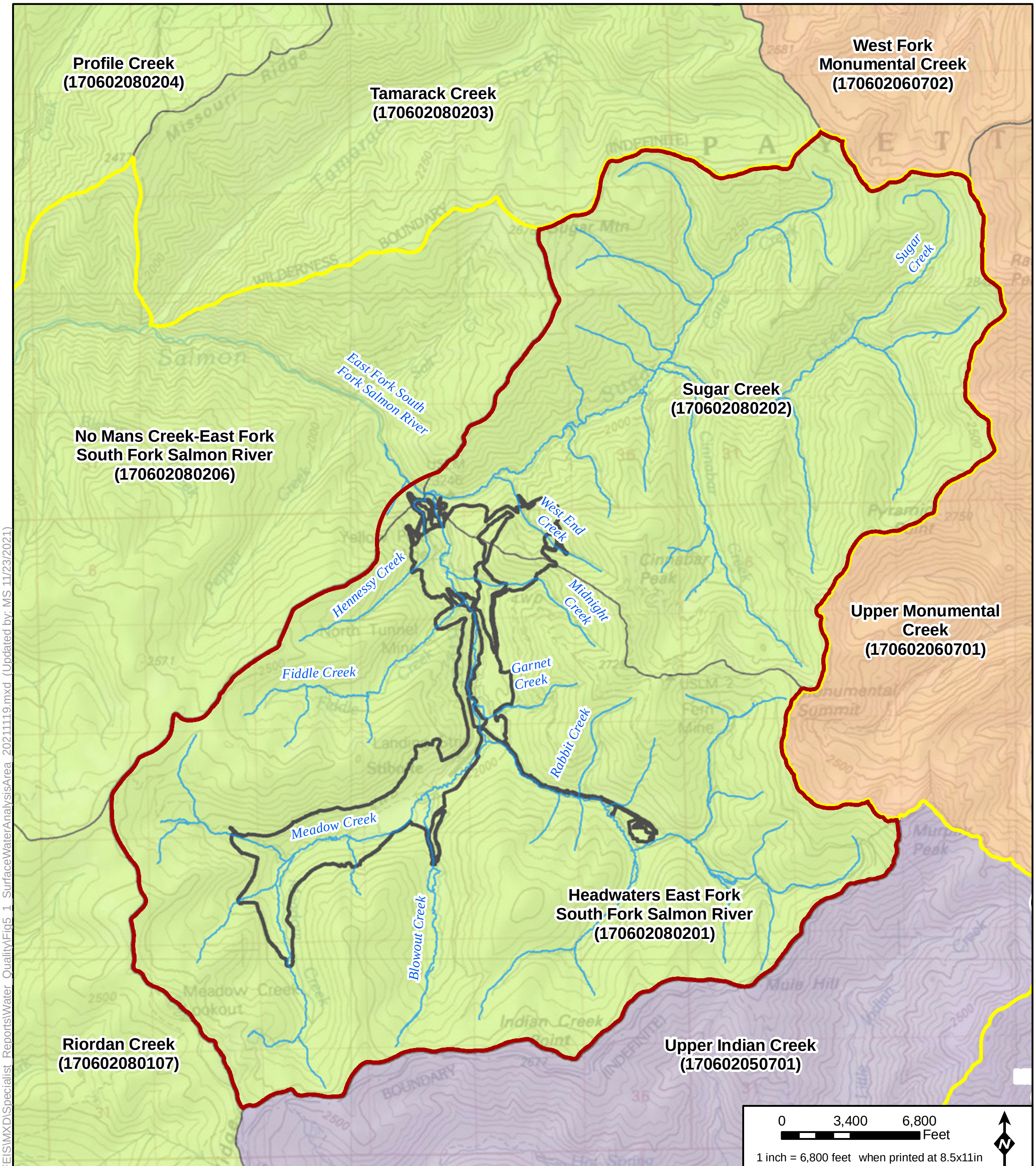
The water quantity analysis area encompasses the 12-digit Hydrologic Unit Codes or sub-watersheds that overlap the proposed SGP. The SGP is near the upper end of the East Fork South Fork Salmon River (East Fork SFSR) within two sub-watersheds: Headwaters East Fork SFSR and Sugar Creek. A portion of the analysis area includes the upper drainage area of the East Fork SFSR (to downstream of the confluence with Sugar Creek), as well as several tributaries of the East Fork SFSR. Those include East Fork Meadow Creek (i.e., Blowout Creek), Meadow Creek, Rabbit Creek, Fiddle Creek, Hennessy Creek, Midnight Creek, Garnet Creek, Sugar Creek, and West End Creek, as shown on **Figure 5-1** (within the “SGP Water Modeling Boundary”). This is the same analysis area for groundwater quality as defined in the companion SGP Water Quality Specialist Report (Forest Service 2022b).

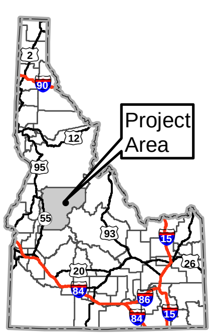
Groundwater within the analysis area moves primarily through unconsolidated alluvium; groundwater flow via deep bedrock is considered minor in comparison (see discussion of hydraulic conductivity of alluvial materials and bedrock formations presented below in **Section 6.3.2**). Because most of the groundwater moves through unconsolidated alluvium, the boundaries of the Sugar Creek and Headwaters East Fork SFSR sub-watersheds also represent a reasonable approximation of the area subject to analysis of groundwater quantity impacts arising from the SGP. Note that the SGP might still alter streamflow conditions (including access roads, utilities, and off-site facilities) outside the analysis area; however, such alterations are expected to be minor based on regulatory requirements for these alterations and the application of best management practices.

The analysis area for water rights is the same as used for surface water and groundwater quantity analysis (**Figure 5-1**) and covers the sub-watersheds of Sugar Creek and the Headwaters East Fork SFSR. The Water Rights discussion identifies instream flow water rights held by the Idaho Water Resource Board and the Forest Service that are located downstream from the analysis area on the South Fork of the Salmon River and on the Salmon River.

### 5.1.1 Direct/Indirect Effects Boundaries

The analysis area for surface water and groundwater quantity that could be directly or indirectly affected by the SGP consists of the area where activities associated with the action alternatives could affect stream flows and/or the quantity of groundwater in storage, groundwater levels, and groundwater transmission (**Figure 5-1**).




**LEGEND**

- Surface Water Analysis Area
- Mine Site Water Modeling Boundary
- Mine Site Components*

**Watersheds**

- Upper Middle Fork Salmon (17060205)
- South Fork Salmon (17060208)
- Lower Middle Fork Salmon (17060206)
- Stream/River

*Mine Site components are associated with all Alternatives
Note:
Subwatersheds displayed are Hydrologic Unit Code (HUC) 6th level (12-digit)

# Figure 5-1
# Water Quantity Analysis Area
# Stibnite Gold Project
# Stibnite, ID

*Base Layer: ESRI USA Topographic Basemap Other Data Sources: Perpetua; Boise National Forest; Payette National Forest*

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Water_Quality\Fig5_1_SurfaceWaterAnalysisArea_20211119.mxd (Updated by: MS 11/23/2021)

The direct and indirect effects associated with surface water and groundwater quantity are considered in the overall context of the local and regional hydrological and hydrogeological conditions of the affected environment. The following are the main characteristics of those conditions:

- The SGP and surrounding area (i.e., the analysis area) consists of mountainous terrain dissected by typically narrow valleys with steep slopes.
- The hydrology of the analysis area is strongly influenced by seasonal patterns of snow accumulation during the winter, and snowmelt in the spring and early summer.
- Water entering the analysis area as precipitation migrates as surface runoff and shallow groundwater down the mountain slopes and along the valley bottoms in an alluvial aquifer formed by unconsolidated Quaternary deposits of sediment. The alluvial aquifer is documented to be the most groundwater-transmissive formation in the analysis area; it is typically more than 50 feet thick (reaching a thickness of 250 feet at some locations).
- Groundwater in the alluvial aquifer eventually discharges to surface streams. However, at some locations, surface water recharges shallow groundwater during periods of high stream stage.
- Groundwater supports many seep-, spring- and wetland ecosystems referred to as groundwater dependent ecosystems (GDE).
- A portion of groundwater flow occurs through a network of fractures in shallow bedrock and through fracture zones (encountered in boreholes) and faults. Shallow bedrock is less transmissive than the alluvial aquifer, but more fractured and transmissive than deeper bedrock which is less transmissive.
- The Meadow Creek Fault Zone acts as an aquitard to bedrock flow based on observations of surface water expressions above the fault zone gouge outcrops and artesian conditions observed in drillholes in its vicinity where it passes between the Yellow Pine pit and West End areas.
- There are four existing water rights held by Perpetua in the vicinity of the SGP that are related to historical mining use, but there are no downstream consumptive-use water rights on the East Fork South Fork Salmon River (East Fork SFSR).

### 5.1.2 Cumulative Effects Boundaries

The cumulative effects analysis area for surface water and groundwater quantity that could be directly or indirectly affected by the SGP consists of the area where activities associated with the action alternatives could affect stream flows and/or the quantity of groundwater in storage, groundwater levels, and groundwater transmission (**Figure 5-1**). Potential effects downstream of the area (e.g., decreased surface water flow) are expected to be minor as aggregate flows from other groundwaters and surface waters render the effects within the boundary undiscernible.

Cumulative effects associated with the SGP consider the range of existing and foreseeable activities and their potential effects with respect to surface water and groundwater quantity. Past and present actions that may have impacted water quantity through short-term water use include historical mining and reclamation activities in the area, as well as the Golden Meadows Exploration Project, which requires water for borehole drilling and other purposes.

The active Valley County Quarry (located near the village of Yellow Pine and about 7 miles to the west of the SGP area) also may require some degree of groundwater consumption, but since the quarry is located in a different sub-watershed from the SGP that is outside the analysis area, it would not contribute to cumulative groundwater quantity impacts and that potential groundwater use does not have any identified effects on surface flow in the East Fork SFSR.

There are no reasonably foreseeable future actions that have or would affect surface water and groundwater quantity in the analysis area. In making this determination, a number of other nearby projects that have the potential to affect surface water and groundwater quantity were considered. These include Big Creek area's small-scale hydroelectric projects and Morgan Ridge Exploration. Although these projects could affect the surface water and groundwater systems within their respective watersheds, they are located within a different sub-watershed from the analysis area and the SGP and lack direct communication via waterways to combine and result in cumulative water quantity effects.

## 5.2 Analysis Area Methodology

Surface water resource investigations for the SGP were initiated in 2012 to characterize existing conditions in the analysis area. United States Geological Survey (USGS) data from nine gaging stations in or near the analysis area provide much of the available surface water quantity data. Additionally, surface water baseline studies completed from 2012 to 2016 contribute to characterization of the existing surface water hydrology conditions. The baseline study reports describe in detail methodologies used to conduct the studies and collect/compile the relevant data (Brown and Caldwell 2017; HydroGeo 2012b). Baseline sampling has continued beyond 2016; however, characterization of surface waters' baseline conditions draws from the data collected during a period from 2012 to 2016 and presented by Brown and Caldwell 2017. The methods and procedures used included:

- Reviewing background information sources relevant to the analysis area;
- Compiling and analyzing climatological data from regional stations near theanalysis area;
- Describing drainage characteristics, completing flow statistics, and peak flow analysis; and
- Developing a summary of seeps and springs identified during the hydrology field survey (HydroGeo 2012b).

Baseline surface water data collection included flow measurements at 32 perennial stream locations and 23 sites where water originated from a seep, adit seep, or another legacy mining-related feature. Investigators selected monitoring locations located at upstream and downstream sites relative to historical and potential future mining activities. For purposes of evaluating the baseline water quantity, monitoring at those locations was carried on from 2012 to 2016. For streams with moderate to high flow, discharge measurements were made using a current meter and the velocity-area (mid-section) method. At sites with very low flow, discharge was measured with graduated buckets using a volumetric method (Brown and Caldwell 2017).

Baseline characterization of groundwater conditions includes description of groundwater levels, hydraulic gradients, groundwater flow directions, hydraulic properties of the rocks and sediments hosting groundwater, groundwater productivity, historical use of groundwater, as well as interactions between surface water and groundwater within the analysis area. Characterization and analyses of baseline groundwater conditions draws from the results of several hydrogeological studies conducted using standard methods, further supported by the results of a surface water and groundwater flow modeling study.

Several parties have investigated groundwater resources in the analysis area for the past 35 years. These investigations evaluated general groundwater hydrology and interaction between groundwater and surface water. A 2017 SPF Water Engineering Groundwater Hydrology Baseline Study report summarizes findings of those previous studies and presents the results of the newer hydrogeological investigations (SPF Water Engineering LLC [SPF] 2017).

Additionally, a Water Resources Summary Report summarizes hydrogeology-related work completed up to 2017 (Brown and Caldwell 2017). The Water Resources Summary Report also provides information regarding IDWR well records for groundwater supply wells constructed in the analysis area.

From 2017 through 2021, Brown and Caldwell completed surface water and groundwater modeling and flow analysis (Brown and Caldwell 2018a, 2018b, 2021b, 2021e). These modeling efforts are summarized in this document with further details available in those references.

# 6.0 Affected Environment

## 6.1 Hydrologic and Geologic Setting

The SGP is located in mountainous terrain with typically narrow valleys and steep slopes. Elevations range from 6,000 to 6,600 feet above mean sea level along valley floors and rise to elevations exceeding 8,500 feet above mean sea level in the surrounding mountains (HydroGeo 2012a).

The climate of the analysis area is influenced by local patterns of wind, precipitation and temperature influenced by topography, slope aspect, and elevation. The analysis area experiences wide annual and diurnal variations in temperature and humidity. During winter, storms typically move through the region resulting in snowfall accumulations of two feet or more. Cloudy and unsettled weather is common during the winter with measurable precipitation occurring on about one-third of the days (Brown and Caldwell 2017, Section 4; Stantec and Trinity Consultants 2017).

Spring months are normally wet and windy with weather conditions fluctuating quickly. Afternoon temperatures in the 30s and 40s (degrees Fahrenheit) with precipitation in the form of rain or snow may occur interspersed with periods of sunny skies and temperatures in the 50s or 60s ºF. Low elevation snowpack usually melts quickly during the spring, but high elevation snow pact can persist into June or later (Stantec and Trinity Consultants 2017).

Although snowmelt may take one month or more in the analysis area, summer weather may begin suddenly with a rapid change to warm and dry weather. Although daytime temperatures are usually warm by June, chilly nights can persist throughout the summer. Showers are common from late spring through summer with an increased frequency surrounding regional high terrain. These storms often produce localized precipitation. Afternoon temperatures often rise into the 80s (°F); however, low humidity usually results in overnight temperatures in the 50s (°F) or even cooler (Stantec and Trinity Consultants 2017).

Autumn has cooler weather with daytime highs generally in the 60s (°F) in early fall, dipping into the mid-30s (°F) by mid-November with generally dry conditions, except for the first of the progressive winter storms. The first cold wave with highs below 20°F and lows around 0°F or lower may arrive any time between late November and late December (Stantec and Trinity Consultants 2017).

The winds in the analysis area follow the traditional up and down valley flow patterns expected in mountain valleys. During the spring months, periods of high winds may persist for days at a time. Winds have a strong tendency toward northeast directionality. Speeds vary widely but tend to be strongest from the southwest (Stantec and Trinity Consultants 2017).

The main East Fork SFSR valley floor is around 6,400 feet in elevation and the tributary valleys—which are at higher elevations like Meadow Creek, Fiddle Creek, Hennessy Creek, and Sugar Creek—all show a strong and pronounced asymmetry with steeper south-facing slopes (Midas Gold 2017). South-facing slopes are more open to sunlight and warm winds and are thus generally warmer and dryer because of the higher levels of evapotranspiration compared to steep north-facing slopes.

A long-term climatological record is not available for the SGP. Therefore, Parameter-elevation Regressions on Independent Slope Model (PRISM) data compared with the National Weather Service and Snow Telemetry (SNOTEL) Secesh Summit site is used to develop average precipitation and temperature estimates (**Table 6-1**). The Secesh Summit site is located 35 miles northwest of the SGP, at a comparable elevation (Brown and Caldwell 2017).

**Table 6-1 Estimated Average Monthly Precipitation and Temperature for the Analysis Area**

| Month | Average Precipitation (inches) | Average Temperature (°F) | Minimum Temperature (°F) | Maximum Temperature (°F) |
|---|---|---|---|---|
| January | 4.11 | 20.10 | 10.67 | 29.52 |
| February | 3.32 | 21.75 | 9.84 | 33.66 |
| March | 3.53 | 27.68 | 15.33 | 40.03 |
| April | 2.98 | 32.89 | 20.50 | 45.27 |
| May | 2.58 | 40.69 | 27.73 | 53.65 |
| June | 2.14 | 48.73 | 33.85 | 63.61 |
| July | 0.95 | 58.05 | 41.31 | 74.79 |
| August | 0.91 | 56.47 | 39.18 | 73.76 |
| September | 1.81 | 48.70 | 32.76 | 64.63 |
| October | 2.10 | 39.18 | 25.97 | 52.39 |
| November | 3.71 | 26.34 | 17.02 | 35.63 |
| December | 3.99 | 18.82 | 9.28 | 28.36 |
| **Annual** | **32.19** | **36.61** | **23.61** | **49.60** |

Source: 800-meter PRISM data, Brown and Caldwell 2017

The spatial and elevation distribution of average precipitation and temperature are described in more detail in the SGP Water Resources Summary Report (Brown and Caldwell 2017, Section 4).

The local geology of the analysis area contains four primary lithologic units (Smitherman 1985, USGS 2007, Brown and Caldwell 2017):

- Neoproterozoic to Ordovician metasedimentary rocks,
- Cretaceous Idaho Batholith,
- Tertiary intrusions and volcanics of the Challis Volcanic Field, and
- Quaternary sedimentary alluvium.

The metasedimentary rocks form a mass of older rock that projects downward into the Idaho Batholith and is surrounded by igneous rock. This mass is composed of various metamorphosed carbonate and siliciclastic rocks including limestones, dolomitic marbles, calcareous siltstones, sandstones, and quartzites.

The cretaceous igneous rocks of the Atlanta lobe of the Idaho Batholith are the predominant bedrock unit in the analysis area. The igneous rocks include dioritic to granitic compositions.

Intrusives associated with the Thunder Mountain Caldera of the larger Challis Volcanic Field appear in the metasedimentary and batholith. These volcanics are composed of rhyolite dikes, latite porphyries, trachyte porphyries, and diabase dikes, most of which are associated with fault zones.

Unconsolidated sedimentary deposits appear near the ground surface in the form of alluvial fans, terrace gravels, glacial tills, fluvium, colluvium, and landslide materials. Glacial moraines are evident in the larger valley areas. These unconsolidated alluvial materials are generally confined to the center of valley bottoms, surrounded by bedrock mountain slopes.

Structural features in the analysis area can be categorized into four structural trends:

- ancient northeast trending compression that resulted in northwest-southeast trending folds and low-angle thrusts and strike-slip faults in the metasedimentary rocks,
- northeast-southwest trending high-angle reverse, normal, and strike-slip faults that cut through the metasedimentary rocks and batholith but predate the Tertiary intrusives,
- northwest-southeast trending normal faulting that forms the caldera complex northeast of the analysis area, and
- Young northeast-southwest trending normal faults that post-date the Tertiary intrusives.

The principal fold in the analysis area is the Garnet Creek Syncline that plunges to the northwest. The fold is intersected by several fault zones that offset the fold's stratigraphic section. The largest offsets occur in the southeast portion of the metasedimentary rock and along the Meadow Creek Fault. Mineralogy is related to the high-angle faults in the analysis area which are summarized in **Table 6-2**.

**Table 6-2 Summary of Fault Zones in the Analysis Area**

| Fault Zone Name | Interpreted Type | Dip | Strike | Width | Location | Notes |
|---|---|---|---|---|---|---|
| Meadow Creek | Right lateral and high-angle reverse | Steep and variable | North area: NE-SW South area: N-S | 100' average up to 200' maximum with gouge and breccia | Western boundary of metasediments | Area's dominant structure consisting of a braided network of fault zones |
| West End | Right lateral and normal | $50^o$-$75^o$ SE | NNE-SSW, $30^o$ azimuth | 100' – 295' | Near western edge of metasediments | Major structure with several ENE splays |
| Cinnabar Peak | Originally thrust, currently appearing as steep normal | Steep to NE, subparallel to bedding | NW-SE | 50'- 100' | Parallel to axis of the Garnet Creek Syncline | Juxtaposition of metasedimentary units |

| Fault Zone Name | Interpreted Type | Dip | Strike | Width | Location | Notes |
|---|---|---|---|---|---|---|
| Hennessy Shear Zone | Right lateral and normal | Near vertical | NE-SW | 15’ – 75’ | Beneath Hennessy Creek, bounding west side of Yellow Pine deposit | No surface exposure but appears in drilling |
| Scout Valley | Uncertain | Steep and variable (E and W) | N-S | 10’- 250’ | East Fork SFSR vicinity in central SGP area | No surface exposure but appears in drilling |
| Garnet Creek | Left lateral and normal | Steep to W | NE-SW | 50’- 100’ | Former Garnet Creek Open pit vicinity | Limited surface exposure |
| Rabbit Creek | Uncertain | Uncertain | NE-SW | Uncertain | SW of Garnet Deposit adjacent to Rabbit Creek | Limited surface exposure |
| Fern | Left lateral and normal | Steep to NW | NE-SW | 10’- 100+’ | Southeastern SGP area | Offsets axis of Garnet Creek Syncline |

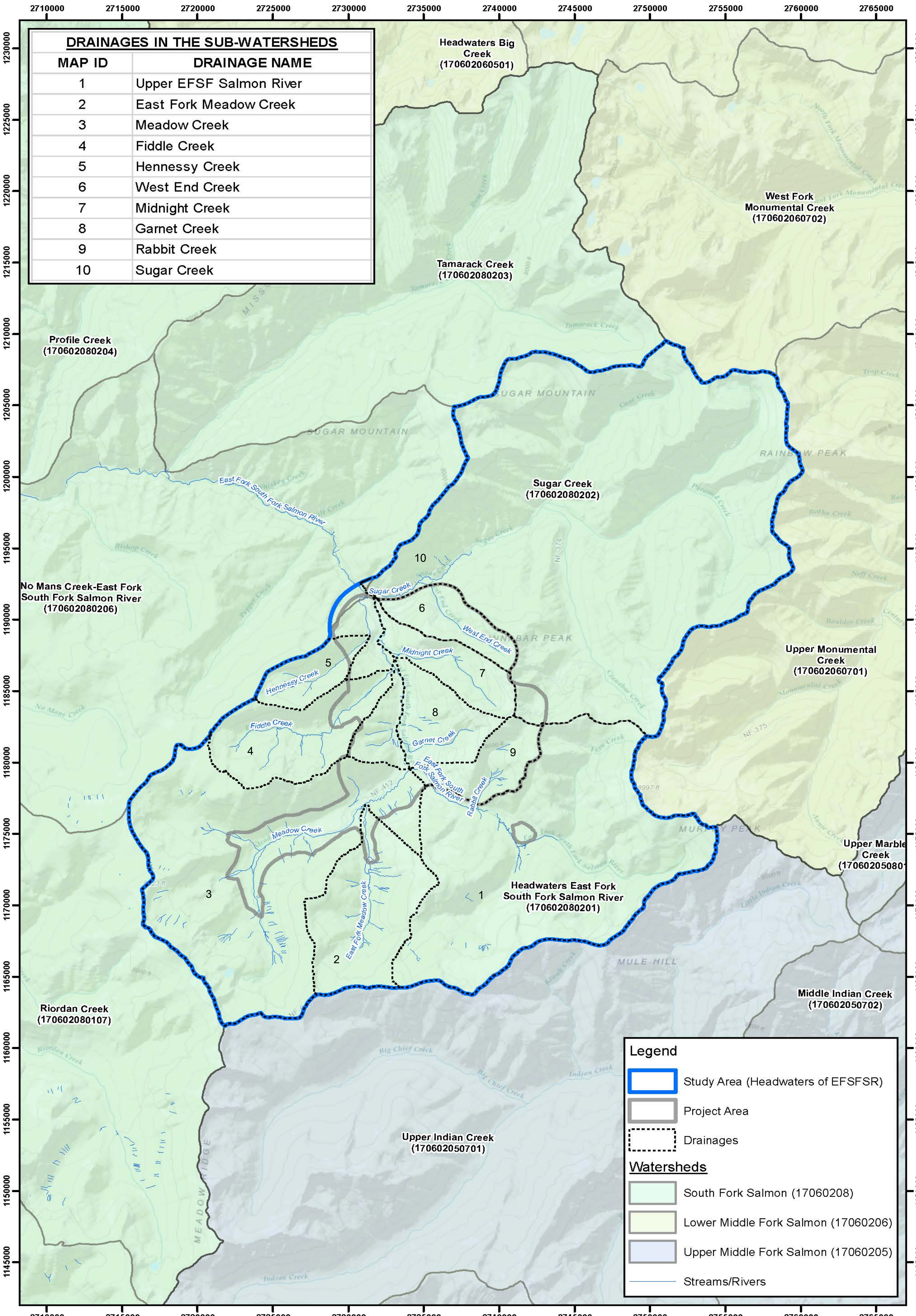
Source: Midas Gold 2017

Fault zones were examined for evidence of influence on groundwater flow (HydroGeo 2012a, SPF 2017, Brown and Caldwell 2021b). Evidence of fault influence on groundwater flow was not detected for most faults, except for the Meadow Creek fault where artesian conditions on the east side of the fault in the West End pit area indicated that the fault acts as an inhibitor to flow in bedrock. Based on this observation, the Meadow Creek Fault was represented in the groundwater flow model.

## 6.2 Surface Waters

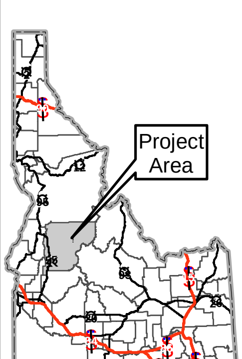
### 6.2.1 Streams

The SGP is in the Headwaters East Fork SFSR and Sugar Creek sub-watersheds. The primary surface water features at the SGP include the East Fork SFSR and its tributaries (**Figure 6-1**), as well as intermittent drainages, ephemeral drainages, seeps, springs, wetlands, and ponds.



| DRAINAGES IN THE SUB-WATERSHEDS | |
|---|---|
| MAP ID | DRAINAGE NAME |
| 1 | Upper EFSF Salmon River |
| 2 | East Fork Meadow Creek |
| 3 | Meadow Creek |
| 4 | Fiddle Creek |
| 5 | Hennessy Creek |
| 6 | West End Creek |
| 7 | Midnight Creek |
| 8 | Garnet Creek |
| 9 | Rabbit Creek |
| 10 | Sugar Creek |







Basemap: 2013 National Geographic Society, i-cubed

0 6,000 12,000
Feet

N

**Figure 6-1**
**Streams Location Map**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017)*

These features include 10 named surface water channels: the East Fork SFSR, Rabbit Creek, Meadow Creek, East Fork Meadow Creek (also known as Blowout Creek), Garnet Creek, Fiddle Creek, Midnight Creek, Hennessy Creek, West End Creek, and Sugar Creek. Most of these streams occur in the Headwaters East Fork SFSR sub-watershed except for Sugar Creek and West End Creek, which are in the Sugar Creek sub-watershed. Brief descriptions of each stream are provided below, and specific drainage and channel characteristics are summarized in **Table 6-3**.

**Table 6-3 Summary of Stream Characteristics in the SGP Area**

| Drainage | Approximate Drainage Area (square miles) | Channel Length (miles) | Elevation Change (feet) | Average Gradient (%) |
|---|---|---|---|---|
| East Fork SFSR (upstream of Sugar Creek) | 25.0 | 7.04 | 2,129 | 5.7 |
| Meadow Creek | 7.7 | 4.78 | 1,570 | 6.2 |
| East Fork Meadow Creek | 2.4 | 2.66 | 1,491 | 10.6 |
| Rabbit Creek | 0.6 | 1.19 | 1,506 | 24.0 |
| Garnet Creek | 0.5 | 1.24 | 1,558 | 23.8 |
| Fiddle Creek | 2.0 | 2.47 | 1,444 | 11.1 |
| Midnight Creek | 0.9 | 1.83 | 2,205 | 22.8 |
| Hennessy Creek | 0.7 | 1.16 | 1,499 | 24.5 |
| West End Creek | 0.6 | 1.55 | 2,234 | 27.3 |
| Sugar Creek | 17.4 | 7.14 | 2,356 | 6.2 |

Source: Brown and Caldwell 2017; HydroGeo, Inc. 2012b

The East Fork SFSR is a perennial stream that flows from southeast to northwest through the SGP and has a drainage basin of 25 square miles upstream of Sugar Creek. It is the principal stream draining the SGP and receives flow either directly or indirectly from all other drainages listed in **Table 6-3**. At ordinary high water, the East Fork SFSR is approximately 2 to 3 feet deep and 25 to 30 feet wide (Brown and Caldwell 2017).

Historical mining activities have affected the course of the East Fork SFSR in the central portion of the SGP where it flows through a lake that has formed in the Yellow Pine pit. The river enters the pit on the south side and exits from the north. The flow velocity of the East Fork SFSR slows as it passes through the abandoned pit, causing the river to drop much of its sediment load which is then deposited across the lake bottom. The original Yellow Pine pit was excavated to a depth of 125 feet below the current pit lake level, but sediment deposited through time has reduced the lake depth to only 35 feet. The lake has a surface area of approximately 4.75 acres and is estimated to contain approximately 92 acre-feet of water (Brown and Caldwell 2017). An artificial drop into the pit creates a steep whitewater cascade on the East Fork SFSR and blocks upstream fish passage above the pit lake.

Meadow Creek originates at the southwestern end of the SGP, flows east into the East Fork SFSR, and drains an area of approximately 7.7 square miles. The Meadow Creek headwaters occur in an alpine lake, and the drainage contains multiple wetland complexes covering an estimated 175.26 acres. At ordinary high-water, Meadow Creek is approximately 2 to 4 feet deep and 20 to 25 feet wide at the bottom of the drainage (Brown and Caldwell 2017). The Meadow Creek valley has been heavily impacted by historical mining activity, including: deposition of tailings across much of the valley floor (some of which is covered by spent heap leach ore); development and operation of an underground mine; construction and operation of a mill and smelter; construction and operation of an airstrip; construction and use of small scale dams to retain water and/or tailings; construction and use of various buildings; construction of heap leach facilities; and repeated straightening and diversion of Meadow Creek in rock-lined channels. Some of these impacts have been partially mitigated by diverting water around the upper tailings/spent ore disposal area in a rip rap lined ditch for approximately 4,400 feet and by constructing a sinuous stream channel in the lower Meadow Creek valley.

East Fork Meadow Creek is a tributary to Meadow Creek that drains an area of 2.4 square miles in the southern end of the SGP (**Figure 6-1**). The creek previously supplied water to a man-made reservoir that provided hydroelectric power and process water to the historical mill and smelter. East Fork Meadow Creek is locally referred to as Blowout Creek because the dam forming the reservoir breached in 1965, causing large-scale scouring of the steep channel downstream, and deposition of an alluvial fan. From its headwaters, East Fork Meadow Creek meanders through a former wetland area that dried up due to stream incision and declining groundwater levels related to the dam failure.

Rabbit Creek and Garnet Creek are small tributaries of the East Fork SFSR that drain 0.6 and 0.5 square mile, respectively. Rabbit Creek is in a steep drainage that has steep side slopes, with numerous seeps and springs occurring throughout its headwaters. Garnet Creek is formed from seeps and springs located in the eastern portion of the SGP. The current shop, camp facilities, and the historical Garnet pit are in the Garnet Creek drainage. Historical waterworks from the 1940s and 1950s as well as a 1990s diversion are present below the former open pit.

Fiddle Creek occurs in a well-defined glacial cirque, drains an area of 2 square miles, and flows into the East Fork SFSR from the west. The drainage area for Fiddle Creek includes forested and open scree slopes. The middle reach of Fiddle Creek also contains a former reservoir and dam, and a former townsite occurs in the lower reach above and below the County Road. In addition, the creek itself was diverted from its natural outfall site to the north under the County Road through a culvert in the 1980s.

Midnight Creek is a small tributary that drains an area of 0.9 square mile and flows into the East Fork SFSR from the east, just above the Yellow Pine pit lake. Several miles of current and historical exploration and haul roads exist in the Midnight Creek drainage.

Hennessy Creek is a small tributary that drains an area of 0.7 square mile and flows into the East Fork SFSR from the west. The upper end of the drainage is heavily forested, and the lower portion of the drainage has been modified by current access roads and historical mine workings. Hennessy Creek also has a historical water diversion just above the county road that included a large pipe system. The creek flows in the direction of and then adjacent to Stibnite Road (County Road 50-412) in a channel around the Bradley Northwest mine dump complex, disappears and then reemerges among historical mine development rock piles, and flows through a culvert before entering the East Fork SFSR.

West End Creek flows into Sugar Creek from the south and has a drainage area of 0.6 square mile. The drainage basin of West End Creek was modified extensively and diverted into a now failed french drain system during construction of the large waste rock dump in the middle reach. The current creek flow disappears and reemerges among historical waste rock piles. Several miles of current and historical exploration roads are present in the West End Creek drainage.

Finally, Sugar Creek is a relatively large tributary that drains an area of approximately 17.4 square miles and flows into the East Fork SFSR from the east. A portion of the upper Sugar Creek valley has been impacted by past mercury mining activities at the former Cinnabar Mine, located in the upper Cinnabar Creek drainage which is a tributary to Sugar Creek. These activities included underground mine development and operations, development rock disposal, ore processing, deposition of tailings in the valley, construction and use of buildings and housing (several of which still exist), and road construction.

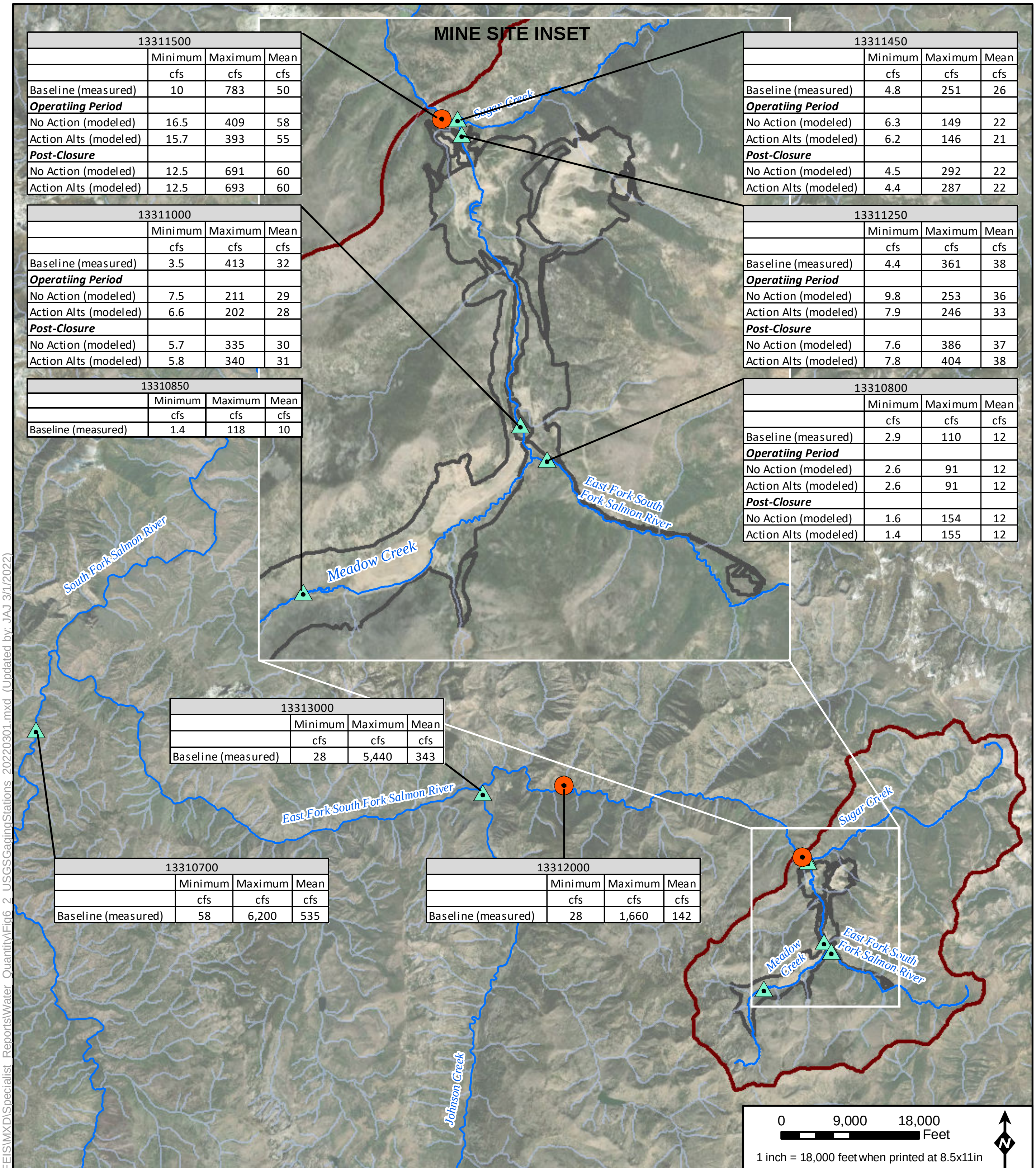
Nine USGS streamflow gages (**Figure 6-2**) in and near the analysis area provide data to characterize the existing environment. **Table 6-4** provides streamflow statistics for the nine USGS gaging stations, and **Figure 6-3** presents average monthly discharge hydrographs for six active USGS gaging stations present in the analysis area. The hydrographs illustrate the snowmelt-dominated streamflow pattern observed in the area with flows beginning to rise in March and April and peaking in May or June, before receding to base flow conditions in late summer/fall and remaining low through the winter.

**Table 6-4 USGS Gaging Station Drainage Area and Flow Statistics**

| Gage Number | Gage Name | Drainage Area (square miles) | Min (cfs) | Max (cfs) | Mean (cfs) | Period of Record (# years monitored) |
|---|---|---|---|---|---|---|
| 13310850 | Meadow Creek near Stibnite, Idaho | 5.6 | 1.37 | 129 | 11.0 | 09/2011–02/2022 (10 years) |
| 13310800 | East Fork SFSR above Meadow Creek near Stibnite, Idaho | 9.0 | 2.20 | 159 | 11.8 | 09/2011–02/2022 (10 years) |
| 13311000 | East Fork SFSR at Stibnite, Idaho | 19.3 | 3.50 | 413 | 31.5 | 1928–1943 1982–1997 2010–2022 (41 years) |
| 13311450 | Sugar Creek near Stibnite, Idaho | 18.0 | 4.00 | 252 | 22.9 | 09/2011–02/2022 (10 years) |
| 13311250 | East Fork SFSR above Sugar Creek near Stibnite, Idaho | 25.0 | 4.39 | 366 | 36.9 | 09/2011–02/2022 (10 years) |
| 13311500 | East Fork SFSR near Stibnite, Idaho[1] | 43.0 | 10 | 783 | 50.4 | 06/1928–09/1941 (13 years) |
| 13312000 | East Fork SFSR near Yellow Pine, Idaho[1] | 107.0 | 28 | 1,660 | 142.4 | 08/1928–07/1943 (13 years) |
| 13313000 | Johnson Creek at Yellow Pine, Idaho | 218.0 | 28 | 5,440 | 342.5 | 09/1928–02/2022 (93 years) |
| 13310700 | South Fork Salmon River near Krassel Ranger Station, Idaho | 330.0 | 35 | 6,200 | 536.6 | 10/1966–02/2022 (55 years) |

Source: Brown and Caldwell 2017 – Table 7-9. Flow data from 2017-2022 updated from waterdata.usgs.gov

[1] Inactive; cfs = cubic feet per second




| 13311500 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 10 | 783 | 50 |
| ***Operatiing Period*** | | | |
| No Action (modeled) | 16.5 | 409 | 58 |
| Action Alts (modeled) | 15.7 | 393 | 55 |
| ***Post-Closure*** | | | |
| No Action (modeled) | 12.5 | 691 | 60 |
| Action Alts (modeled) | 12.5 | 693 | 60 |

| 13311450 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 4.8 | 251 | 26 |
| ***Operatiing Period*** | | | |
| No Action (modeled) | 6.3 | 149 | 22 |
| Action Alts (modeled) | 6.2 | 146 | 21 |
| ***Post-Closure*** | | | |
| No Action (modeled) | 4.5 | 292 | 22 |
| Action Alts (modeled) | 4.4 | 287 | 22 |

| 13311000 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 3.5 | 413 | 32 |
| ***Operatiing Period*** | | | |
| No Action (modeled) | 7.5 | 211 | 29 |
| Action Alts (modeled) | 6.6 | 202 | 28 |
| ***Post-Closure*** | | | |
| No Action (modeled) | 5.7 | 335 | 30 |
| Action Alts (modeled) | 5.8 | 340 | 31 |

| 13311250 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 4.4 | 361 | 38 |
| ***Operatiing Period*** | | | |
| No Action (modeled) | 9.8 | 253 | 36 |
| Action Alts (modeled) | 7.9 | 246 | 33 |
| ***Post-Closure*** | | | |
| No Action (modeled) | 7.6 | 386 | 37 |
| Action Alts (modeled) | 7.8 | 404 | 38 |

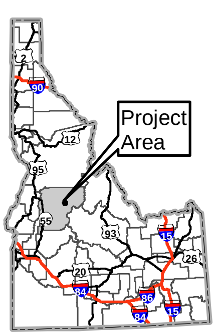
| 13310850 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 1.4 | 118 | 10 |

| 13310800 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 2.9 | 110 | 12 |
| ***Operatiing Period*** | | | |
| No Action (modeled) | 2.6 | 91 | 12 |
| Action Alts (modeled) | 2.6 | 91 | 12 |
| ***Post-Closure*** | | | |
| No Action (modeled) | 1.6 | 154 | 12 |
| Action Alts (modeled) | 1.4 | 155 | 12 |

| 13313000 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 28 | 5,440 | 343 |

| 13310700 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 58 | 6,200 | 535 |

| 13312000 | Minimum | Maximum | Mean |
|---|---|---|---|
| | cfs | cfs | cfs |
| Baseline (measured) | 28 | 1,660 | 142 |




## LEGEND

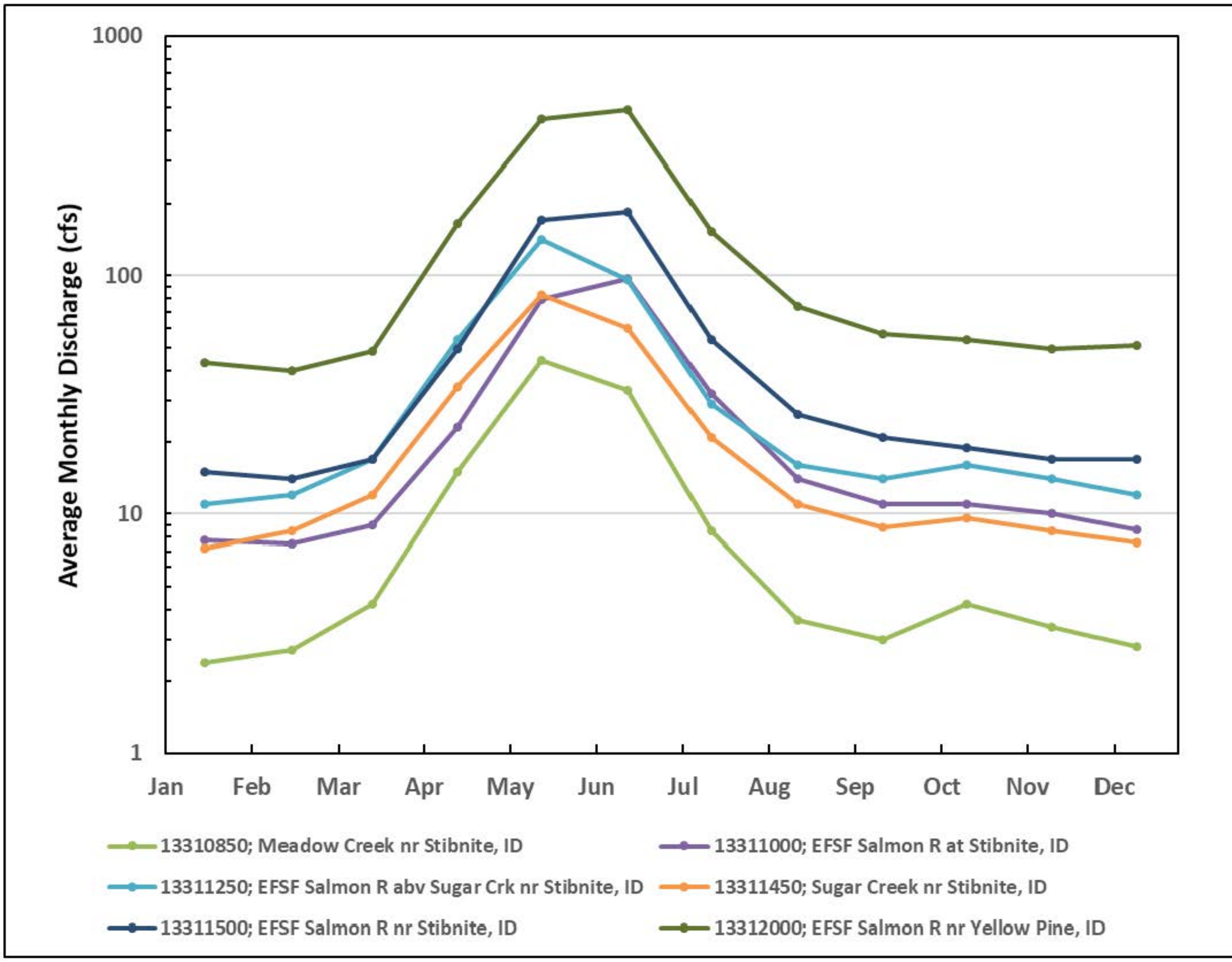
- Mine Site Water Modeling Boundary
- SGP Features *
- USGS Active Gaging Stations
- USGS Inactive Gaging Station
- Stream/River

*Mine Site Components are associated with 2021 MMP

## Figure 6-2
## USGS Gaging Stations
## 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*

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Water_Quantity\Fig6_2_USGSGagingStations_20220301.mxd (Updated by: JAJ 3/1/2022)



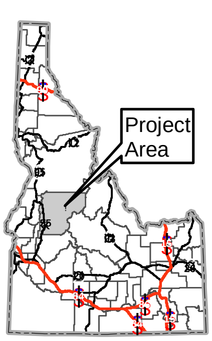




**Figure 6-3**
**Stream Monthly Discharge**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017))*

Baseflow and groundwater recharge estimates were derived using data from two of the USGS gaging stations in the analysis area (Brown and Caldwell 2017). Those two stations, USGS 13311250 (located at the East Fork SFSR above Sugar Creek) and USGS 13311450 (located at Sugar Creek before its discharge to the East Fork SFSR), together provide measurements that can be used to estimate groundwater recharge over the entire analysis area by calculating combined baseflow leaving the analysis area. These estimates assume that groundwater flow across the analysis area boundaries are negligible. The estimates also assume that during the periods of low flow (late summer, fall, and winter), the entire flow of each stream is derived from groundwater discharge into the stream. Stream discharges measured at the USGS gages during August, September, and October are interpreted to represent baseflow conditions (Brown and Caldwell 2017). This interpretation is based on 1) analysis of hydrographs, 2) lack of significant precipitation during these months, and 3) minor flow variations during this period of year.

Mean discharges measured during October 1-7, 2012, and August 13-19, 2015 (Brown and Caldwell 2017) at the two key stations were:

- 7.64 cfs and 9.02 cfs, respectively, for station 13311450 (Sugar Creek) – with an average of 8.33 cfs; and
- 12.00 cfs and 12.77 cfs, respectively, for station 13311250 (East Fork SFSR) – with an average of 12.39 cfs.

Considering approximate drainage areas for each of those two stations (18 square miles for Sugar Creek and 25 square miles for the East Fork SFSR [Brown and Caldwell 2017]), groundwater recharge over the Sugar Creek and East Fork SFSR drainage areas was calculated to 8.1 inches per year the alluvial valley bottom areas and 6.2 inches per year in the bedrock dominated mountainous areas. These values represent about 20 percent of the estimated annual precipitation for the SGP area, which is equal to 32.19 inches (Brown and Caldwell 2021a).

USGS data also were used to derive peak flow statistics for the seven major drainages in the analysis area. Results from the peak flow analysis were summarized in the baseline study (HydroGeo 2012b) and **Table 6-5**. 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 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** provides the maximum instantaneous flow predicted to occur for various return periods from a 1.5-year event up to a 500-year event.

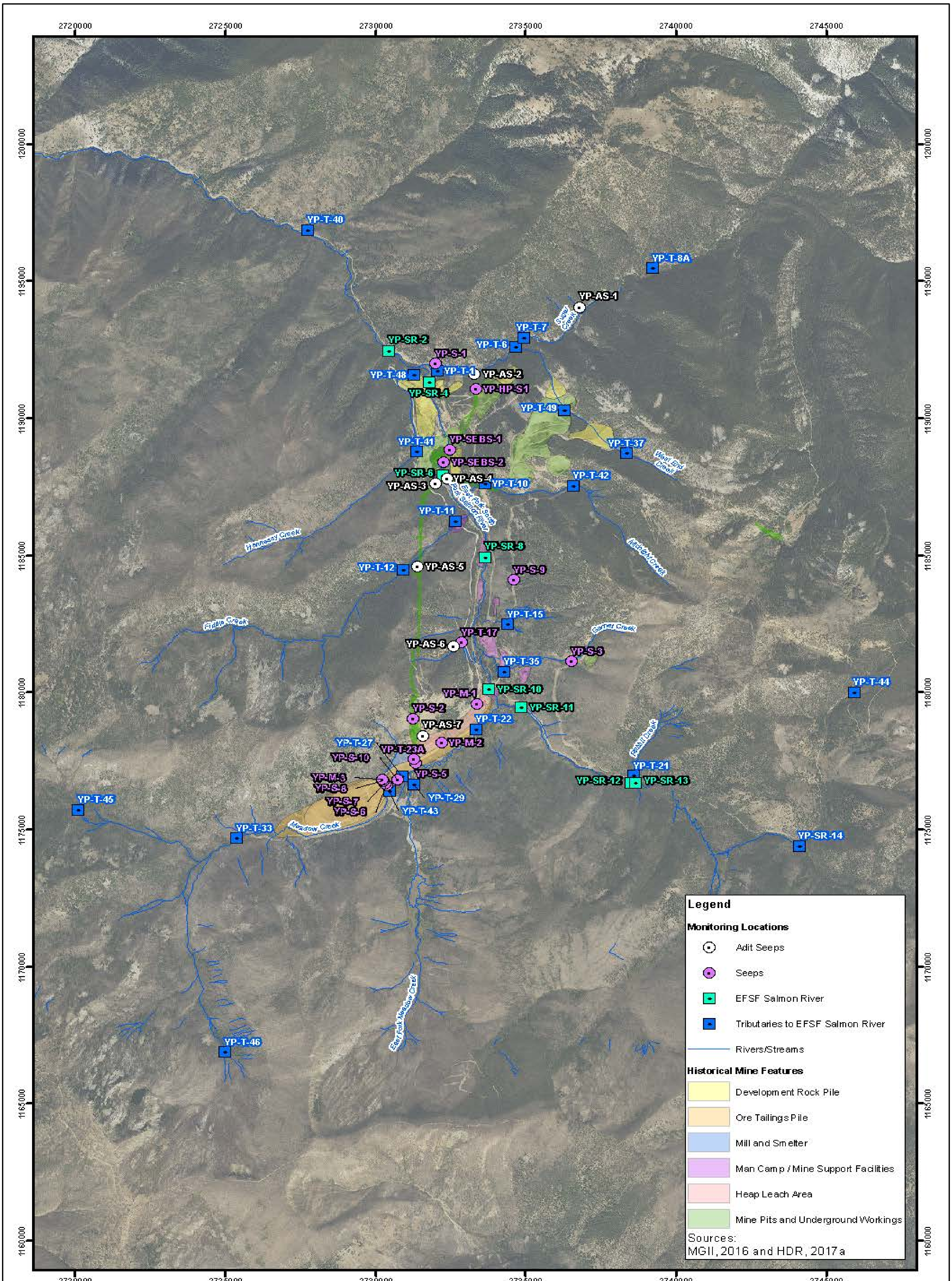
**Table 6-5 Peak Steam Flow Statistics for Drainages in the Analysis Area**

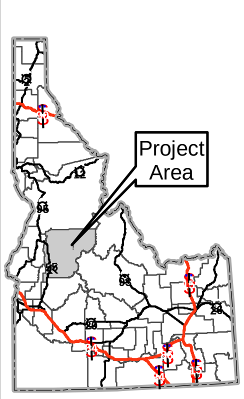
| Drainage | 1.5-year event | 2-year event | 2.33-year event | 5-year event | 10-year event | 25-year event | 50-year event | 100-year event |
|---|---|---|---|---|---|---|---|---|
| | PK1_5 (cfs) | PK2 (cfs) | PK2_33 (cfs) | PK5 (cfs) | PK10 (cfs) | PK25 (cfs) | PK50 (cfs) | PK100 (cfs) |
| Meadow Creek (13310850) | 83 (76-91) | 98 (90-107) | 105 (97-114) | 132 (122-144) | 152 (140-168) | 175 (159-200) | 191 (170-223) | 205 (179-247) |
| East Fork SFSR above Meadow Creek (13310800) | 83 (75-90) | 97 (89-105) | 104 (96-112) | 130 (120-141) | 149 (138-165) | 171 (156-195) | 186 (167-218) | 200 (176-241) |
| East Fork SFSR below Meadow Creek (13311000) | 174 (154-195) | 215 (193-240) | 235 (211-261) | 316 (285-353) | 379 (341-432) | 454 (401-539) | 507 (438-623) | 557 (469-710) |
| East Fork SFSR above Sugar Creek (13311250) | 229 (205-254) | 279 (252-307) | 301 (273-331) | 395 (359-437) | 466 (423-525) | 550 (491-643) | 608 (532-733) | 662 (566-826) |
| East Fork SFSR below Sugar Creek (13311500) | 372 (327-418) | 465 (415-520) | 508 (454-567) | 693 (622-777) | 837 (749-959) | 1010 (888-1207) | 1133 (973-1403) | 1249 (1044-1606) |
| Sugar Creek (13311450) | 143 (124-162) | 181 (160-204) | 199 (177-224) | 278 (247-314) | 340 (301-393) | 415 (361-502) | 469 (398-589) | 520 (429-680) |
| Johnson Creek (13313000) | 2497 (2268-2727) | 2962 (2713-3230) | 3175 (2911-3563) | 4079 (3737-4491) | 4789 (4356-5375) | 5652 (5058-6592) | 6273 (5521-7574) | 6877 (5936-8617) |

Source: Rio ASE 2021, Appendix C.

cfs = cubic feet per second; peak flow volume statistic reported followed by its 95% confidence interval in parentheses

In addition to the USGS data, streamflow data were collected in conjunction with surface water quality baseline sampling on a monthly or quarterly basis at 32 non-USGS monitoring stations (**Figure 6-4**). 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** provides streamflow 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 YP-SR-14, to 31.31 cfs at the most downstream location YP-SR-2. Note that the baseline monitoring sites are at different locations than the USGS gaging stations, thus providing additional site-specific data proximal to historical and proposed facilities.




Basemap: Aerial Photo, 2015

0 3,000 6,000
Feet

N

**Figure 6-4**
**Surface Water Monitoring Locations**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017)*

**Table 6-6 Baseline Monitoring Surface Water Flow Statistics**

| Monitoring Site | Stream | Min (cfs) | Max (cfs) | Mean (cfs) |
|---|---|---|---|---|
| YP-SR-2 | East Fork SFSR | 8.97 | 74.56 | 31.31 |
| YP-SR-4 | East Fork SFSR | 7.67 | 37.84 | 16.92 |
| YP-SR-6 | East Fork SFSR | 8 | 50.76 | 20.38 |
| YP-SR-8 | East Fork SFSR | 5.88 | 61.08 | 19.33 |
| YP-SR-10 | East Fork SFSR | 6.23 | 106.21 | 23.97 |
| YP-SR-11 | East Fork SFSR | 3.32 | 40.67 | 10.41 |
| YP-SR-13 | East Fork SFSR | 2.05 | 54.92 | 11.56 |
| YP-SR-14 | East Fork SFSR | 0.48 | 22.25 | 4.47 |
| YP-T-1 | Sugar Creek | 5.71 | 78.06 | 21.24 |
| YP-T-6 | West End Creek | 0.16 | 1.68 | 0.51 |
| YP-T-7 | Sugar Creek | 5.25 | 34.12 | 12.51 |
| YP-T-8A | Sugar Creek | 4.61 | 77.36 | 19.27 |
| YP-T-10 | Midnight Creek | 0.15 | 2.62 | 0.67 |
| YP-T-11 | Fiddle Creek | 0.22 | 20.57 | 3.3 |
| YP-T-12 | Fiddle Creek | 0.15 | 17.87 | 3.59 |
| YP-T-15 | Scout Creek | 0.04 | 0.62 | 0.15 |
| YP-T-21 | Rabbit Creek | 0.22 | 3.47 | 0.95 |
| YP-T-22 | Meadow Creek | 3.91 | 86.61 | 17.94 |
| YP-T-27 | Meadow Creek | 2.78 | 76.45 | 14.86 |
| YP-T-29 | East Fork Meadow Creek | 0.78 | 24.45 | 4.69 |
| YP-T-33 | Meadow Creek | 1.96 | 41.13 | 9.22 |
| YP-T-35 | Garnet Creek | 0.01 | 1.16 | 0.19 |
| YP-T-37 | West End Creek | 0.003 | 0.12 | 0.03 |
| YP-T-40 | Salt Creek | 0.8 | 13.38 | 2.8 |
| YP-T-41 | Hennessy Creek | 0.15 | 7.37 | 1.25 |
| YP-T-42 | Midnight Creek | 0.12 | 3.59 | 0.99 |
| YP-T-43 | Meadow Creek | 1.97 | 49 | 13.48 |
| YP-T-44 | Fern Creek | 0.06 | 2.65 | 0.54 |
| YP-T-45 | North Fork Meadow Creek | 0.24 | 19.01 | 3.92 |
| YP-T-46 | South Fork Meadow Creek | 0.28 | 9.67 | 3.04 |
| YP-T-48 | Hennessy Creek | 0.09 | 5.09 | 1 |
| YP-T-49 | West End Creek | 0.37 | 1.37 | 0.71 |

Source: Brown and Caldwell 2017

cfs = cubic feet per second

### 6.2.2 Seeps and Springs

Seeps and springs are locations where water emanates from the ground to form surface water resources aside from the perennial streams that serve to drain the analysis area. Depending on their site-specific conditions, flow from seeps and spring may be perennial or ephemeral and may or may not be enhanced by surface water runoff. Further, depending on site-specific characteristics, seeps and springs may provide an accessible water source for wildlife and vegetation, functioning as the water source for a groundwater-dependent ecosystem (GDE).

The HydroGeo hydrology field survey completed in 2012 identified 347 hydrologic seep/spring sites within the analysis area (HydroGeo 2012a). The survey identified 37 seeps, 153 seeps with wetlands, 33 springs, 117 springs with wetlands, 1 pond, 2 ponds with wetlands, 3 seep/pond/wetland complexes, and 1 reemerging creek (HydroGeo 2012a). The majority of seeps and springs were found in the glacial cirques that form the headwaters of Meadow Creek, Fiddle Creek, and Hennessy Creek (**Figure 6-5**). Monitoring of seep discharge was established at 23 sites (**Figure 6-4**) during the baseline studies to assess seep and spring contributions and for conceptualization of surficial flow in the analysis area. Mean discharge measured at the sites ranged from 0.0023 cfs at YP-AS-7 in the Meadow Creek drainage to 0.25 cfs at YP-SEBS-2 in the East Fork SFSR drainage. **Table 6-7** provides statistics for the seep discharge.

**Table 6-7 Baseline Monitoring Seep and Spring Discharge Statistics**

| Monitoring Site | Drainage | Min (cfs) | Max (cfs) | Mean (cfs) |
|---|---|---|---|---|
| YP-AS-1 | Sugar Creek | 0.0003 | 0.09 | 0.01 |
| YP-AS-2 | Sugar Creek | 0.03 | 0.22 | 0.08 |
| YP-AS-3 | East Fork SFSR | 0.0005 | 0.03 | 0.005 |
| YP-AS-4 | East Fork SFSR | 0.015 | 0.3 | 0.1 |
| YP-AS-5 | Fiddle Creek | NM | NM | NM |
| YP-AS-6 | East Fork SFSR | 0.0004 | 0.01 | 0.0043 |
| YP-AS-7 | Meadow Creek | 0.000012 | 0.0052 | 0.0023 |
| YP-HP-S1 | Sugar Creek | 0.0052 | 0.29 | 0.085 |
| YP-M-3 | Meadow Creek | 0.006 | 0.75 | 0.135 |
| YP-M-4 | Fiddle Creek | NM | NM | NM |
| YP-S-1 | Sugar Creek | 0.00003 | 0.03 | 0.004 |
| YP-S-2 | Meadow Creek | 0.000003 | 0.02 | 0.004 |
| YP-S-3 | East Fork SFSR | 0.005 | 0.23 | 0.05 |
| YP-S-5 | Meadow Creek | 0.002 | 0.04 | 0.02 |
| YP-S-6 | Meadow Creek | 0.0003 | 0.006 | 0.0036 |
| YP-S-7 | Meadow Creek | 0.007 | 0.01 | 0.01 |
| YP-S-8 | Meadow Creek | 0.0003 | 0.05 | 0.008 |
| YP-S-9 | East Fork SFSR | 0.0007 | 0.004 | 0.002 |
| YP-S-10 | Meadow Creek | 0.03 | 0.86 | 0.21 |
| YP-SEBS-1 | East Fork SFSR | 0.006 | 0.07 | 0.036 |
| YP-SEBS-2 | East Fork SFSR | 0.024 | 0.54 | 0.25 |
| YP-T-17 | East Fork SFSR | 0.0004 | 0.12 | 0.02 |
| YP-T-23A | Meadow Creek | 0.0003 | 0.05 | 0.02 |

Source: Brown and Caldwell 2017

cfs = cubic feet per second, NM = Not Measured

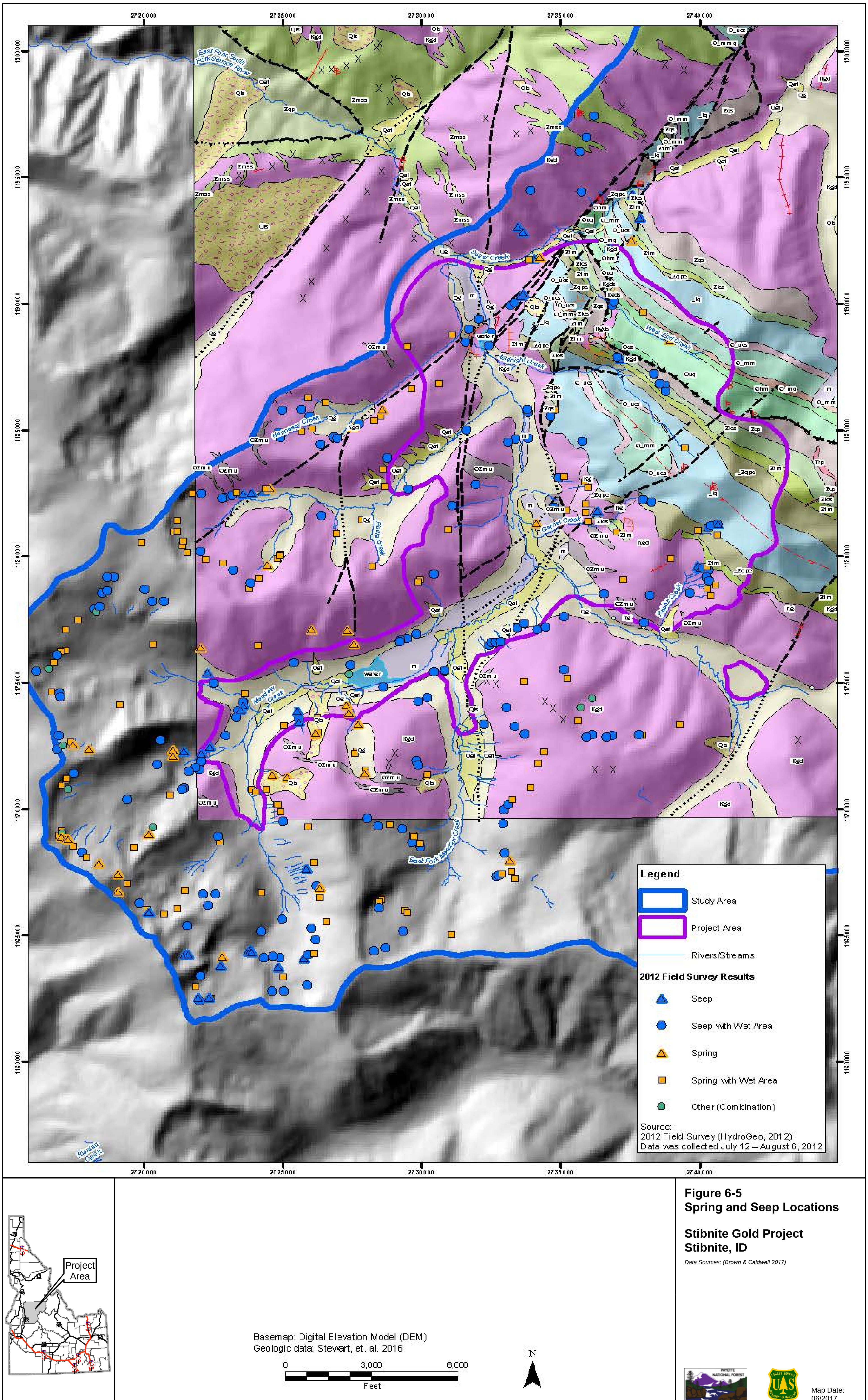



**Figure 6-5**
**Spring and Seep Locations**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017)*

Map Date: 06/2017

HydroGeo (2012a, 2012b) provides the following summary of results of the 2018 spring and seep survey:

- Many of the springs or seeps at higher elevations were located near bedrock outcrops. Due to colluvial cover of the slopes, it was difficult or impossible to recognize whether the water was emanating from a bedrock source, or daylighting as unsaturated flow within the colluvium (e.g., interflow and/or throughflow).
- Springs and seeps were found in the lower Meadow Creek drainage around the spent heap leach ore disposal area.
- Most of the springs were found in alluvial or colluvial slump areas. Emerging water was often found flowing only a short distance above ground before going underground again, especially at higher elevations where snowmelt recharges the colluvial cover.
- Some of the spring and seep sites were located along road cuts. These types of springs and seeps are not naturally occurring and bear no discernible relationship to any local geologic features.
- The results of the survey indicate no clear-cut relationship between the springs and seeps and mapped geologic structures and stratigraphy.

### 6.2.3 Waters of the United States

Waters of the U.S. are defined by 33 CFR 328.3 as: *all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; all interstate waters including interstate wetlands; all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters that are or could be used by interstate or foreign travelers for recreational or other purposes, or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce, or that are used or could be used for industrial purpose by industries in interstate commerce; all impoundments of waters otherwise defined as Waters of the U.S. under the definition; tributaries of waters identified in paragraphs (a)(1)-(4) of this section; the territorial seas; and wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1)-(6) of this section*. Various related definitions, Supreme Court findings, and regulatory guidance currently affect how the definition is applied. In part, the CWA, through Part 404, requires permits before fill can be placed in jurisdictional Waters of the U.S. Waters of the U.S. are regulated by the USACE. This section discusses non-wetland Waters of the U.S.; wetland Waters of the U.S. are described in the companion SGP Wetlands and Riparian Resources Specialist Report (Forest Service 2022c).

Field investigations to evaluate the potential jurisdictional status of ephemeral channels and wetlands within the analysis area were performed between 2013 and 2021 (TetraTech 2021). The investigation identified 7.2 acres of non-jurisdictional wetlands out of a total of 123.5 wetland acres in the vicinity of proposed Project activity. The non-jurisdictional wetlands occur primarily in proximity to non-jurisdictional seeps and springs in the Meadow Creek drainage and along the electrical transmission line and Burntlog Road routes.

### 6.2.4 Surface Water Rights

Within the analysis area, there are no federal, state, or other private surface water rights aside from two water rights held by Perpetua (**Table 6-8**). However, the Idaho Water Resource Board (IWRB) and the Forest Service hold minimum flow water rights downstream of the SGP on the East Fork SFSR, South Fork of the Salmon River, and the mainstem of the Salmon River.

**Table 6-8 Surface Water Rights Summary**

| Water Right ID | Type | Source | Diversion Point | Priority Date | Beneficial Use | Diversion Rate (cfs) | Max Total Usage (acre-feet) |
|---|---|---|---|---|---|---|---|
| 77-7293 | Surface Water | Unnamed Stream (Hennessy Creek) | SW¼ of the NE¼, Section 3, T18N, R9E | 4/19/1989 | Mining | 0.25 | 20.0 |
| 77-7122 | Surface Water | East Fork SFSR | NW¼ of the NW¼, Section 14, T18N, R9E | 4/16/1981 | Storage and Mining | 0.33 | 7.1 |

Source: Midas Gold 2016 (Table 8-1)

cfs = cubic feet per second.

The four existing water rights at the SGP (two surface water rights and two groundwater rights) are specific to historical use related to activities in the 1980s and 1990s. While these are valid water rights, the specific points of diversion, place of use, and beneficial use does not reflect planned SGP activities and would need to be adjusted through the transfer process, and through filing additional applications for permit. It is not necessary to record a water right for the random diversion of water for fire suppression purposes. However, water used for dust control and exploration activities requires a water right.

A review of IDWR water right records indicates that there are no downstream consumptive-use water rights on the East Fork SFSR until after the river merges with Johnson Creek (HDR 2017). The Idaho Water Resource Board maintains minimum streamflow rights (MSR) on various rivers and creeks in the state, including a location near the end of the East Fork SFSR below the confluence with Johnson Creek, which is covered under water right 77-14190. A minimum streamflow is the amount of flow necessary to preserve stream values, including protecting fish and wildlife habitat, aquatic life, navigation, transportation, recreation, water quality, or aesthetic beauty. The minimum flow varies throughout the calendar year (**Table 6-9**), with a base flow minimum of 173 cfs between October 1 and October 31 as measured on the East Fork SFSR at the confluence of the East Fork SFSR with the South Fork Salmon River. Water Right 77-14190 is subordinate to future non-domestic, commercial, municipal, and industrial uses and future non-domestic, commercial, municipal, and industrial development up to 8.2 cfs.

**Table 6-9 State of Idaho, IDWR Water Right No. 77-14190 Minimum Stream Flow**

| Usage Period | Diversion Rate (cfs) |
|---|---|
| 8/1 to 8/31 | 223 |
| 9/1 to 9/30 | 179 |
| 10/1 to 10/31 | 173 |
| 11/1 to 11/30 | 214 |
| 12/1 to 12/31 | 222 |
| 1/1 to 1/31 | 254 |
| 2/1 to 2/28 | 232 |
| 3/1 to 3/31 | 291 |
| 4/1 to 4/30 | 625 |
| 5/1 to 5/31 | 1,829 |
| 6/1 to 6/30 | 2,269 |
| 7/1 to 7/31 | 590 |
| Total Diversion | 2,269 |

Source: HDR 2017

cfs = cubic feet per second.

The Idaho Water Resource Board also holds a minimum streamflow water right downstream (approximately 26.4 miles from the SGP and approximately 9 miles from the East Fork SFSR confluence) on the South Fork of the Salmon River (77-14174). Water Right 77-14174 is also subordinate to all future domestic, commercial, municipal, and industrial uses and future non- domestic, commercial, municipal, and industrial development up to 20.6 cfs.

The Forest Service holds two water rights on the Salmon River (75-13316 and 77-11941) below the Shoup quantification site (Shoup gage) which is upstream of the SF confluence. These are instream, non-consumptive water rights that maintain flows for the Wild and Scenic River designated segment of the Salmon River. When flows measured at the Shoup gauge are less than 13,600 cfs, the minimum in-stream flow rates provided by the water rights range from 1,200 cfs for the period of September 1 to September 15 to 9,450 cfs for the period of June 1 to June 15. The South Fork of the Salmon River joins this segment of the mainstem Salmon River approximately 64.6 miles downstream from the SGP area. These water rights are subordinated to all water rights claims filed in the Snake River Basin Adjudication as of the effective date (September 1, 2003) of the Stipulation among the United States, the State of Idaho, and other objectors. They also are subordinated to specified quantities of future beneficial use rights. Additional detailed information regarding these two water rights can be found in Water Right Reports (referenced by water right number) available on the IDWR website (https://idwr.idaho.gov/water-rights/).

### 6.2.5 Surface Water Diversion and Discharge

Under current conditions, surface water diversion within the analysis area is limited to water usage by Perpetua in accordance with its current surface water rights. As part of the proposed mining activity, additional surface water diversion from the East Fork SFSR is proposed from a location upstream of the proposed fish tunnel (Brown and Caldwell 2021f). New appropriation can be accommodated under the subordination amounts specified in the Idaho Water Resource Board and Forest Service minimum flow rights for future beneficial use and are most relevant to the SGP.

Storage of water is not subordinated as specified in the partial decree for the two Federal Wild and Scenic rights (Fifth Judicial District 2004) which states that "[t]hese subordinated amounts do not include storage, other than incidental storage, which is defined as storage not more than a 24 hour water supply for any beneficial use."

There are currently no permitted wastewater discharges to surface water within the analysis area. Stormwater runoff associated with current exploration activities has been covered under the March 2021 Multi-Sector General Permit administered by IDEQ. The proposed mining activity includes a treated industrial wastewater discharge and a treated residential wastewater discharge that would be permitted under the State of Idaho's IPDES process. A discharge to Meadow Creek would be located adjacent to the TSF Buttress and discharges to East Fork SFSR would be located west of the Stibnite Worker Housing Facility and west of the Process Plant (Brown and Caldwell 2021f).

## 6.3 Groundwater

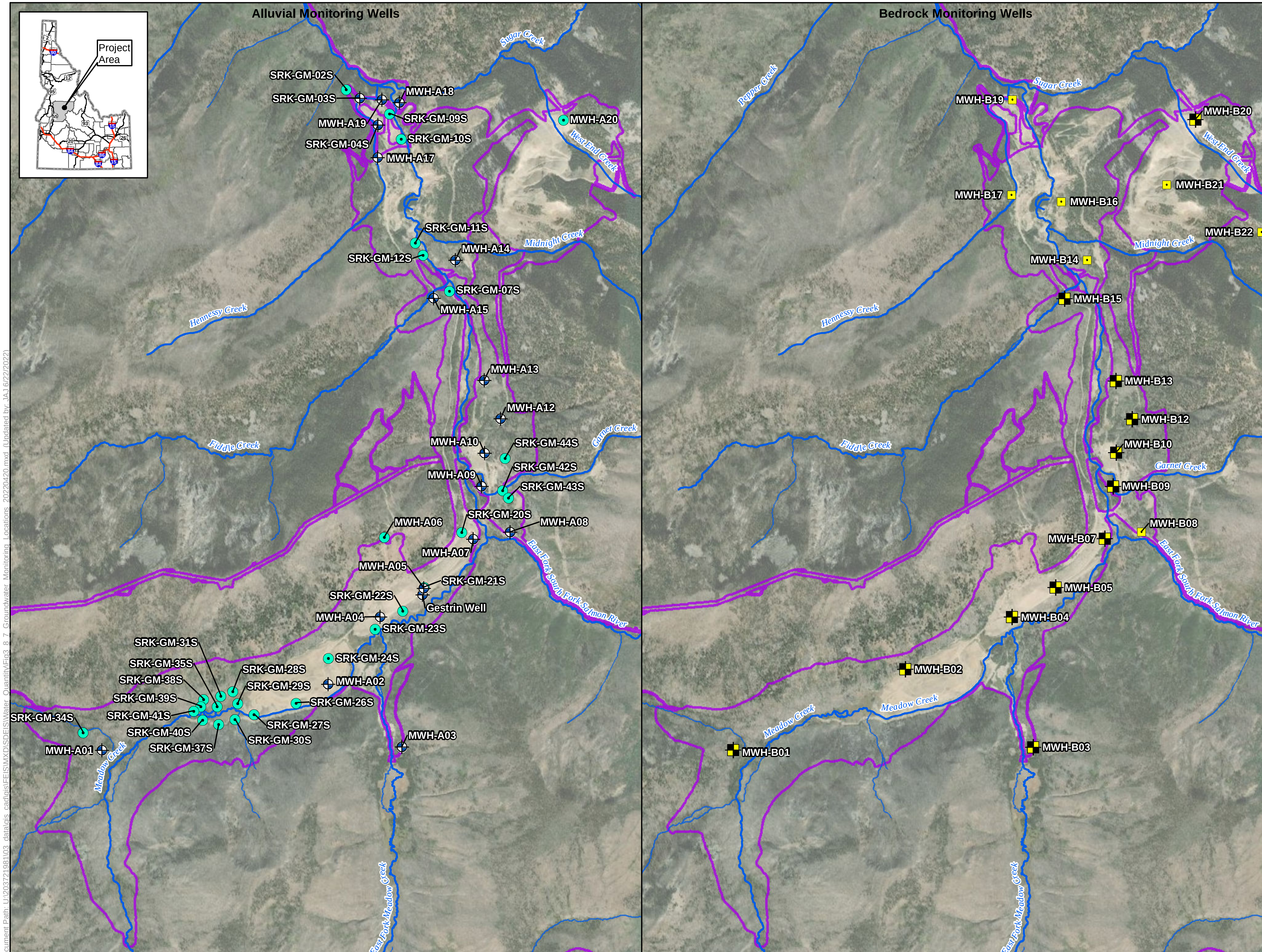
Groundwater flow in the analysis area occurs primarily in the Quaternary unconsolidated deposits in the valleys (composed of alluvium, glacial, and glaciofluvial materials), and through the unconsolidated deposits covering the mountainsides (e.g., glacial moraines, talus, colluvial, and landslide materials). The unconsolidated Quaternary deposits in the valleys form what is referred to as an alluvial aquifer. Some groundwater flow also occurs within bedrock in areas where secondary porosity including fractures and fracture zones are present and sufficiently connected to promote water flow (SPF 2017). In select locations, historical mine workings, such as adits, that penetrate the bedrock units act to promote groundwater flow in bedrock.

The unconsolidated deposits receive water from snowmelt, precipitation, and infiltration of surface runoff from upland areas, and groundwater discharge from the underlying bedrock. Groundwater discharges primarily to streams, but also supports wetlands, seeps, and springs. The water discharging from unconsolidated deposits to the surface via seeps and springs often flows only a short distance over the surface before infiltrating back into the unconsolidated materials (SPF 2017).

### 6.3.1 Groundwater Observations

Baseline characterization of groundwater observations, including water levels, gradients, and flow directions is founded on measurements collected from 65 groundwater wells and four exploration boreholes converted to vibrating wire piezometers (VWPs; Brown & Caldwell 2017). Of those 65 wells, 49 are completed in alluvium, and 16 in bedrock. Well locations are provided in **Figure 6-6** with well completion information summarized in **Table 6-10**. Groundwater level data used for baseline characterization was collected from December 2011 through December 2019 (SPF 2017, Brown and Caldwell 2021c). Collection of groundwater level data is ongoing.

Spatially, alluvial monitoring wells characterize alluvium where it is present, primarily in the valley bottom areas (**Figure 6-6**). Bedrock monitoring wells are also located primarily in valley bottom areas where they can observe the effects of interactions between the lower flow bedrock lithologies and the higher flow alluvium (**Figure 6-6**). Most bedrock wells in the analysis area are screened within the batholith unit, with wells in the northeastern part of the project screened within the metasedimentary units (**Figures 6-7** and **6-8**). Tertiary intrusive rock units are interspersed within the other bedrock lithologies and are generally not specifically targeted by monitoring well completions due to their generally low permeability and small volumetric presence compared to the batholith and metasedimentary units.




**LEGEND**

- Alluvial Baseline Monitoring Well
- Other Alluvial Monitoring Well/Piezometer
- Bedrock Baseline Monitoring Well
- Other Bedrock Monitoring Well/Piezometer

**Project Components**

- SGP Features

**Other Features**

- Stream/River

0 0.25 0.5 Miles

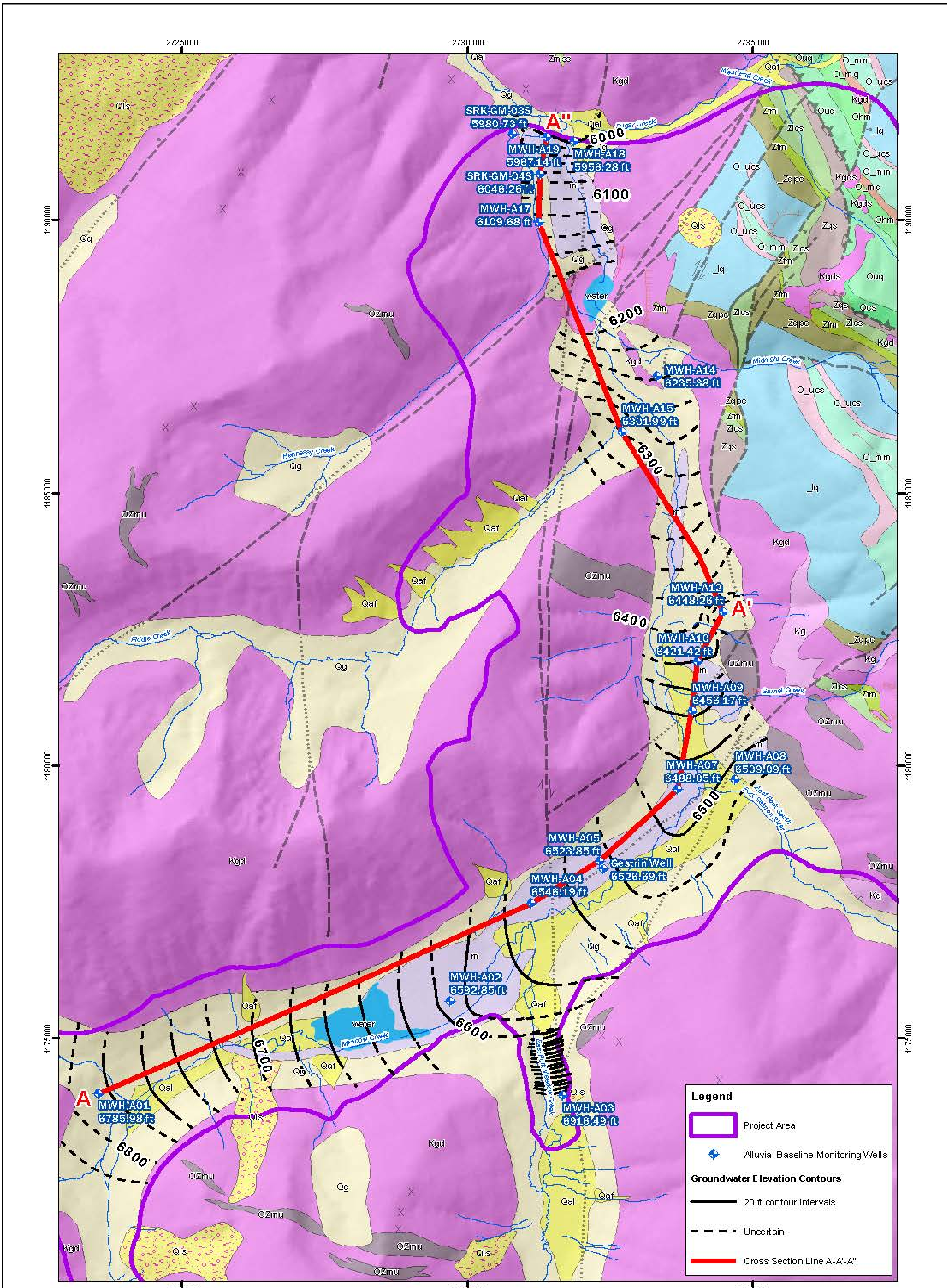
1 inch = 2,500 feet when printed at 11x17

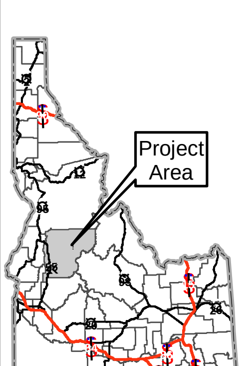
N

**Figure 6-6**
**Groundwater Monitoring Well 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. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*
*Other Data Sources: Perpetua; USGS NHD,*

Document Path: U:\2037219\81\03_data\gis_cad\gis\FEIS\MXD\SDEIS\Water_Quantity\Fig3_8_7_Groundwater_Monitoring_Locations_20220420.mxd (Updated by: JAJ 6/22/2022)




Basemap: Aerial photo, November 2011
Geologic data: Stewart, et. al. 2016

0 1,500 3,000
Feet

N

**Figure 6-7**
**Surface Geology**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017)*

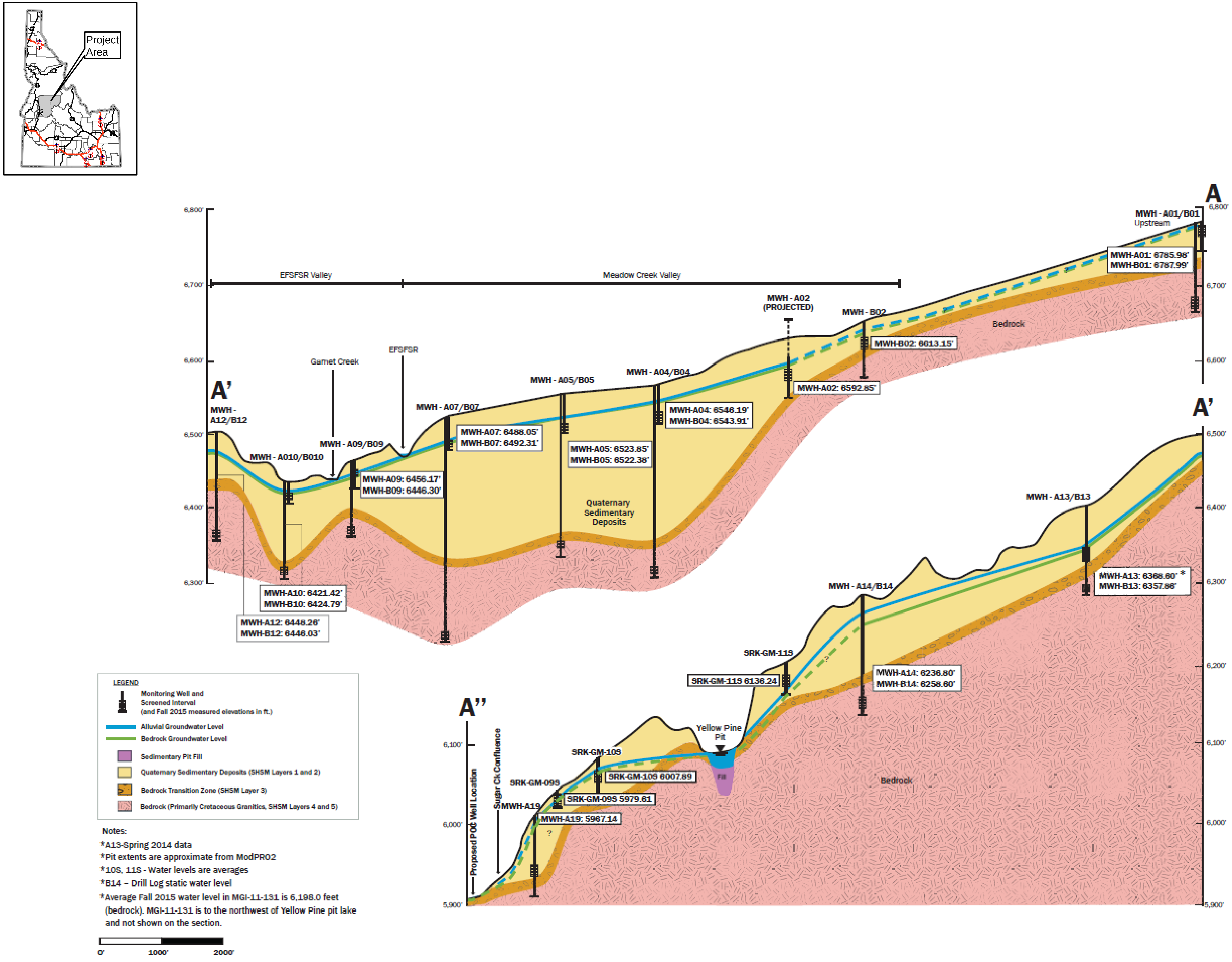



**Figure 6-8**
**Hydrogeologic Cross-Sections**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2017)*

## Table 6-10 Monitoring Well Completion Details

| Well Number | Global Position System Coordinates[1] | | Approximate Elevation | Screen Interval Depth (feet bgs[2]) | | Screen Interval Elevation (feet AMSL) | | Hydrogeologic Unit Screened | Water Level (feet AMSL) | Depth to Water (feet bgs)[3] | Completion Date | Completion Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Easting | Northing | (feet AMSL) | From | To | From | To | | | | | |
| Gestrin | 631510 | 4973000 | 6543 | 99 | 209 | 6544 | 6434 | Alluvium | 6526 | 17 | 11/23/2011 | 8” pumping well |
| MGI-19-HFPW | 631488 | 4973090 | 6540 | 60 | 140 | 6480 | 6400 | Alluvium | 6515 | 25 | 11/01/2019 | 10” pumping well |
| | | | | 170 | 430 | 6370 | 6110 | Bedrock | | | | |
| MWH-A01 | 628834 | 4971703 | 6784 | 30 | 40 | 6754 | 6744 | Till | artesian | - | 02/22/2012 | 2” piezometer |
| MWH-A02 | 630703 | 4972250 | 6659 | 100 | 110 | 6559 | 6549 | Alluvium | 6716 | 68 | 12/01/2011 | 2” piezometer |
| MWH-A03 | 631315 | 4971731 | 7034 | 290 | 310 | 6744 | 6724 | Alluvium | 6580 | 79 | 03/16/2013 | 2” piezometer |
| MWH-A04 | 631133 | 4972805 | 6563 | 55 | 65 | 6508 | 6498 | Alluvium | 7015 | 19 | 08/04/2012 | 2” piezometer |
| MWH-A05 | 631494 | 4973043 | 6543 | 34 | 44 | 6509 | 6499 | Alluvium | 6547 | 16 | 08/15/2012 | 4” monitoring well |
| MWH-A06 | 631172 | 4973465 | 7322 | 9 | 14 | 7313 | 7308 | Alluv./Quartz Monzonite | dry | - | 10/29/2012 | 2” piezometer |
| MWH-A07 | 631904 | 4973448 | 6520 | 32 | 42 | 6488 | 6478 | Alluvium | 6489 | 31 | 08/07/2012 | 4” monitoring well |
| MWH-A08 | 632207 | 4973507 | 6525 | 28 | 38 | 6498 | 6488 | Alluvium | 6508 | 17 | 11/15/2012 | 2” piezometer |
| MWH-A09 | 631972 | 4973886 | 6462 | 21 | 26 | 6441 | 6436 | Alluvium | 6454 | 8 | 09/09/2012 | 2” piezometer |
| MWH-A10 | 631997 | 4974160 | 6439 | 20 | 30 | 6419 | 6409 | Alluvium | 6422 | 17 | 08/02/2012 | 2” piezometer |
| MWH-A12 | 632129 | 4974443 | 6498 | 50 | 60 | 6449 | 6439 | Alluvium | 6451 | 47 | 02/15/2013 | 2” piezometer |
| MWH-A13 | 631995 | 4974760 | 6427 | 50 | 65 | 6377 | 6362 | Alluvium | 6376 | 51 | 02/21/2013 | 2” piezometer |
| MWH-A14 | 631756 | 4975755 | 6288 | 59 | 69 | 6229 | 6219 | Alluvium | 6237 | 51 | 02/26/2013 | 2” piezometer |
| MWH-A15 | 631574 | 4975439 | 6354 | 70 | 75 | 6284 | 6279 | Alluvium | 6303 | 51 | 11/10/2012 | 2” piezometer |
| MWH-A17 | 631114 | 4976604 | 6202 | 98 | 108 | 6104 | 6094 | Alluvium | 6110 | 92 | 10/29/2011 | 2” piezometer |
| MWH-A18 | 631294 | 4977057 | 5975 | 20 | 30 | 5955 | 5945 | Alluvium | 5957 | 18 | 09/13/2012 | 2” piezometer |
| MWH-A19 | 631148 | 4977079 | 6021 | 50 | 60 | 5971 | 5961 | Alluvium | 5966 | 55 | 10/15/2012 | 2” piezometer |
| MWH-A20 | 632650 | 4976915 | 6654 | 43 | 53 | 6611 | 6601 | Alluvium | dry | - | 10/25/2012 | 2” piezometer |
| MWH-B01 | 628833 | 4971706 | 6786 | 125 | 135 | 6661 | 6651 | Diorite/Granite | artesian | - | 03/02/2013 | 2” piezometer |
| MWH-B02 | 630254 | 4972374 | 6637 | 48 | 58 | 6589 | 6579 | Quartz Monzonite/Granite | 6615 | 22 | 09/22/2012 | 2” piezometer |
| MWH-B03 | 631312 | 4971729 | 7038 | 463 | 478 | 6575 | 6560 | Alaskite | 6915 | 123 | 03/10/2013 | 2” piezometer |
| MWH-B04 | 631136 | 4972805 | 6563 | 238 | 258 | 6325 | 6305 | Quartz Monzonite | 6543 | 20 | 08/07/2012 | 2” piezometer |
| MWH-B05 | 631497 | 4973050 | 6543 | 208 | 218 | 6335 | 6325 | Quartz Monzonite | 6524 | 19 | 08/18/2012 | 4” monitoring well |
| MWH-B07 | 631903 | 4973452 | 6520 | 284 | 294 | 6236 | 6226 | Quartz Monzonite | 6492 | 28 | 09/04/2012 | 4” monitoring well |
| MWH-B09 | 631972 | 4973886 | 6462 | 85 | 100 | 6377 | 6362 | Calc-silicate | 6444 | 18 | 09/08/2012 | 2” piezometer |
| MWH-B10 | 631995 | 4974164 | 6439 | 78 | 88 | 6361 | 6351 | Calc-silicate | 6426 | 13 | 07/20/2012 | 2” piezometer |

| Well Number | Global Position System Coordinates[1] | | Approximate Elevation | Screen Interval Depth (feet bgs[2]) | | Screen Interval Elevation (feet AMSL) | | Hydrogeologic Unit Screened | Water Level (feet AMSL) | Depth to Water (feet bgs)[3] | Completion Date | Completion Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Easting | Northing | (feet AMSL) | From | To | From | To | | | | | |
| MWH-B12 | 632129 | 4974440 | 6498 | 130 | 140 | 6368 | 6358 | Quartz Monzonite | 6443 | 55 | 02/13/2013 | 2" piezometer |
| MWH-B13 | 631995 | 4974757 | 6426 | 120 | 130 | 6306 | 6296 | Quartzite-Schist | 6358 | 68 | 02/20/2013 | 2" piezometer |
| MWH-B14 | 631757 | 4975757 | 6288 | 180 | 190 | 6108 | 6098 | Quartz Monzonite | 6259 | 29 | 02/25/2013 | 2" piezometer |
| MWH-B15 | 631571 | 4975438 | 6354 | 155 | 185 | 6199 | 6169 | Quartz Monzonite | 6304 | 50 | 11/07/2012 | 2" piezometer |
| MWH-B20 | 632652 | 4976916 | 6654 | 456 | 476 | 6198 | 6178 | Quartzite/Schist/Pelite/ Meta-Siltstone | 6497 | 157 | 07/24/2013 | 4" monitoring well |
| SRK-GM-02S | 630857 | 4977163 | 6078 | 162 | 172 | 5916 | 5906 | Alluvium | 5978 | 100 | 10/21/2011 | 2" piezometer |
| SRK-GM-03S | 630965 | 4977094 | 6047 | 110 | 120 | 5937 | 5927 | Alluvium | 5980 | 67 | 10/13/2011 | 2" piezometer |
| SRK-GM-04S | 631116 | 4976872 | 6145 | 100 | 110 | 6045 | 6035 | Alluvium | 6053 | 92 | 10/25/2011 | 2" piezometer |
| SRK-GM-07S | 631708 | 4975500 | 6296 | 24 | 34 | 6272 | 6262 | Alluvium | 6020 | 15 | 03/13/2012 | 2" piezometer |
| SRK-GM-09S | 631214 | 4976964 | 6035 | 58 | 68 | 5977 | 5967 | Alluvium | 5980 | 55 | 10/08/2011 | 2" piezometer |
| SRK-GM-10S | 631309 | 4976758 | 6032 | 27 | 37 | 6005 | 5995 | Alluvium | 6006 | 26 | 02/15/2012 | 2" piezometer |
| SRK-GM-11S | 631426 | 4975898 | 6179 | 25 | 55 | 6154 | 6144 | Alluvium | 6159 | 20 | 03/14/2012 | 2" piezometer |
| SRK-GM-12S | 631489 | 4975797 | 6204 | 26 | 36 | 6178 | 6168 | Alluvium | 6178 | 26 | 03/12/2012 | 2" piezometer |
| SRK-GM-21S | 631500 | 4973050 | 6541 | 170 | 180 | 6371 | 6361 | Alluvium | 6521 | 20 | 11/02/2011 | 2" piezometer |
| SRK-GM-22S | 631323 | 4972856 | 6549 | 149 | 159 | 6400 | 6390 | Alluvium | 6539 | 10 | 02/12/2012 | 2" piezometer |
| SRK-GM-23S | 631095 | 4972705 | 6568 | 88 | 98 | 6480 | 6479 | Alluvium | 6544 | 24 | 03/09/2012 | 2" piezometer |
| SRK-GM-24S | 630708 | 4972464 | 6628 | 107 | 117 | 6521 | 6511 | Alluvium | 6484 | 44 | 11/12/2011 | 2" piezometer |
| SRK-GM-26S | 630442 | 4972094 | 6618 | 74 | 84 | 6544 | 6534 | Alluvium | 6597 | 21 | 12/03/2011 | 2" piezometer |
| SRK-GM-27S | 630094 | 4971998 | 6612 | 58 | 68 | 6554 | 6544 | Alluvium | 6601 | 11 | 02/18/2012 | 2" piezometer |
| SRK-GM-28S | 629919 | 4972189 | 6615 | 27 | 37 | 6588 | 6578 | Alluvium | 6609 | 6 | 02/26/2012 | 2" piezometer |
| SRK-GM-29S | 629960 | 4972090 | 6605 | 40 | 50 | 6565 | 6555 | Alluvium | 6602 | 3 | 02/19/2012 | 2" piezometer |
| SRK-GM-30S | 629937 | 4971959 | 6629 | 47 | 57 | 6582 | 6572 | Alluvium | 6603 | 26 | 02/27/2012 | 2" piezometer |
| SRK-GM-31S | 629818 | 4972152 | 6618 | 34 | 44 | 6584 | 6574 | Alluvium | 6611 | 7 | 02/25/2012 | 2" piezometer |
| SRK-GM-34S | 628682 | 4971848 | 6952 | 30 | 40 | 6922 | 6912 | Alluvium | 6924 | 28 | 02/22/2012 | 2" piezometer |
| SRK-GM-35S | 629788 | 4972066 | 6613 | 39 | 49 | 6574 | 6564 | Alluvium | 6608 | 5 | 02/20/2012 | 2" piezometer |
| SRK-GM-37S | 629802 | 4971918 | 6631 | 21 | 31 | 6610 | 6601 | Alluvium | 6613 | 18 | 02/27/2012 | 2" piezometer |
| SRK-GM-38S | 629678 | 4972124 | 6637 | 44 | 54 | 6593 | 6583 | Alluvium | 6614 | 23 | 02/24/2012 | 2" piezometer |
| SRK-GM-39S | 629653 | 4972067 | 6630 | 44 | 54 | 6586 | 6576 | Alluvium | 6629 | 1 | 02/25/2012 | 2" piezometer |
| SRK-GM-40S | 629670 | 4971952 | 6632 | 28 | 38 | 6604 | 6594 | Alluvium | 6615 | 17 | 02/27/2012 | 2" piezometer |
| SRK-GM-41S | 629596 | 4972027 | 6630 | 45 | 55 | 6585 | 6576 | Alluvium | 6615 | 15 | 02/26/2012 | 2" piezometer |

| Well Number | Global Position System Coordinates[1] | | Approximate Elevation | Screen Interval Depth (feet bgs[2]) | | Screen Interval Elevation (feet AMSL) | | Hydrogeologic Unit Screened | Water Level (feet AMSL) | Depth to Water (feet bgs)[3] | Completion Date | Completion Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Easting | Northing | (feet AMSL) | From | To | From | To | | | | | |
| SRK-GM-42S | 632146 | 4973850 | 6512 | 27 | 37 | 6485 | 6475 | Alluvium | 6499 | 13 | 03/16/2012 | 2” piezometer |
| SRK-GM-43S | 632196 | 4973791 | 6533 | 25 | 35 | 6508 | 6498 | Alluvium | 6509 | 24 | 03/16/2012 | 2” piezometer |
| MGI-19-HFOW1A | 631408 | 4972929 | 6545 | 40 | 170 | 6506 | 5376 | Alluvium | 6536 | 9 | 10/27/2019 | 2” piezometer |
| MGI-19-HFOW1B | 631411 | 4972932 | 6545 | 225 | 425 | 6320 | 6120 | Bedrock | 6538 | 7 | 10/24/2019 | 2” piezometer |
| MGI-19-HFOW2A | 631542 | 4973024 | 6539 | 40 | 185 | 6499 | 6354 | Alluvium | 6515 | 24 | 10/13/2019 | 2” piezometer |
| MGI-19-HFOW2B | 631545 | 4973026 | 6539 | 235 | 420 | 6304 | 6119 | Bedrock | 6520 | 19 | 10/11/2019 | 2” piezometer |
| MGI-19-HFOW3A | 631845 | 4973520 | 6509 | 28 | 38 | 6481 | 6471 | Alluvium | 6486 | 23 | 10/05/2019 | 2” piezometer |
| MWH-B16 | 631542 | 4976239 | 6204 | 166 | 222 | 6038 | 5982 | Quartz Monzonite and Alaskite/Diorite | 6170 | 34 | 10/16/2012 | multi-level sampler |
| | | | | 451 | 476 | 5753 | 5728 | Quartz Monzonite/ Quartzite and Alaskite | 6169 | 35 | | |
| | | | | 567 | 619 | 5637 | 5585 | Quartzite-Schist | 6169 | 35 | | |
| MWH-B17 | 631132 | 4976295 | 6307 | 116 | 177 | 6191 | 6139 | Quartz Monzonite and Alaskite | 6295 | 12 | 11/04/2012 | multi-level sampler |
| | | | | 394 | 425 | 5913 | 5882 | Quartz Monzonite and Alaskite | 6297 | 10 | | |
| MWH-B21 | 632415 | 4976378 | 7290 | 125 | 160 | 7165 | 7130 | Calc-silicate/Carbonate | dry | - | 08/23/2012 | multi-level sampler |
| | | | | 328 | 353 | 6962 | 6937 | Quartzite-Schist/ Quartz Pebble Conglomerate | 6990 | 300 | | |
| | | | | 430 | 470 | 6860 | 6820 | Carbonate | - | - | | |
| | | | | 765 | 815 | 6525 | 6475 | Quartz Pebble Conglomerate/Schist Pelite Meta-Siltstone | 6892 | 398 | | |
| MWH-B22 | 632200 | 4975988 | 6969 | 91 | 122 | 6878 | 6847 | Calc-Silicate | dry | - | 10/02/2012 | multi-level sampler |
| | | | | 229 | 389 | 6740 | 6580 | Quartzite | dry | - | | |
| | | | | 400 | 536 | 6569 | 6433 | Quartzite/Quartz Pebble Conglomerate | 6598 | 371 | | |

Source: SPF 2017; Brown and Caldwell 2021c

[1]UTM coordinates

[2]Screen interval depth from ground surface

[3]Water level depth from ground surface

Most wells and boreholes (completed in alluvium or bedrock) exhibit seasonal groundwater level fluctuations typically ranging from approximately 2 to 20 feet. The highest water levels occur at the peak of the spring runoff period (i.e., between May and July), with levels receding to a minimum by late summer or early fall. The spot measurements in these wells indicate both the seasonality and the amplitude of annual fluctuations. Continuous water level measurements also show responses to major recharge events.

**Figure 6-9** shows water table elevation contours for the analysis area computed by the groundwater model calibrated to water levels (Brown and Caldwell 2018a, 2021b). The model calibration statics (Brown and Caldwell 2021b) indicate that the modeled groundwater elevations compare acceptably to monitoring well water level observations which are concentrated in valley bottoms. There are fewer observation locations for comparison on the mountain side areas. The water table contours mimic the land surface topography. The contours shown indicate that the water table is present both within unconsolidated sediments (particularly in the valley alluvium), and within shallow bedrock (mainly outside of the valley bottoms).

Groundwater horizontal hydraulic gradients within the alluvial deposits range from approximately two to 10 percent and are generally consistent with gradients of adjacent streams. Gradients in shallow bedrock are similar to gradients in the alluvial deposits but are steeper on the mountain slopes outside of the valley bottoms.

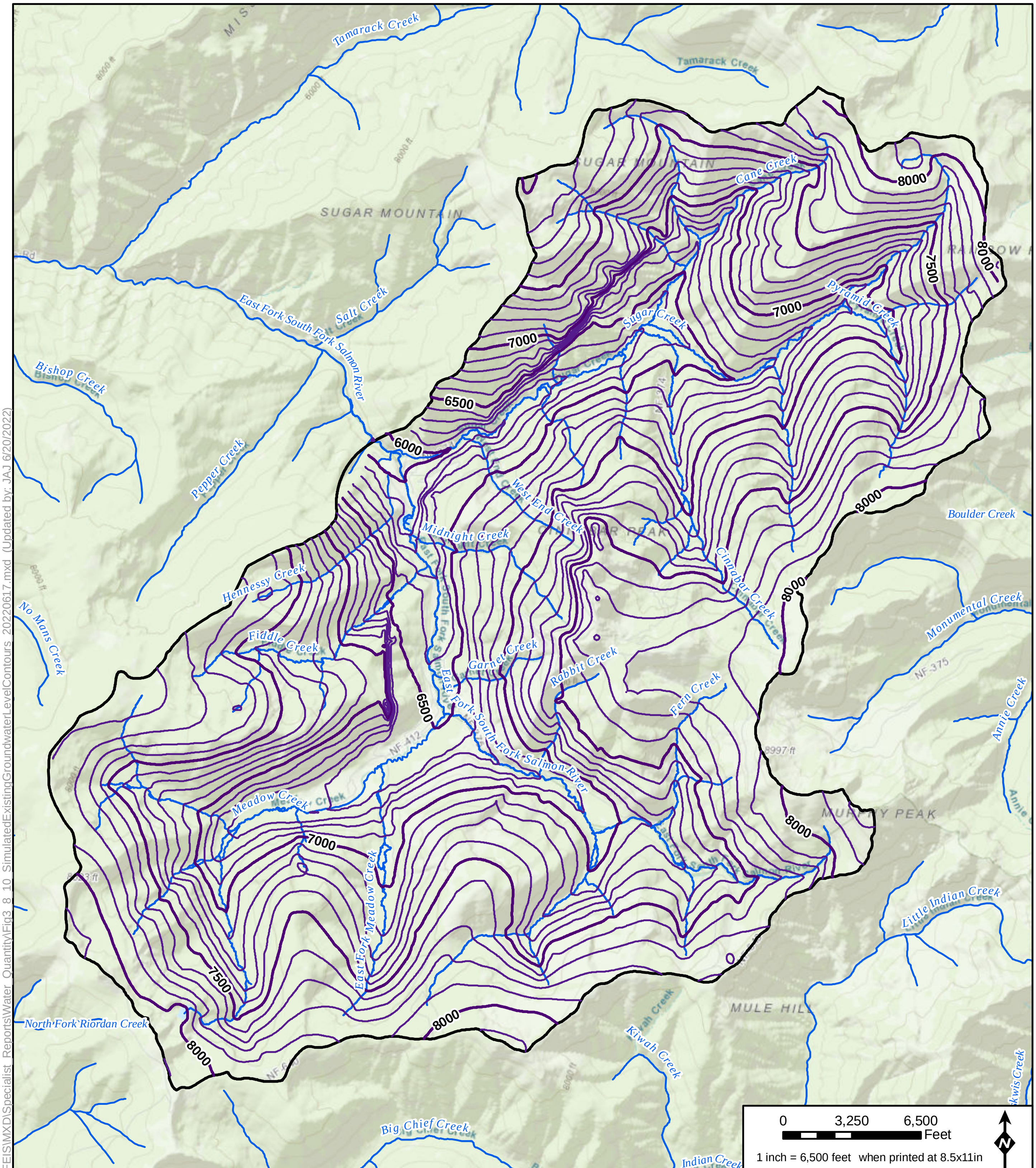
Vertical hydraulic gradients were calculated using data collected from 12 well nests (pairs of alluvial and shallow bedrock wells with screens completed at different depths) and multilevel samplers and vibrating wire piezometers installed in bedrock boreholes. Upland areas exhibit strong downward gradients (e.g., MWH-B21), indicating the presence of groundwater recharge areas outside of the mountain valleys, while the valley bottoms exhibit weak upward or downward gradients (SPF 2017). The lack of strong upward gradients along the valley axis may indicate an absence of a larger scale, deeper groundwater system of a type described by Winter (1976) with recharge zones coinciding with high mountain ridges and slopes and discharge zones located in mountain valleys. Low permeability of the underlying bedrock likely prevents development of such a system in the analysis area.

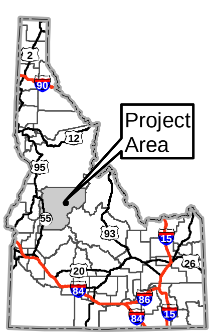
Accumulated baseline groundwater level data indicate that the streams in the analysis area are primarily gaining and groundwater flow near the valley bottoms is angled (in the downstream direction) toward the gaining streams (SPF 2017).

In summary, groundwater flows follow the land surface topography, with most groundwater migrating at shallow depths down the mountain slopes and along the valley bottoms, and eventually discharging to surface streams. On a more local scale, the flow also is affected by distribution of recharge, geology, and existing anthropogenic features (e.g., mine workings).

### 6.3.2 Hydrogeologic Units

The major hydrogeologic units in the Analysis Area and their estimated hydraulic conductivity values are summarized in **Table 6-11** (Brown and Caldwell 2017, 2021b, 2021d; SPF 2017). The hydrogeology of the Analysis Area consists of basement intrusive rocks of the Idaho Batholith partially overlain by metasedimentary rocks in the eastern portion of the Analysis Area. The most common intrusive rock in the mine area is granodiorite and the metasedimentary rocks are comprised of quartzites, marbles, dolomites, and schists. Younger volcanic intrusives are located within the Idaho Batholith rocks and metasedimentary rocks, and the bedrock is overlain by alluvium, with the thickest covers (up to approximately 250 feet) located in the valley bottoms.




**LEGEND**

Simulated Current Groundwater Contours

- Index Contour (500 ft)
- Normal Contour (100 ft)
- Perennial Stream
- StudyArea

**Figure 6-9**
**Simulated Existing Groundwater Level Contours**
**Stibnite Gold Project**
**Stibnite, ID**

*Base Layer: ESRI World Topographic Base*
*Other Data Sources: Brown & Caldwell, Perpetua, USGS*

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**Table 6-11 Summary of Hydrogeologic Units**

| Hydrogeologic Unit | Description | Hydraulic Conductivity Estimates | |
|---|---|---|---|
| | | Range of Estimates from Aquifer Tests (feet per day) | Geometric Mean (feet per day) |
| Idaho Batholith Rocks | Cretaceous igneous rock with dioritic to granitic composition | 0.0003 – 6.3 | 0.02 |
| Metasedimentary Rocks | Metamorphosed carbonate and siliciclastic rocks | 0.02 – 5.9 | 0.3 |
| Valley Fill Alluvium/Colluvium | Unconsolidated sedimentary deposits | 1-100 | 10 |

Sources: SPF 2017; Brown and Caldwell 2021d

Alluvial aquifer pumping tests were performed in 1989, February 2012, December 2013, and December 2019 at the Stibnite Gestrin airstrip well located close to Meadow Creek, about 2,500 feet upgradient from the Meadow Creek–East Fork SFSR confluence, to establish alluvial aquifer characteristics in areas most likely to be impacted by mine operations. In 1989, the well was pumped at a constant rate of about 114 gallons per minute (gpm) for 300 minutes. In February 2012, the well was pumped for 480 minutes at rates ranging from 46 gpm (average for first 15 minutes) to 208 gpm (average for last 100 minutes of test). Those were the preliminary tests and the results of analysis completed using the collected data were considered uncertain (Brown and Caldwell 2017). A more comprehensive test on the Gestrin well was conducted in December 2013. During the 2013 test, the well was pumped at an average rate of about 100 gpm for almost 31 days. Groundwater levels were monitored during the 2013 test in five alluvial wells and three shallow bedrock wells. Analyzing drawdown data collected from observation wells completed in the alluvium and bedrock allowed hydraulic properties to be estimated for both formations. Hydraulic conductivities estimated from the 2013 test data are 10.2 feet/day for the alluvial aquifer and 4.5 feet/day for the shallow bedrock. These results provide documentation of groundwater productivity of the alluvial sediments and the shallow bedrock in the area of the Gestrin well (Brown and Caldwell 2017; SPF 2017).

In December 2019, the Gestrin well was pumped for a three-day period at a rate of 60 gpm. The diminished water production from this well between 2013 and 2019 was attributed to well inefficiency, and the 2013 test results were retained as representative of the system and its responses (Brown and Caldwell 2021c). However, data from observation wells during the 2019 pump test was informative in examining the response to alluvial groundwater pumping in the broader area around the Gestrin Well.

Pump based aquifer tests of the four SGP production wells (Stibnite's Hooterville and main camp domestic wells, Hecla's Pioneer well, and the Stibnite Plant utility well) completed in 1994 in the alluvium of the East Fork SFSR provided transmissivity values ranging from 67 to 134 feet$^2$/day. Given an average aquifer thickness of 20 feet in the area of those tested wells, the calculated hydraulic conductivities range from 3.3 to 6.7 feet/day (Brown and Caldwell 2017).

A pump test of the new Camp Well (SPF 2017) conducted in 2012 provided hydraulic conductivity of 12 feet/day, calculated from transmissivity of 350 feet$^2$/day and a given average thickness for the alluvial aquifer (around the Camp Well) of 30 feet.

In addition to the pumping tests, slug tests conducted in 1996 in two alluvial monitoring wells produced hydraulic conductivity estimates averaging 4.9 feet/day. Additionally, nine slug tests conducted in 2012 on wells completed in various unconsolidated materials at proposed locations for the SGP features including the Yellow Pine pit area (six tests), Hangar Flats pit area (two tests), and proposed tailings disposal area (one test) provided estimation of hydraulic conductivities ranging from 0.3 to 139 feet/day. Slug tests conducted in 2013 in eight alluvial monitoring wells allowed estimation of average and median hydraulic conductivity values of 11.3 feet/day and 7.3 feet/day, respectively. The range of measured/estimated values was 2.8 to 28 feet/day.

Overall, the results reported by the investigations (from 1989 to 2013) for the alluvial groundwater system indicate hydraulic conductivity ranging from 1 to 100 feet/day, with an average of approximately 10 feet/day (SPF 2017).

Hydraulic characteristics of the portion of the regional Idaho Batholith in the analysis area have been assessed via 45 packer tests conducted in exploration boreholes, seven slug tests, 11 air lift or well development monitoring of bedrock monitoring well installations, plus one observation of bedrock discharge from the DMEA tunnel (Brown and Caldwell 2021d). These data represent 64 relatively localized observations of the Idaho Batholith rocks' hydraulic properties. In general, packer test results returned lower hydraulic conductivity measurements than the other test methods which tested larger subsurface intervals in boreholes. This is consistent with the interpretation that fracture flow represents the primary flow mechanism within the Batholith rocks, as smaller interval packer tests had less probability of encountering a conductive fracture.

Hydraulic conductivity measurements ranged between 0.0003 and 6.3 feet per day with a geometric mean measurement of 0.02 feet per day, indicating that bedrock conductivity is minor compared to alluvial conductivity. Measurements were laterally consistent across the mine area and generally decreased with depth in the borehole (Brown and Caldwell 2021d).

A long-term pumping test has not been completed in the deeper bedrock portions of the Idaho Batholith rocks in the analysis area as zones of groundwater inflow at depth sufficient to sustain a multi-day constant rate test have not been typically encountered in drillholes (Brown and Caldwell 2021d). Monitoring of shallow bedrock rock portions of the Batholith rocks during alluvial pumping tests exhibit bedrock responses to drawdown and depressurization in the overlying alluvium. Responses of bedrock wells to alluvial pumping at the Gestrin Well in 2019 indicate hydraulic conductivities between 1.2 and 4.5 feet/day in the transition area from alluvium to shallow bedrock where bedrock fractures would be more prevalent than at depth (Brown and Caldwell 2021c).

Hydraulic characteristics of the metasedimentary rocks have been assessed via 16 packer tests conducted in exploration boreholes and six slug tests of bedrock monitoring well installations, (Brown and Caldwell 2021d). These data represent 22 localized observations of the metasedimentary units' hydraulic properties. Unlike the Idaho Batholith rocks, packer test and slug test results yielded comparable hydraulic conductivity measurements, indicating that the overall permeability of the units is higher than in the underlying Batholith rocks.

Hydraulic conductivity measurements in the metasedimentary units ranged between 0.02 and 5.9 feet per day with a geometric mean measurement of 0.3 feet per day, confirming that the metasediment conductivity is minor compared to alluvial conductivity but more conductive than the Idaho Batholith rocks. Measurements were laterally consistent across the mine area and generally decreased with depth in the borehole (Brown and Caldwell 2021d).

### 6.3.3 Groundwater Budget

A groundwater budget is a basic accounting of the inflows and outflows from a hydrologic system in a specific area. Water budgets provide a means evaluate the availability and sustainability of a water resource. Under existing conditions for the Analysis Area, the predominant inflow component for the groundwater system is recharge from precipitation. The principal groundwater outflow component is discharge of groundwater to surface water along with losses to evapotranspiration in areas where vegetation is utilizing water from a groundwater aquifer.

Locally, stream elevations at most locations are slightly lower than the water table in adjacent areas, suggesting that the streams receive groundwater discharge from the alluvial aquifer. However, there are areas where the opposite is true, indicating the presence of losing stream reaches. For example, groundwater elevations suggest the following losing reaches: 1) on the East Fork SFSR between Garnet Creek and Fiddle Creek; 2) on the East Fork SFSR immediately upgradient of the Yellow Pine pit; and 3) in the lower reach of the East Fork of Meadow Creek (SPF 2017). In aggregate, there is a net groundwater discharge to streams that represents the most significant groundwater outflow from the system, balancing the input from meteoric recharge.

In a secondary outflow to stream discharge, groundwater from fractured bedrock likely contributes flow to hillside springs located above the alluvial deposits. Springs and seeps near the northerly trending faults along the east side of both upper Meadow Creek and East Fork Meadow Creek may be related to these faults (SPF 2017).

### 6.3.4 Groundwater Rights

Existing groundwater rights at the SGP have been acquired by Perpetua and are described in **Table 6-12**.

**Table 6-12 Groundwater Rights Summary**

| Water Right ID | Type | Source | Diversion Point | Priority Date | Beneficial Use | Diversion Rate (cfs) | Max Total Usage (acre-feet) |
|---|---|---|---|---|---|---|---|
| 77-7285 | Ground-water | Well | SE¼ of the NE¼, Section 15, T18N, R9E | 11/7/1988 | Storage and Mining | 0.50 | 30.2 |
| 77-7141 | Ground-water | Well | SW¼ of the SW¼, Section 11, T18N, R9E | 6/9/1981 | Domestic | 0.20 | 11.4 |

Source: Midas Gold 2016 (Table 8-1)

cfs = cubic feet per second.

The existing groundwater rights are specific to historical use. While these are valid water rights, the specific points of diversion, place of use, and beneficial use does not reflect planned SGP activities and would need to be adjusted through the transfer process, and through filing additional applications for permit. These filings were initiated in December 2021.

### 6.3.5 Groundwater Production Areas

IDWR records indicate that three permitted water supply wells are located at the SGP (**Figure 6-10**). **Table 6-13** provides a summary information about those wells (Brown and Caldwell 2017). Anticipated Project groundwater supply areas would be in the vicinity of Hangar Flats pit area south of the currently authorized points of diversion (77-7141 and 77-7285) plus in the vicinity of the Yellow Pine pit (**Figure 6-11**). The supply well locations represented on **Figure 6-11** are preliminary in that specific locations have not been finalized and would depend on engineering site evaluations to finalize well designs.

**Table 6-13 Permitted Water Supply Wells in the Analysis Area**

| Well | Permit # | Diameter (inch) | Screen Depth (ft bgs) | Static Water Level (ft bgs) | Notes |
|---|---|---|---|---|---|
| The Gestrin Airstrip permitted mining well | 914059-862689, Tag # D0060354 | 8 | 99 to 109 | 18 | Date of completion: 1988, re-drilled in November 2011; is owned by Perpetua; is located near the airstrip, completed in alluvium; discharge rate (production capacity) of 100 to 150 gpm. |
| The original temporary Camp water supply well | 913929-862557 | 6 | 58 to 72 | 12 | Date of completion: October 1981; was permitted in 1981 in the mine shop area (Former Man Camp Well); completed in alluvium; discharge rate (production capacity) of 30 gpm. This well has not been used since 2013. |
| The new camp water supply well | 914899-863525, Tag # D0063781 | 8 | 57 to 64 | 14 | Date of completion: 2012; is installed in alluvium on the Stibnite Road portion of the McCall Stibnite Road (County Road 50-412); discharge rate (production capacity) of 15 gpm. Brown and Caldwell (2017) state that, as of June 2017, this well has never been used, except to test the drinking water system in 2014. |

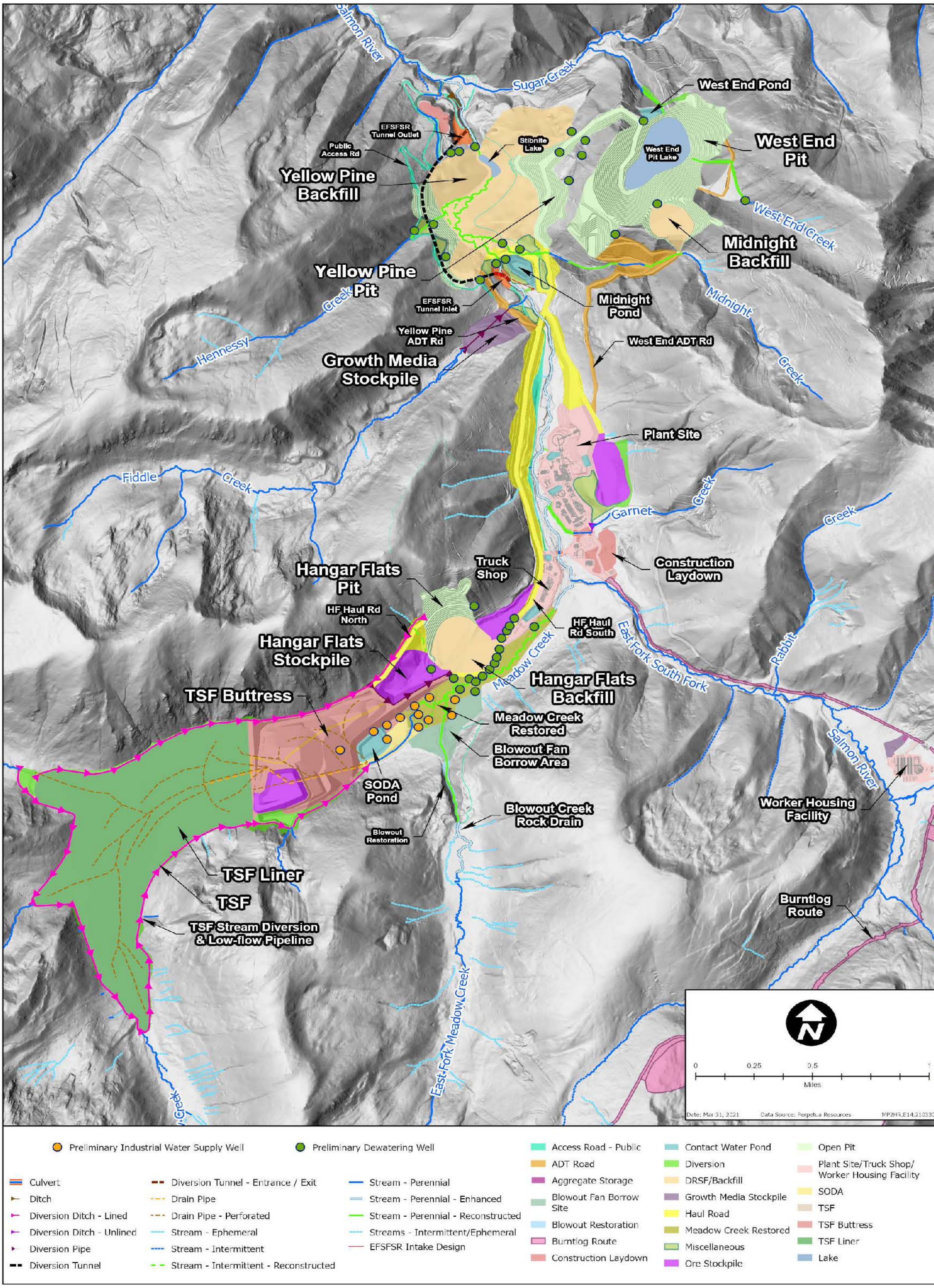
Source: Brown and Caldwell 2017

ft = feet, bgs = below ground surface.

Groundwater production associated with the SGP would occur in the vicinity of the proposed open pit mine operations and the housing facility (**Figure 6-11**). Most groundwater production would occur in the Hangar Flats pit area both as dewatering pumping and industrial supply well production. Additional dewatering pumping would also occur in the Yellow Pine pit area and to a lesser extent in the West End pit area. There would also be groundwater production from a well located near the worker housing facility.


**Figure 6-10**
**Points of Diversion for Existing Valid Water Rights**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (HDR 2017)*



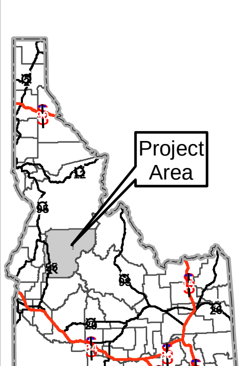




**Figure 6-11 Groundwater Production Areas**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a)*

# 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.

The surface water and groundwater quantity effects analysis primarily used information provided in the modeling reports prepared for the SGP by Perpetua, or their contractors (Brown and Caldwell 2017, 2018a, 2021a, 2021b, 2021c, 2021d, 2021e; HDR 2017; SPF 2017) but also included scientific literature.

The analysis for water rights was performed by gathering existing pertinent data related to surface water and groundwater resources, and existing and proposed water rights in the analysis area. The analysis then considered the timing, place of use, and impact of the proposed transfer of existing water rights and new water rights. The IDWR would determine if the water rights applications in the analysis area would impact downstream senior rights.

# 7.2 Direct and Indirect Effects

## 7.2.1 No Action Alternative

Under the No Action Alternative, there would be no large-scale mine operations by Perpetua, and water resources would continue to be impacted by currently permitted Perpetua drilling activities for exploration. The continuation of approved exploration activities at the SGP by Perpetua would result in the continued use of the existing man camp, office trailers, truck maintenance shop area, potable water supply system, wastewater treatment facility, helipad and hangar, and airstrip. Local minor withdrawals of surface water and groundwater to sustain the permitted exploration activities would continue. Consequently, there would be little change in the current status of water quantity conditions at the SGP.

In January 2021, Perpetua entered into an ASAOC with the Forest Service and EPA for removal actions at the Stibnite legacy mining site. Phase 1 of this agreement includes removal of tailings and other mining wastes from the stream channels of lower Meadow Creek and East Fork SFSR and placing the excavated wastes in selected, on-site locations where they would no longer impact water quality in these streams. It also includes construction of three stream diversions to avoid contact of runoff with legacy mining wastes. Following these construction activities, the disturbed areas would be reclaimed with growth medium and revegetated to stabilize the sites in concert with the Reclamation and Closure Plan developed by Perpetua for the SGP. This work is planned to occur between 2022 and 2024. These activities are not anticipated to have noticeable impacts on water quantity in the SGP area.

## 7.2.2 2021 Modified Mine Plan and Johnson Creek Route Alternatives

The water quantity related impacts associated with the 2021 MMP and Johnson Creek Route alternatives are identical. Water for dust control on access roads would be obtained from permitted freshwater sources. The relative sourcing of dust control water from permitted diversion locations would vary depending on access route but would remain within the authorized diversions (e.g., off-site maintenance facilities, on-site freshwater sources).

### 7.2.2.1 Water Resources Conceptualization

This section provides a summary of the methods used to evaluate the potential changes to groundwater elevations (drawdown) and surface water flows resulting from open pit mining, pumping the water supply wells, and utilizing surface water diversion at the proposed Project, predict the development of the West End pit lake projected to develop in the post-mining period, and evaluate potential drawdown impacts to surface water resources and water rights in the affected areas. Several water models were utilized to predict water flow rates, volumes, quality and temperatures throughout the mine life, closure, and post-closure. These water models are inter-related as output from one model is used as input to another model (**Figure 7-1**; Brown and Caldwell 2021f). The meteoric water balance model (MWB) uses monthly meteorological data to provide groundwater recharge and surface water runoff volumes for the site-wide water balance model (SWWB, Brown and Caldwell 2021a) and the Stibnite hydrologic site model (SHSM, Brown and Caldwell 2021b). The SWWB evaluates operational consumptive use (e.g., mill water supply, dust control), TSF water volumes, and contact water volumes generated over the span of the project from construction through closure (**Figure 7-2**).

The SHSM simulates groundwater and surface water systems to forecast the pit dewatering rates and water supply diversions required for operations (**Figure 7-3**). The SHSM also forecasts the groundwater drawdown, effects on groundwater discharge to surface water and pit lake recharge associated with the dewatering and water supply diversions (Brown and Caldwell 2021f). Both the SWWB and SHSM provide input to the water chemistry and water temperature models described in the companion SGP Water Quality Specialist Report (Forest Service 2022b).

#### 7.2.2.2 Watershed Drainage Effects

This section describes the direct effects of the SGP on surface water quantities in the analysis area. The indirect effects of groundwater pumping on surface streams are described in **Section 7.2.2.3**.

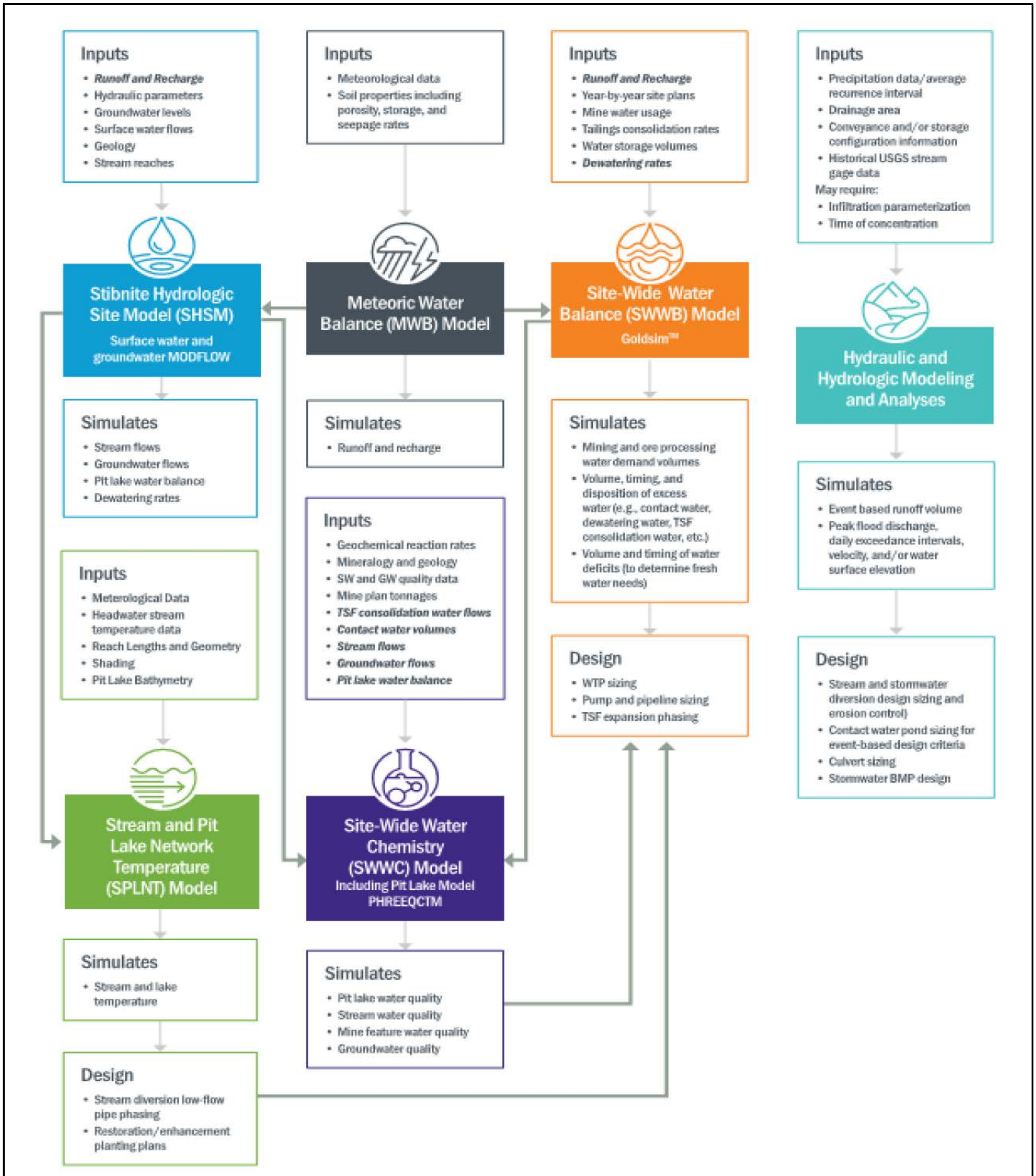
##### *Streams*

The SGP is located within the upper reaches of the East Fork SFSR, and several perennial streams flow through the project site (**Figure 6-1**). The streams would be temporarily diverted around mine facilities from construction through closure to prevent generation of contact water (Brown and Caldwell 2021f). The stream diversions would divert stream flow and also capture stormwater runoff from areas upslope from mine facilities. These diversions would consist of:

- rock-cut channels along steep slopes in areas with shallow or at-surface bedrock,
- excavated earthen channels and berms constructed of alluvium,
- HDPE or steel pipelines, and
- the East Fork SFSR tunnel.

Pipelines and culverts would be used in areas where open channels are infeasible or ineffective such as steep hill slopes, road crossings, or underneath mine facilities, and for temperature control in the Meadow Creek diversion (Brown and Caldwell 2021f). Open channel diversion designs would incorporate:

- riprap lining for channels in erodible materials,
- geosynthetic lining for channels across fill or highly permeable materials,
- gradients sufficient to ensure continuous flow at velocities allowable for the channel lining.



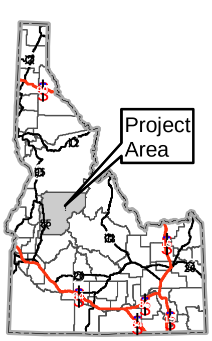
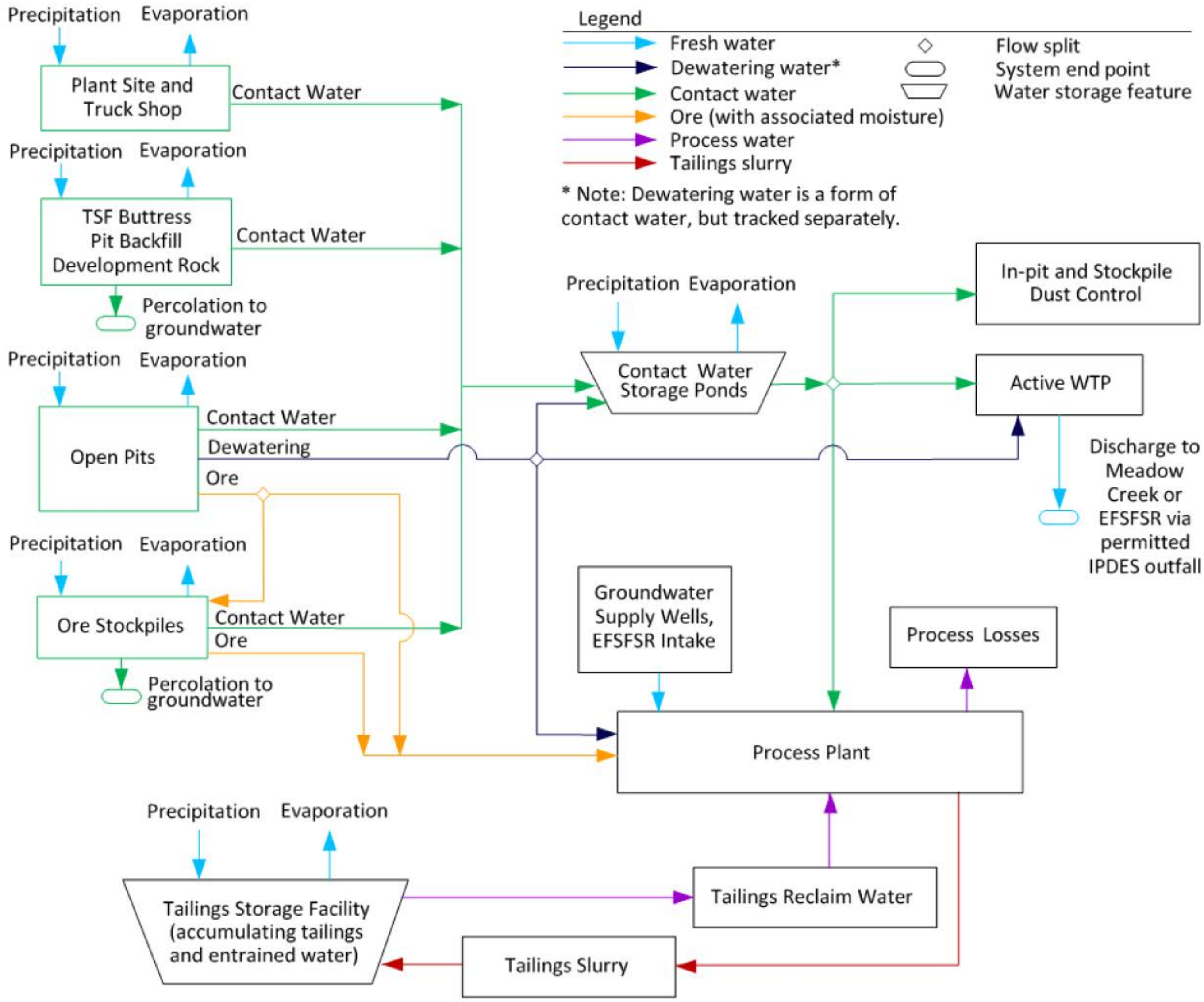




**Figure 7-1**
**Water Quantity Conceptual Model**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



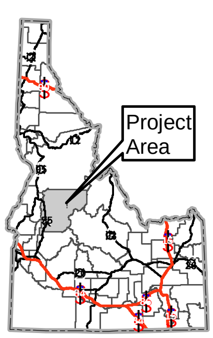
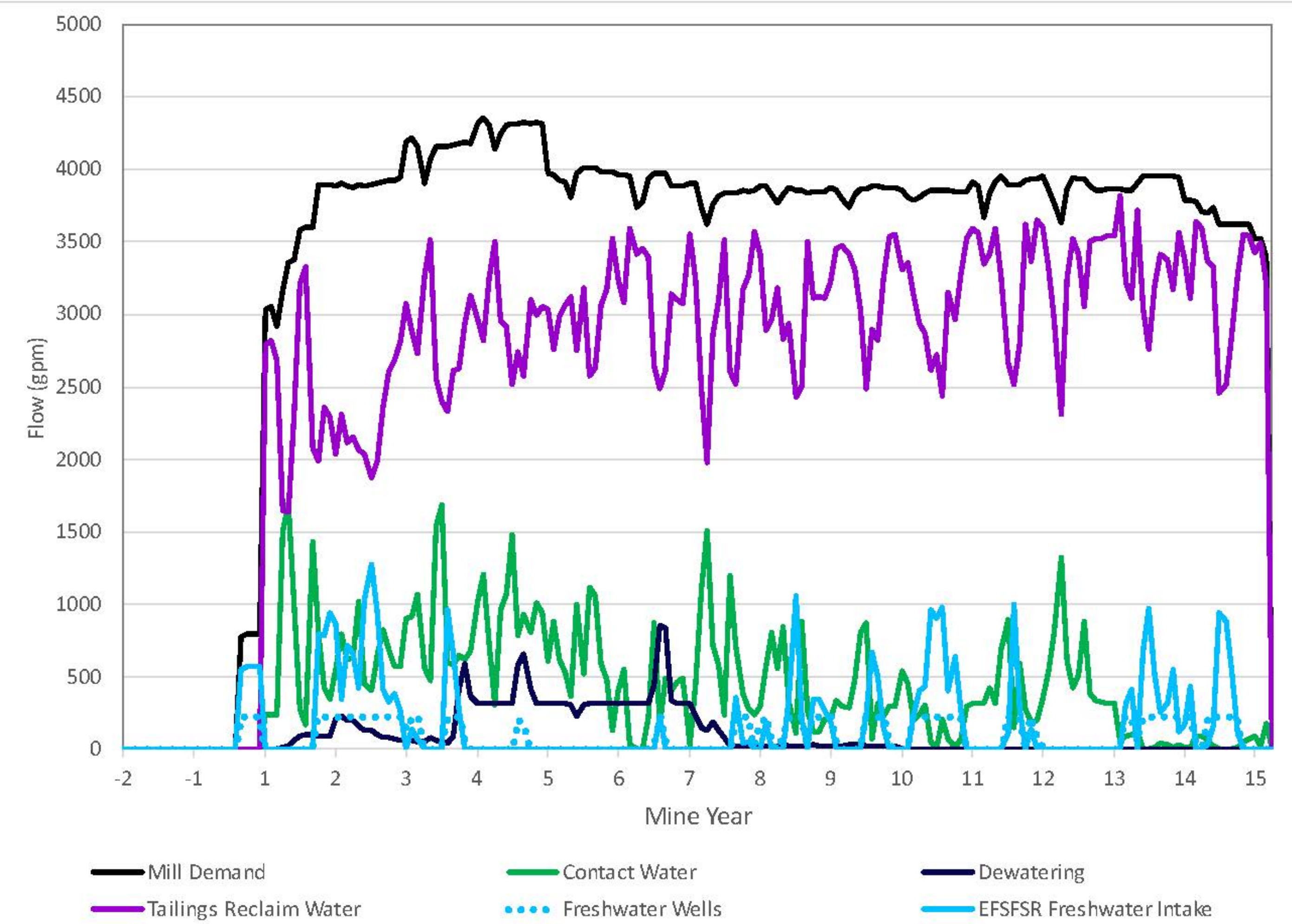




**Figure 7-2**
**Project Water Management Schematic Flow Diagram**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



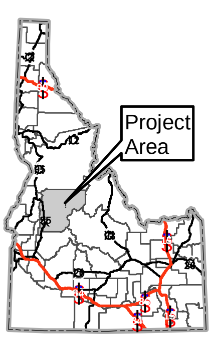




**Figure 7-3**
**Mill Processing Water Requirements**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (Brown & Caldwell 2021b)*

The East Fork SFSR currently flows through the existing Yellow Pine pit. Renewed mining activity would require temporarily diverting the East Fork SFSR to allow expansion, mining, backfilling, and reclamation of the pit. A tunnel would be constructed around the west side of the pit to divert the East Fork SFSR during operations and closure activities.

Properties of the East Fork SFSR tunnel design include:

- rock-cut, concrete-lined tunnel 15 feet wide by 15 feet high,
- sediment trap and debris collection at upstream portal,
- freshwater intake for mine water supply at upstream portal, and
- a transition zone for flow to native channel at the downstream portal.

Additional details regarding stream diversions and the East Fork SFSR tunnel are provided in the SGP Water Management Plan (Brown and Caldwell 2021f).

Stream diversion descriptions for the streams are summarized in **Table 7-2**. Unlike other streams, diversion of the East Fork of Meadow Creek (Blowout Creek) is not associated with proposed mining activity. This diversion would be associated with a voluntary restoration effort to create a stable, sustainable solution to the continual erosion and sediment loading resulting from the 1965 failure of a water storage dam in the upper East Fork of Meadow Creek valley.

**Table 7-2 SGP Stream Diversions**

| Stream | Diversion Length (miles) | Diversion Type | Discharge Location | Post-Closure |
|---|---|---|---|---|
| East Fork SFSR | 0.9 | Tunnel | East Fork SFSR below Yellow Pine pit | Restored stream channel |
| Hennessy Creek | 0.7 | Pipeline | Fiddle Creek | Restored stream channel |
| Midnight Creek | 0.3 | Open channel with culverts | East Fork SFSR above the East Fork SFSR tunnel | Restored stream channel |
| West End Creek | 1.5 | Open channel | West End Creek below West End pit | Within West End Pit |
| Fiddle Creek | 0.2 | Pipeline | Fiddle Creek below the Growth Media Stockpile | Restored stream channel |
| Garnet Creek | 0.2 | Open channel with culverts | East Fork SFSR below plant site | Restored stream channel |
| Meadow Creek | 2.0 | Open channel | SODA diversion channel | Restored stream channel |
| East Fort of Meadow Creek (Blowout Creek) | - | Open channel | Lower Meadow Creek | Restored stream channel with water retention structures in meadow area |

Source: Brown and Caldwell 2021f

Streams would be routed into the diversions by temporary flow barriers, such as berms or cofferdams that redirect flows from the existing stream channel into the diversion channel. During closure, stream channels would be restored near their pre-mining locations using designed stream channels to cross reclaimed mine facilities. The East Fork SFSR tunnel openings would be sealed and the East Fork SFSR flow returned to a restored stream channel crossing the Yellow Pine pit backfill.

Designs for restored stream channels would incorporate as needed:

- open channels for surface water flow,
- meadow reaches,
- step pool reaches
- cascade reaches,
- energy dissipation pools,
- reach transitions,
- small and larger woody debris structures, and
- riparian planting.

The portion of the restored stream channel across the backfilled Yellow Pine pit would incorporate an in-stream lacustrine feature (Stibnite Lake) analogous to the existing Yellow Pine pit lake, with the exception that it is lined, to assist in emulating current flow and water temperature conditions (see Forest Service 2022b for more discussion of residence time and temperature conditions).

Therefore, use of stream diversions and subsequent stream restoration would modify the location of surface water flows. Flow rates would be affected by contact water capture, groundwater pumping, and surface water diversion as described below and in **Section 7.2.2.4**. The effects of stream diversions on water quantity would be moderate, long-term, and localized.

### *Seeps and Springs*

Certain seeps and springs in the vicinity of proposed facilities have already been covered or disturbed by historical mining activities. Therefore, new direct impacts to these springs and seeps associated with surface disturbance from the proposed Project would not occur. Seeps and springs covered by facilities would be intercepted by facility underdrains that would collect flows and route them to pipelines for conveyance back to the ground surface. Indirect impacts to springs and seeps associated with groundwater pumping are described in **Section 7.2.2.3**.

### *Stormwater*

Stormwater diversions would be used to divert non-contact stormwater runoff around mine facilities and disturbed areas and would remain in place from facility constructure through closure. Stormwater diversion designs would generally be the same as surface water diversions except pipelines would not be used and the need for geosynthetic liners would be less frequent.

Stormwater diversion outfalls would discharge to existing drainages and would incorporate best management practices (BMPs) such as sediment ponds, energy dissipation structures, or other erosion and sediment control measures.

### *Contact Water*

Contact water is mine-impacted water that contacts disturbed areas and/or mine facilities with the potential to contribute sediment and dissolved constituents to surface water and groundwater without proper management. SGP contact water sources would include stormwater runoff and seepage from

- legacy materials (e.g., Bradley tailings, Hecla heap, SODA),
- SGP haul roads,
- open pits,
- plant site and truck shop,
- TSF Buttress, and
- ore stockpiles.

In addition, groundwater produced by the dewatering system would be managed as contact water (Brown and Caldwell 2021f).

Runoff from haul roads and access roads outside the mine area is also considered contact water to be managed via best management practices applicable to those specific locations.

Contact water storage ponds would be used to provide temporary storage of contact water flows. The location of these storage ponds is constrained by topography, other proposed mine facilities, legacy materials, and near-surface groundwater levels. The ponds are also located to manage runoff in proximity to the water-generating areas.

Contact water ponds would be geomembrane-lined earthen facilities, equipped with emergency spillways and designed to contain runoff volumes associated with design storm runoff events (**Table 7-3**).

**Table 7-3 SGP Contact Water Ponds**

| Pond | Pond Capacity (excluding freeboard; acre-feet) | Design Storm Runoff (acre-feet) | Freeboard (feet) | Embankment Height (feet) |
|---|---|---|---|---|
| Hangar Flats Pond | 201.8 | 33.9 | 3 | 35.0 |
| Soda Pond | 147.7 | 24.6 | 3 | 29.4 |
| West End Pond | 28.7 | 39.3[1] | 3 | 60.5 |
| Midnight Pond | 83.9 | 16.8 | 3 | 72.7 |
| North Truck Shop Pond | 3.2 | 3.2 | 2 | n/a |
| South Truck Shop Pond | 18.3 | 17.9 | 2 | n/a |
| North Plant Pond | 7.5 | 7.3 | 2 | n/a |
| Central Plant Pond | 4.3 | 4.3 | 2 | n/a |
| Scout Pond | 9.0 | 9.0 | 2 | n/a |

Source: Brown and Caldwell 2021f, Table 6-2

[1]West End Pond can contain the 100-year, 24-hour storm volume (25.8 acre-feet). Additional potential volume from snowmelt would be managed using in-pit sumps or pumping stored water from West End Pond to Midnight Pond or Yellow Pine pit.

n/a = not available

Additional details regarding the management of contact water are available in the SGP Water Management Plan (Brown and Caldwell 2021f).

Capture of contact water for consumptive use would reduce the volume of runoff and hence, stream flow by between 0 and 1,600 gpm with typical average capture rates of approximately 800 gpm during the first six years of processing as the site water inventory is built (**Figure 7-3**). Average capture rates for consumptive use decrease after year six as recycled water from the tailings facility fulfills a greater proportion of the process needs. This volume of capture represents a relatively small portion of overall flow rates in the EFSFSR which range annually between 20 cfs and more than 120 cfs (approximately 9,000 gpm to more than 54,000 gpm) near Yellow Pine, Idaho.

Contact water that is not used consumptively would be routed to the water treatment plant to achieve a water chemistry suitable for discharge to surface water in accordance with Idaho IPDES permit requirements. The effects of contact water management on surface water quantity would be moderate, long-term, and localized.

#### 7.2.2.3 Groundwater Quantity

This section provides a summary of the methods used to evaluate the potential changes to groundwater elevations (drawdown) resulting from mine dewatering and pumping the water supply wells at the proposed Project, predicted development of a pit lake in the West End pit in the post-closure period, and evaluate potential drawdown impacts to surface water resources and water rights in the affected areas.

***Water Quantity Modeling of the Proposed Project***

The three proposed open pits and exploration decline would extend below the water table and, therefore, require systems to capture and remove groundwater that flows toward or into them as mining progresses. In addition, while not below the local water table, the East Fork SFSR tunnel would intercept inflows of groundwater in its vicinity. Furthermore, water demands for ore processing would necessitate the installation of production wells and a surface water diversion, in addition to the dewatering system. A calibrated three-dimensional numerical groundwater flow model was developed to estimate effects to groundwater and surface water resources from the proposed activity. Specifically, the groundwater flow model estimates: 1) dewatering rates for the open pit mines; 2) drawdown and groundwater levels resulting from dewatering and water supply pumping; 3) potential for pit lake development in the post-mining period; and 4) changes in groundwater discharge to stream flows.

The numerical groundwater model used the modeling code MODFLOW 6 and utilized Newton-Raphson numerical solver to simulate drying and wetting of model cells representing the groundwater system in response to dewatering and production well pumping plus seasonal recharge (Brown and Caldwell 2021b). The groundwater model domain encompassed approximately 48 square miles (six miles by eight miles), which included the analysis area (**Figure 7-4**). A detailed explanation of the conceptual hydrogeologic model, modeling approach and setup, steady-state and transient calibration, sensitivity analysis, water budget, and model predictions is presented in the groundwater model technical report (Brown and Caldwell 2021b).

The numerical model domain was discretized into 11,547 grid cells for each of five model layers. The grid cell dimensions were set up with the horizontal dimension of cells 640 feet. A quad-tree grid structure that divided cells into four equal quadrants was applied to refine the discretization in the vicinity of streams, fault zones, and mine features. The model used a 320-foot grid size with a further refinement to a 160-foot grid for primary stream features in the mine area. The Meadow Creek Fault Zone (MCFZ) used an 80-foot grid size in the model.

The groundwater modeling included the development of a conceptual model of the groundwater flow systems. The conceptual model of the study consisted of three hydrogeologic categories based on groupings of geologic and stratigraphic units with similar hydraulic characteristics plus faults and fracture zones that act to inhibit or enable groundwater flow. In the analysis area, groundwater flows downhill from the mountainous areas toward the valley areas including the Meadow Creek Valley where most of the historical and proposed mining activities are located. Groundwater flow encounters the high angle MCFZ that inhibits bedrock flow creating local upward groundwater gradients on the eastern, uphill, side of the fault. After slowly migrating through the bedrock units and intervening fault structures, groundwater eventually discharges into the alluvial valley fill and subsequently into streams, departing the analysis area predominantly as surface flow.

No flow conditions were set around the perimeter of the model to represent inferred hydrologic divides associated with the mountain ridgetop topography. Modelled meteoric recharge to the groundwater system (**Figure 7-5**) was applied based on a water balance calculation that partitioned precipitation into recharge, runoff, and evaporation (Brown and Caldwell 2021b). Runoff and recharge estimates were partitioned in unconsolidated dominated areas (UDA) and bedrock dominated areas (BDA) to allow differentiation between areas prone to recharge versus areas prone to runoff. This calculation resulted in relatively higher recharge rates in the alluvial valley bottoms as they received runoff from the surrounding mountainous areas. Monthly recharge rates from the water balance were applied to the model using the MODFLOW Recharge Package.

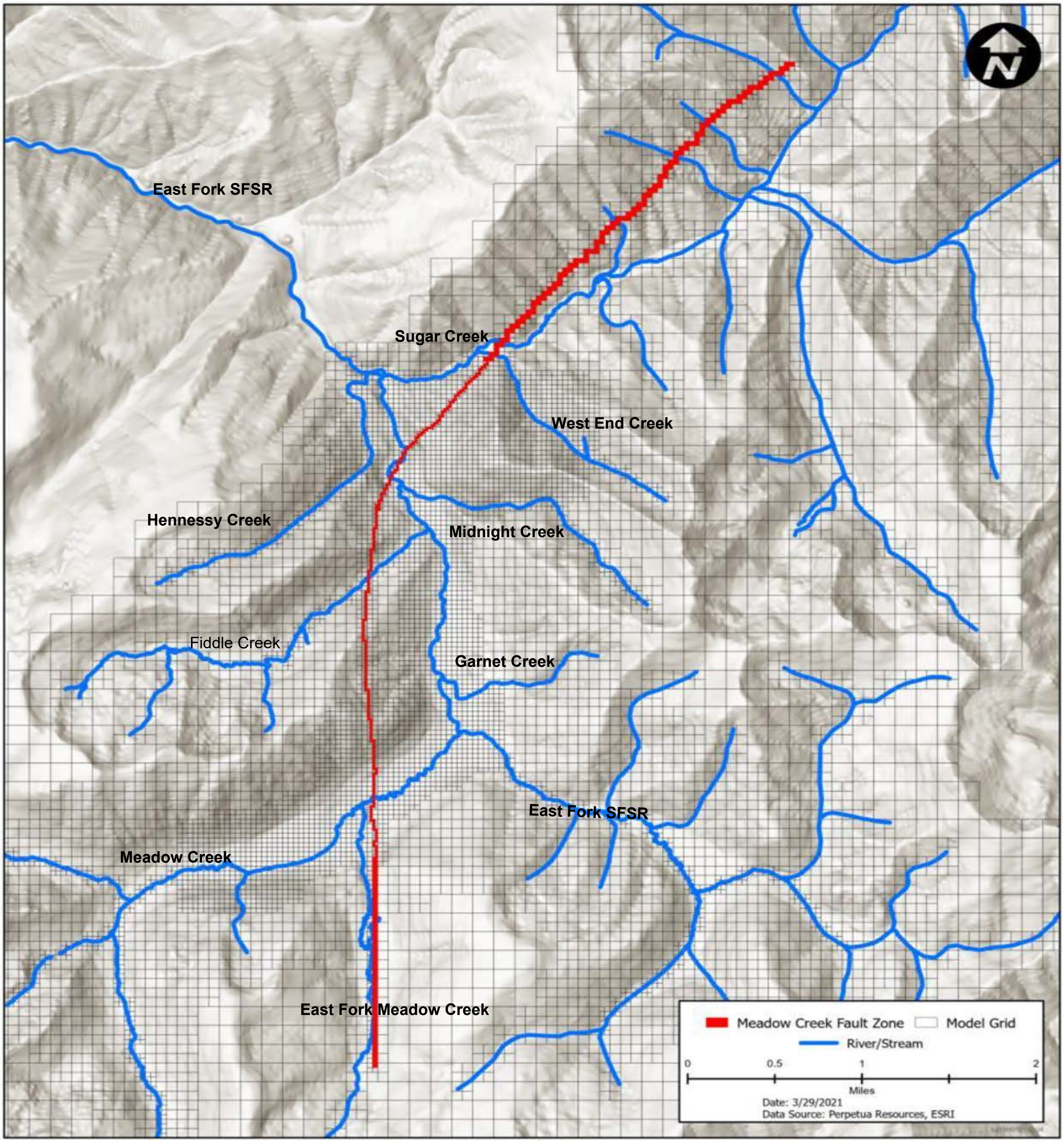
Flows in surface streams were simulated using the MODFLOW 6 Surface Flow Routing (SFR) package. The SFR package was applied to grid cells in the top model layer corresponding to stream locations. Stream bed elevation, stream stage elevations (a height of two feet of surface water above the stream bed was utilized), and stream bed conductance parameter values are assigned to each SFR package grid cell. The SFR package models inflow or outflow from the stream grid cell depending on the cell's modelled groundwater elevations at a rate associated with the cell's stream bed conductance.

Model calibration was accomplished using a process that included simulation of pre-mining steady state conditions and then transient conditions associated with the pumping tests. The model was calibrated to water levels measured between 2011 and 2019 in 55 wells and piezometers plus flow rates at five stream locations by allowing the hydraulic conductivity values to vary within the range of the aquifer test results for each unit. Variation of water levels was performed manually and by utilizing an unbiased optimization code (PEST; Brown and Caldwell 2021b). The calibrated parameter values utilized for modeled hydrologic units are summarized in **Table 7-4**.

**Table 7-4 Parameter Values for Modeled Hydrologic Units**

| Hydrogeologic Unit | Hydraulic Conductivity (feet/day) | Vertical Anisotropy Ratio | Specific Yield | Specific Storage (1/feet) |
|---|---|---|---|---|
| Alluvium | 12 | 10:1 | 0.20 | 1.0E-07 |
| Alluvium-Bedrock Transition | 0.2 | 1:1 | 0.04 | 1.0E-07 |
| Shallow Idaho Batholith Bedrock | 0.1 | 1:1 | 0.006 | 1.0E-07 |
| Deep Idaho Batholith Bedrock | 0.03 | 1:1 | 0.002 | 1.0E-07 |
| Shallow Metasedimentary Bedrock | 0.5 | 1:1 | 0.006 | 1.0E-07 |
| Deep Metasedimentary Bedrock | 0.15 | 1:1 | 0.002 | 1.0E-07 |
| Meadow Creek Fault Zone | 0.0001 | 1:1 | 0.025 | 1.0E-04 |

Source: Brown and Caldwell 2021b



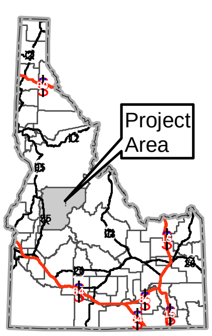
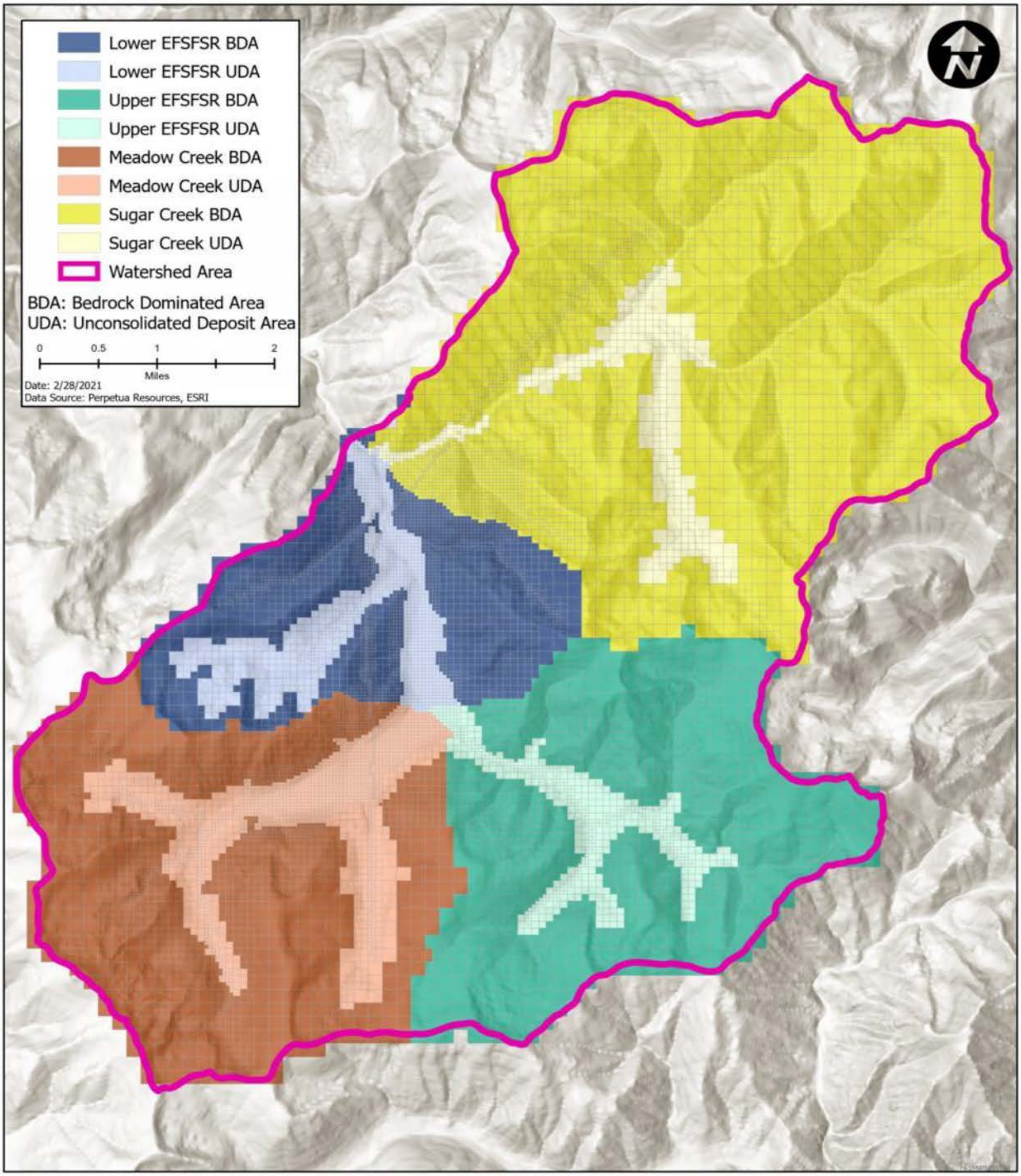




**Figure 7-4 Groundwater Flow Model Domain and Model Grid**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a) Figure shows model cells in mine area but does not show entire model domain.*



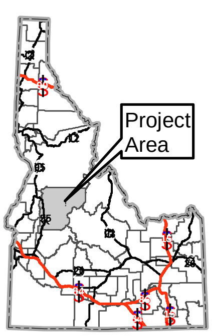




**Figure 7-5 Groundwater Flow Model Recharge Zones**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (Brown & Caldwell 2021a)*

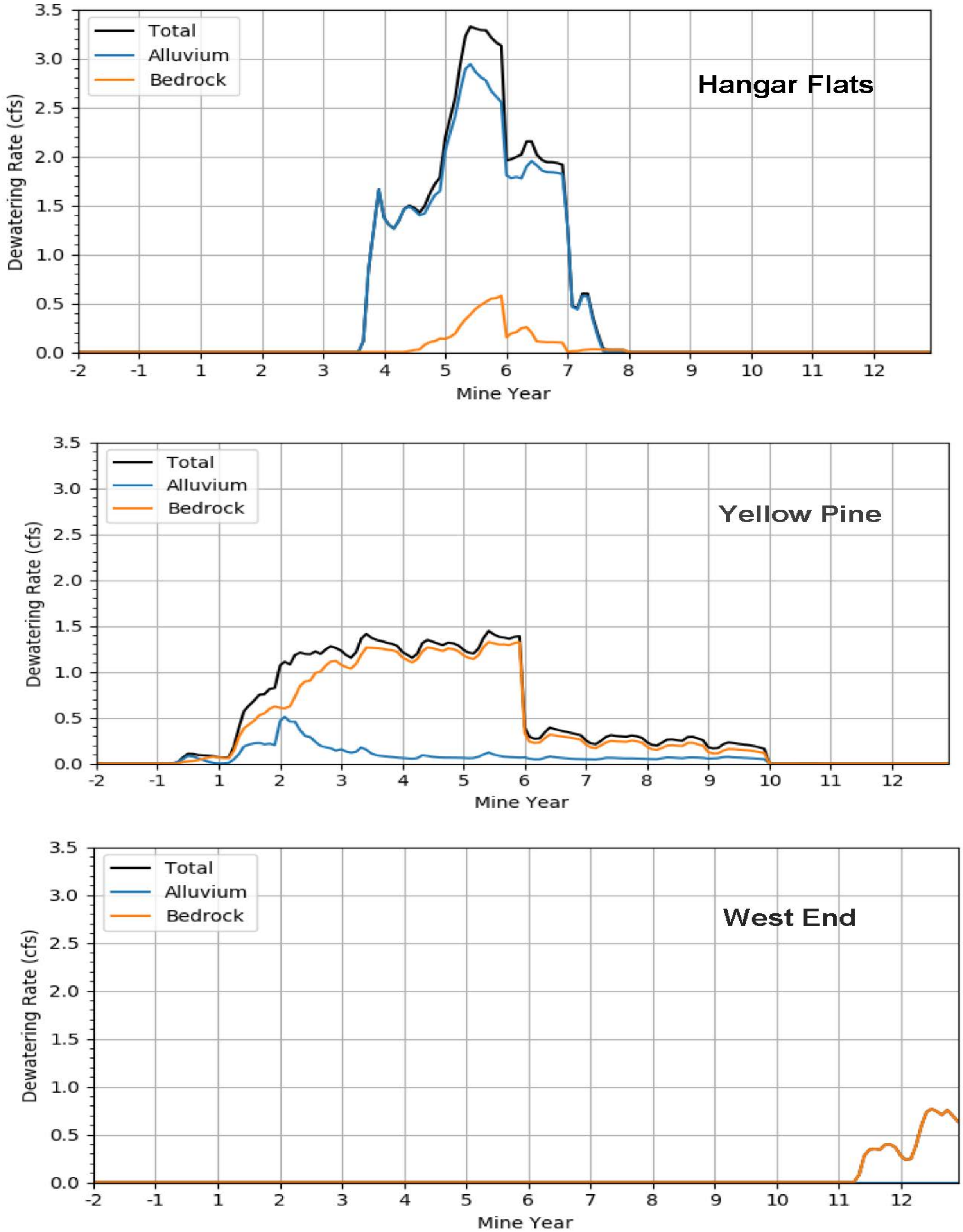
Parameter values for the alluvium in immediate vicinity (approximately 500 feet) of the Gestrin Well location were further refined to represent localized zones of lower and higher alluvial hydraulic conductivity (around the typical 12 feet/day value) observed during the pumping tests at that location (Brown and Caldwell 2021b, Appendix A). Other alluvial locations were not similarly refined because differences in hydraulic properties were either not observed or not directly tested. Uncertainty in the characterization of hydraulic properties is described in **Section 7.3**.

The calibrated model was used to estimate dewatering requirements to achieve dry mining conditions in the open pits, the magnitude and areal extent of drawdown resulting from the open pit mining and additional groundwater production required for process needs, and pit lake development and post-mining groundwater flow conditions in the vicinity of the open pit and analysis area as discussed below. The model predicts that dewatering requirements for the open pit would range from less than 0.2 cfs (approximately) 100 gpm in Mine Year 1 to approximately 5 cfs (approximately 2,200 gpm) in Mine Year 6 with an average rate of 2.75 cfs (approximately 1,250 gpm) over that six-year period. **Figure 7-6** shows the estimated dewatering requirements over the active mining period for the Hangar Flats pit, Yellow Pine pit, and West End pit. Total dewatering rates would be the sum of the predicted rates for these three pits. Total pumping rates would decrease to less than 1 cfs (approximately 450 gpm) during Mine Year 7 through the end of dewatering. These dewatering rates were based on the calibrated model's hydraulic parameter values. A sensitivity analysis examining order of magnitude changes in hydraulic parameter values was used to examine the range of likely dewatering rates (**Section 7.3**; Brown and Caldwell 2021e) The groundwater inflow into the pit areas would be pumped out for dewatering purposes by dewatering wells in the vicinity of the open pits and/or collection sumps within the pits.

### *Impacts to Groundwater Levels*

For this impact analysis, the area that is predicted to experience a change in groundwater elevation of ten feet or more is used for quantification and comparison of project effects and baseline conditions. The numerical groundwater flow model was not used to quantify changes in groundwater elevation of less than ten feet due to the scale of the model and unavoidable uncertainty associated with regional groundwater flow models. In addition, within the analysis area, changes in groundwater levels of less than ten feet can be difficult to distinguish from natural seasonal or annual fluctuations in groundwater levels.

Predicted dewatering rates and underdrain flows were combined with estimated volumes of mine-impacted waters from the SWWB to forecast the volume requirements for water treatment during operations and closure. Water treatment is required whenever the volume of produced groundwater plus mine-impacted waters exceeded the consumptive use demands for the project. Hence, the water treatment volume estimate represents the sum of predicted mine-impacted water values (e.g., dewatering production, contact water) less the consumptive use by the project (i.e., process water). These volumes ranged from 2,000 gpm during the years of highest dewatering production down to 150 gpm from the collection of mine-impacted waters post-closure (**Figure 7-7**). Estimates also included potential variability associated with meteoric conditions on the generation of contact water. The project water management system is designed with storage capacity for meteoric water events so that water destined for treatment can be contained until it can be transferred to the water treatment plant for constituent removal at the plant's 2,000 gpm design rate. The installation of geosynthetic liner systems on the top surface of the TSF, TSF Buttress, Yellow Pine pit backfill, and Hangar Flats backfill inhibits the generation of contact water in the post-closure period plus drainage of the water entrained in the TSF results in the abatement of contact water flows after approximately 40 years. Further details on the collection of waters for water treatment are located in the companion SGP Water Quality Specialist Report (Forest Service 2022b).



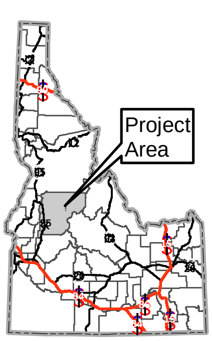
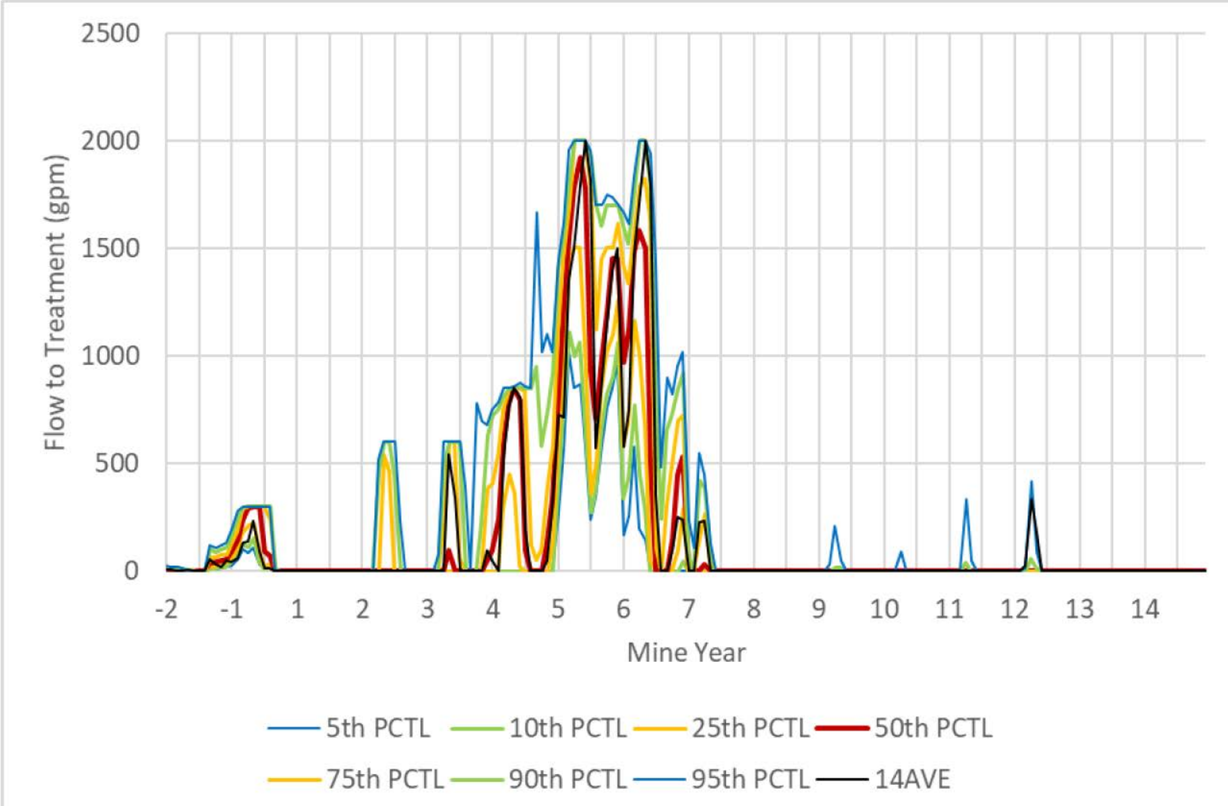
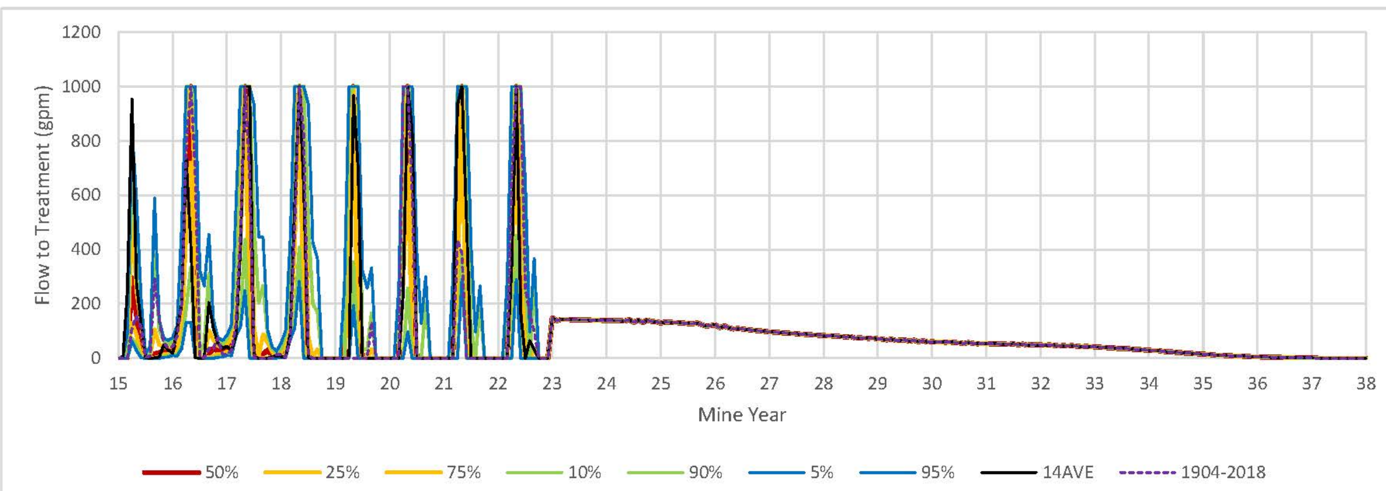




**Figure 7-6 Predicted Dewatering Pumping Rates**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a)*



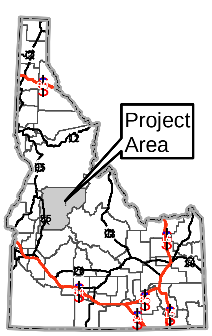




**Figure 7-7**
**Predicted Water Treatment Rate Requirements**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*

Drawdown effects were predicted based on the net effect of pumping from pit dewatering wells and industrial supply wells. The maximum extent of alluvial groundwater drawdown in the Yellow Pine pit area is predicted to occur at the end of Mine Year 5 (**Figure 7-8a**, Brown and Caldwell 2021b, 2021e). The cone of depression induced by dewatering of the Yellow Pine pit (and defined by drawdown greater than or equal to 10 feet) would extend to the Sugar Creek drainage to the north, to the topographic basin divide to the west, and approximately a half mile south of the pit. Maximum drawdown during operations is coincident with the pit bottom elevation (740 feet bgs). Water levels start recovering at the end of dewatering and re-inundate the pit area after around Mine Year 12. The extent of predicted drawdown cones was generally insensitive to variation in hydraulic parameters (see **Section 7.3**).

Alluvial drawdown near the West End pit along West End Creek would result from dewatering production and rerouting the creek around the pit. The maximum extent of drawdown from the West End pit activities would occur at the end of Mine Year 12, with a cone of depression extending approximately one mile to the north, east and south of the West End pit (**Figure 7-8a**). The cone of depression also extended to the northeast into the Sugar Creek drainage. Maximum drawdown during operations is coincident with the pit bottom elevation (approximately 6200 feet amsl). Water levels start recovering at the end of dewatering and re-inundate the pit area after approximately 50 years.

The maximum alluvial drawdown near the Hangar Flats pit would occur at the end of Mine Year 5, after which dewatering production rates would decrease. The cone of depression is predicted to extend up to approximately three-quarters of a mile from the pit area within the Meadow Creek Valley (**Figure 7-8a**). Maximum drawdown during operations is coincident with the pit bottom elevation (460 feet bgs). Water levels start recovering at the end of dewatering and re-inundate the pit area around approximately Mine Year 8.

Lowered groundwater levels in the vicinity of the TSF and TSF Buttress are predicted to slightly reduce flows in underdrain systems constructed below the facilities and their liners to collect groundwater discharge from below the facilities. Predicted flows averaging approximately 1,400 gpm would reduce to approximately 1,200 gpm in response to Hangar Flats dewatering and water supply activities that result in lowered groundwater levels in that vicinity (**Figure 7-8b**, Brown and Caldwell 2018a, 2018b, 2021b). The effects of the SGP on groundwater levels would be minor to major, long-term, and localized to the analysis area. Groundwater levels away from the pit dewatering focus areas would observe measurable reductions in water levels constituting a minor or moderate effect while groundwater levels in the dewatering focus areas would observe drawdown of several hundred feet, constituting a major effect.

The implications of lowered and subsequently recovered water tables on stream flows are discussed in **Section 7.2.2.4** with the implications of water level changes on other water resourced described in next four sub-sections.

### *Pit Lake Development*

The numerical groundwater flow model developed for the proposed Project was used to predict the rate of recovery and pit lake development for the final West End pit configuration. Predicted lake filling would commence within the first year after the cessation of dewatering activities and would continue for approximately 40 years until the lake stage reaches near steady-state at an elevation of approximately 6600 feet AMSL (Brown and Caldwell 2021b), resulting in a maximum pit lake depth of approximately 300 feet (**Figure 7-9**) with a ponded surface area of approximately 150 acres. The pit lake is not expected to overflow to the surface. Outflow from the pit lake would be in the form of subsurface outflow to groundwater. This effect is described in the companion SGP Water Quality Specialist Report (Forest Service 2022b).

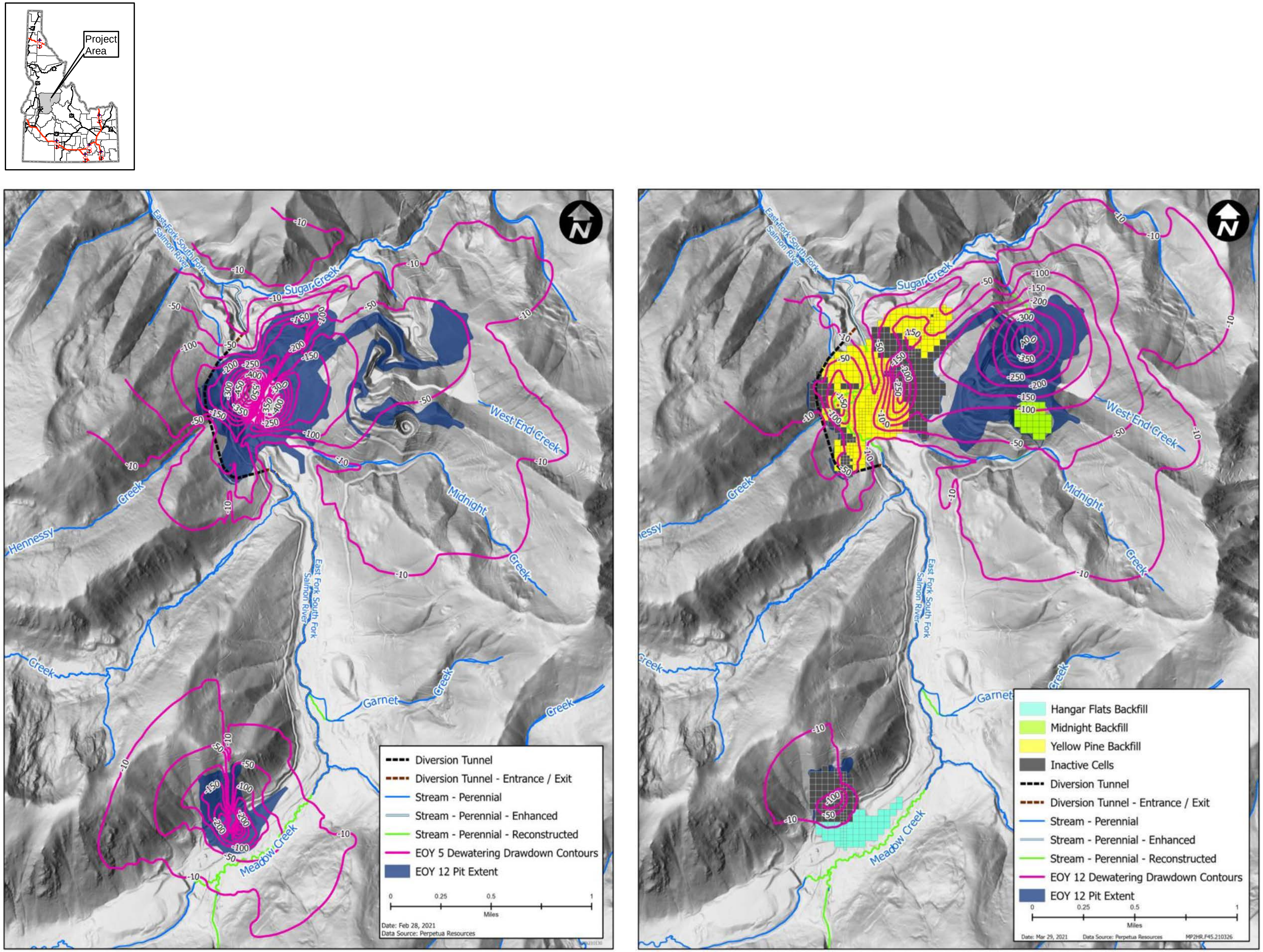
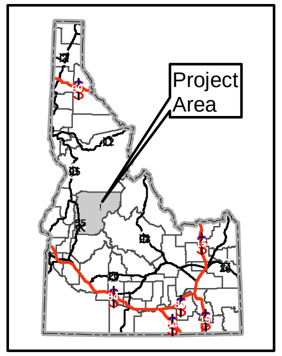
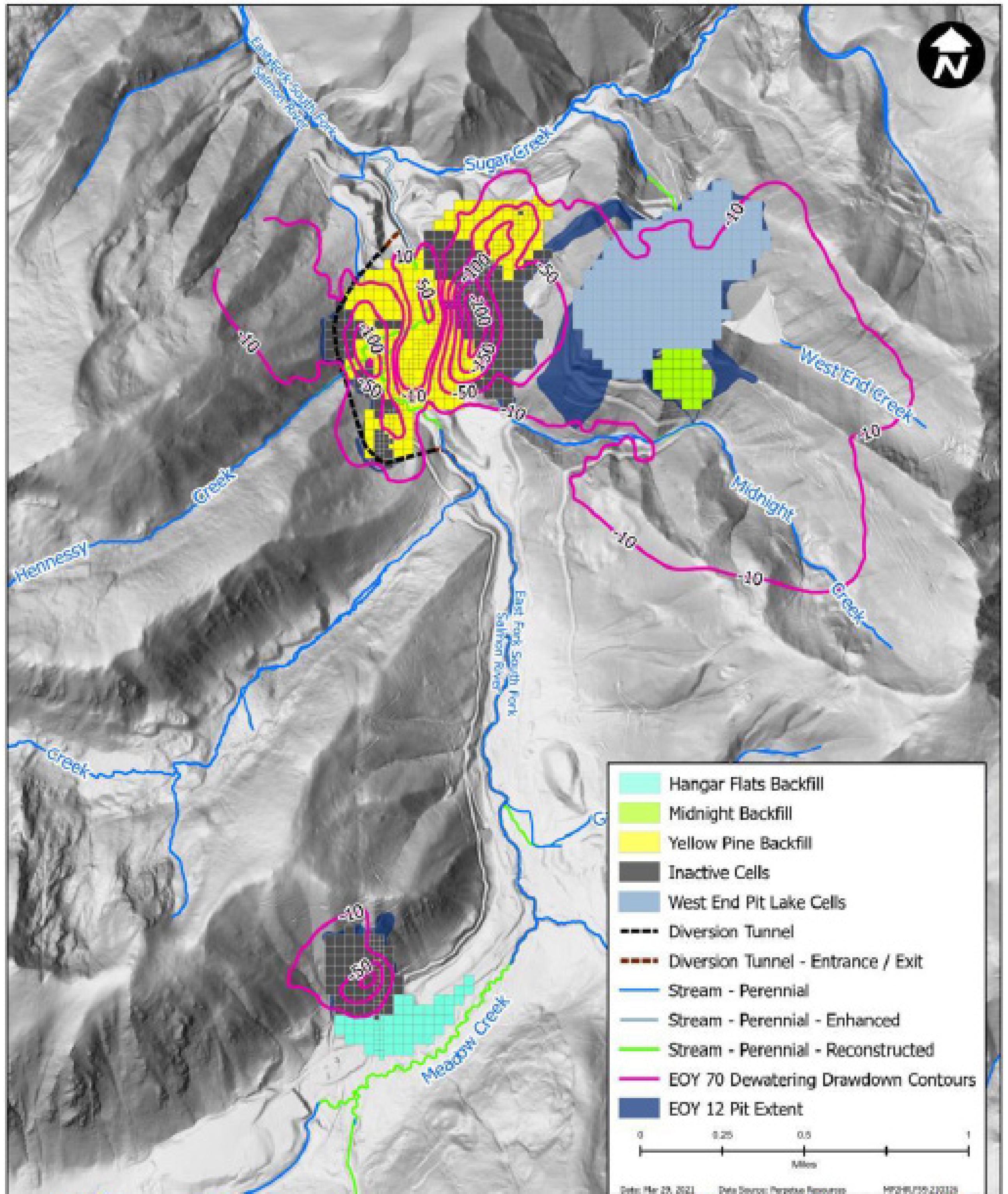



**Figure 7-8a**
**Predicted Dewatering Drawdown**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (Brown & Caldwell 2021a)*



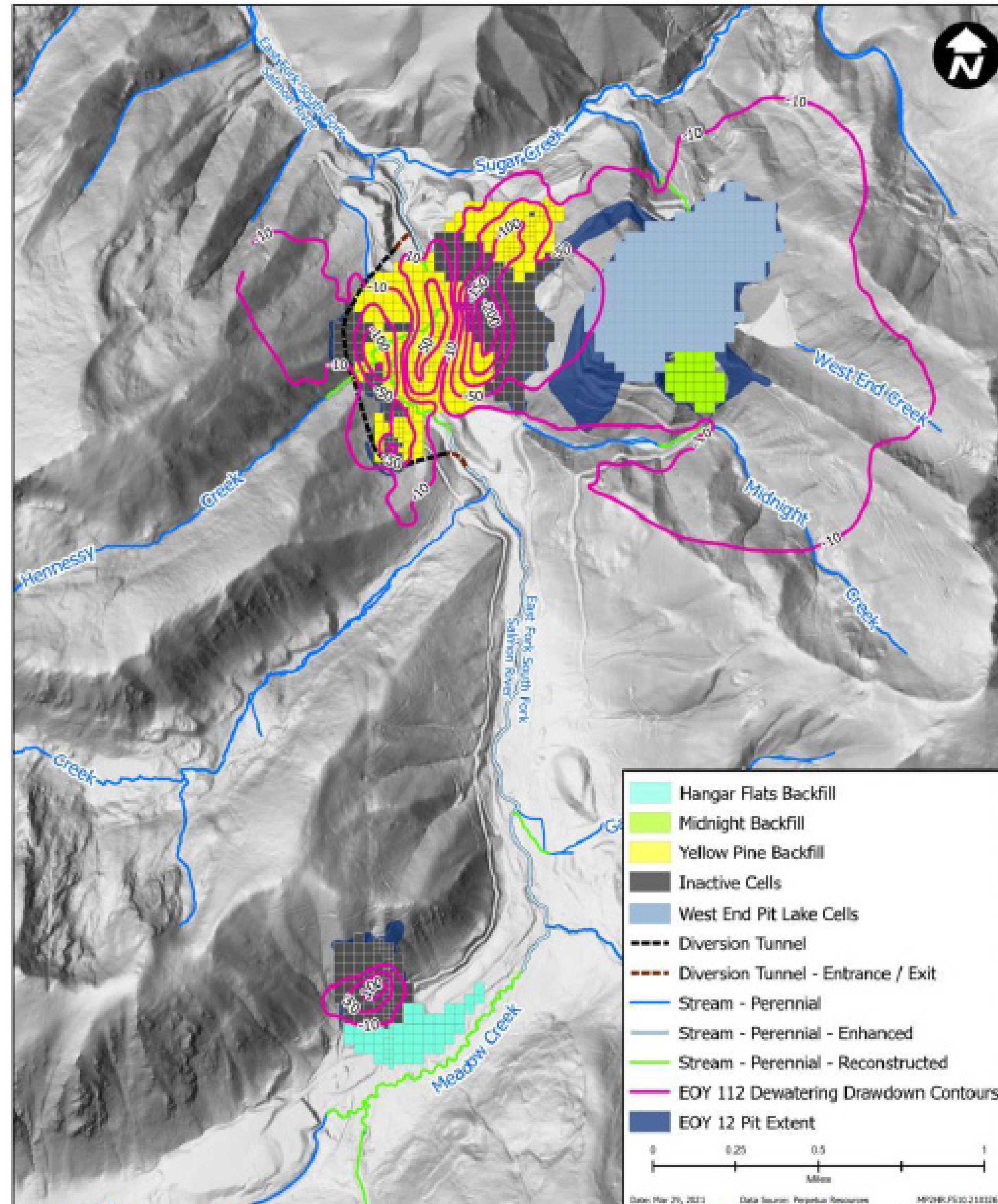
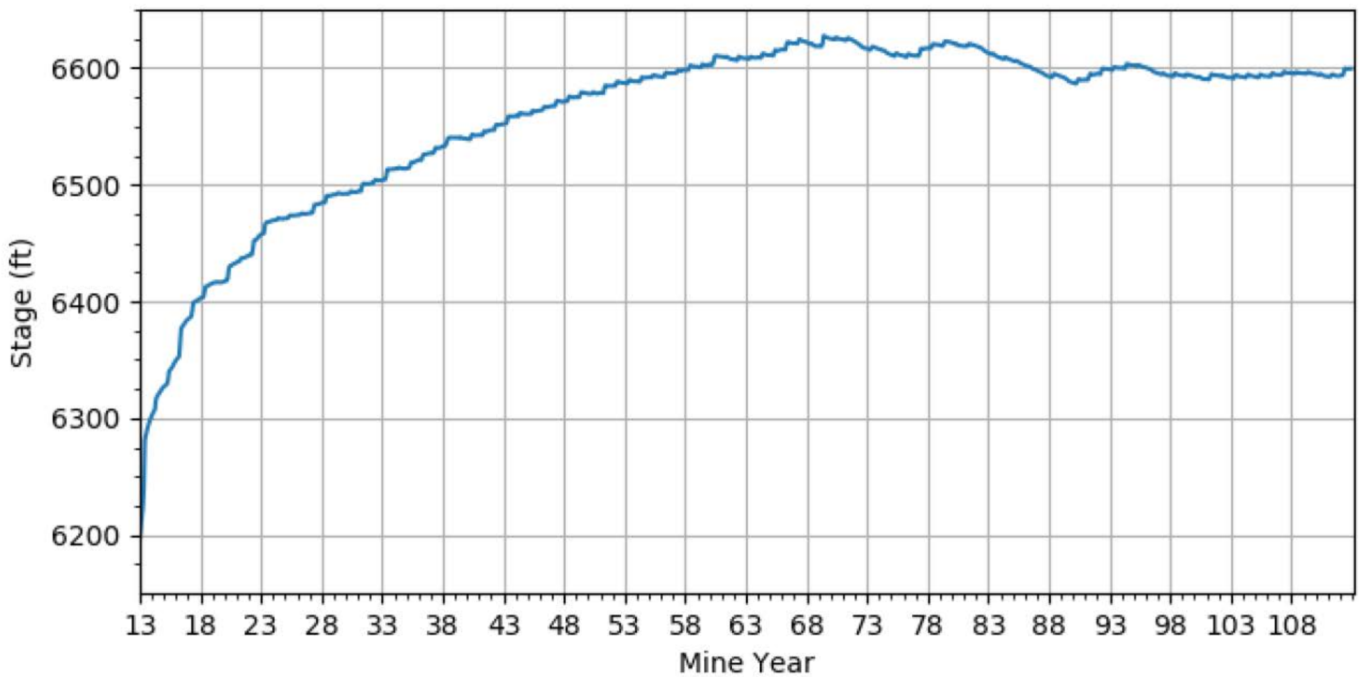




**Figure 7-8b**
**Predicted Dewatering Drawdown**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (Brown & Caldwell 2021a)*



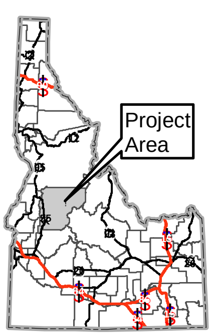




**Figure 7-9**
**West End Pit Lake Recovery**

**Stibnite Gold Project**
**Stibnite, ID**
*Data Sources: (Brown & Caldwell 2021a)*

Because they would be backfilled with development rock, pit lakes would not form in the Hangar Flats or Yellow Pine pits. Recovering water levels would inundate the portions of the backfill below the pre-dewatering water levels around approximately Mine Years 8 and 12 years, respectively.

### *Impacts to Groundwater Flow*

The presence of the fully lined TSF and TSF Buttress along with the lined Yellow Pine pit and Hangar Flats pit backfills would alter local groundwater recharge and flow permanently, as these liners would inhibit groundwater recharge across the areas of their footprints and thereby, increase surface water runoff from these areas while potentially lowering groundwater levels locally. The total covered area would be approximately 430 acres (Perpetua 2021a, Table 3-4) of a total basin area of 25 square miles (16,000 acres).

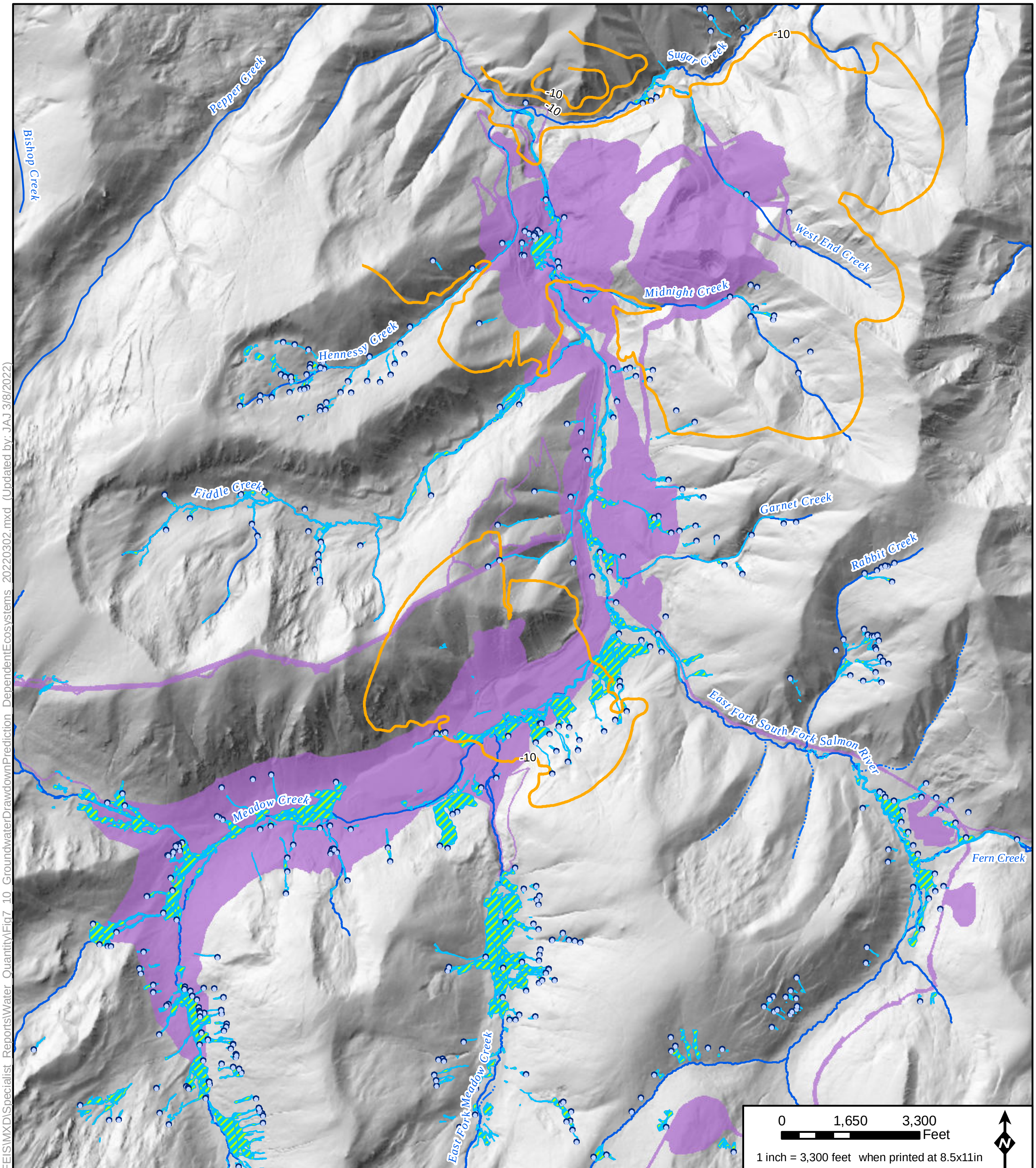
In addition, the underdrains for the TSF and TSF Buttress facilities would continue to function and locally lower groundwater levels beneath these facilities to the elevation of the drains. Therefore, groundwater flow away from this location would be reduced compared to baseline conditions because groundwater flow to the area would be partially converted to underdrain discharge.

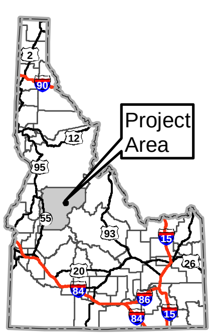
Away from the TSF area, groundwater levels would rebound during the post closure period, with most recovery occurring within three years following the cessation of groundwater pumping (Brown and Caldwell 2021b). The groundwater flow pattern and flow directions are predicted to be only minimally affected by the presence of the West End pit lake, where the presence of the lake would result in a flat hydrologic gradient across the ponded area. Groundwater in areas away from the pit lake would return to stable conditions, with seasonal responses to recharge followed by lower winter water levels. The simulated groundwater levels and seasonal changes are similar to pre-mining conditions simulated by the existing conditions model.

Impacts to groundwater flow would be minor, permanent, and localized, as when mining and reclamation are completed, there would be minor reductions in groundwater flows due to local reductions in recharge in the vicinities of the TSF, TSF Embankment and Buttress, Hanger Flats pit backfill, and Yellow Pine pit backfill.

### *Impacts to Groundwater Dependent Ecosystems*

As described above, mine-induced drawdown resulting from proposed dewatering and water production activities is predicted to cause a reduction in groundwater levels within the analysis area. These reductions are predicted to occur in the vicinity of existing seeps and springs plus the GDEs they support (**Figure 7-10**). These seep and spring locations can be characterized as either ephemeral or perennial. Ephemeral locations flow only during or after wet periods primarily in response to precipitation or runoff events. Thereby, these surface water features are not controlled by discharge from the regional groundwater system. During low precipitation periods of the year, ephemeral locations typically would be dry. In contrast, perennial seeps and springs generally flow throughout the year. Flows observed during wet periods include a combination of surface runoff and groundwater discharge, whereas flows during dry periods are sustained primarily by groundwater discharge. This groundwater discharge may emanate from a local system or from the regional groundwater system. If the flow from these seeps and springs relies on groundwater from an aquifer experiencing drawdown, that reduction in groundwater levels could reduce the surface water discharge resulting in potential reductions to the length of flow reach, rate of flow, and corresponding reduction in the associated riparian vegetation area.




**LEGEND**

- Seep/Spring
- SHSM Drawdown Maximum Contour
- Intermittent Stream
- Perennial Stream
- Delineated Wetland

**Project Components ***

- Mine Footprint (Mine Year 12)

*Mine Site components are associated with 2021 MMP

**Figure 7-10**
**Predicted Groundwater Drawdown in the Vicinity of Groundwater Dependent Ecosystems**
**Stibnite Gold Project**
**Stibnite, ID**

*Base Layer: Midas Hillshade Raster 10m*
*Other Data Sources: Perpetua; Boise National Forest; Payette National Forest*

PAYETTE NATIONAL FOREST

Document Path: U:\203721981\03 data\gis cad\gis\FEIS\MXD\Specialist Reports\Water Quantity\Fig7 10 GroundwaterDrawdownPrediction DependentEcosystems 20220302.mxd (Updated by: JAJ 3/8/2022)

Potential impacts to seeps, springs, and GDEs were evaluated by comparing surface water locations to the predicted ten-foot drawdown contour resulting from mine dewatering and water production. **Figure 7-10** illustrates that there are 45 GDEs catalogued to be present within the analysis area potentially affected by dewatering drawdown of groundwater levels at the end of mining. During mining there are also 48 locations potentially affected by drawdown from the Hangar Flats pit dewatering and industrial well supply pumping. Such impacts would occur only in cases where the hydrology of the seeps, springs, and wetlands affected is dominated, or largely influenced by groundwater discharge from the aquifer where water levels are subject to drawdown. The actual impact to each specific seep or spring would depend on the degree of interconnection between that perennial surface water and the aquifer affected by mine-related pumping. Considering the complexity of hydrogeologic conditions and the inherent uncertainty in numerical modeling predictions relative to the exact areal extent of groundwater drawdown, conclusive *a priori* identification of specific seep and spring impacts is not possible. Therefore, a precautionary principle is applied where seep and spring locations within the vicinity of the predicted drawdown would be subject to monitoring and mitigation requirements (**Section 7.4**).

Impacts to GDEs would be negligible to potentially major, long-term, and localized.

Impacts of lowering groundwater levels on surface streams is discussed in **Section 7.2.2.4**.

#### *Impacts to Groundwater Rights*

There are no groundwater rights located within the predicted ten-foot drawdown contour associated with the drawdown prediction for mining activity. Current Perpetua groundwater rights are located outside of the predicted dewatering impact areas.

Additional groundwater rights would be needed for the SGP and would be secured through direct permit application for approval of such rights from the IDWR. Perpetua plans to apply for a maximum total diversion rate of 9.6 cfs to maintain ore processing and mine operations. This rate would be for combined groundwater and surface water diversion in addition to existing water rights. Perpetua is currently in the process of applying for these additional rights.

Groundwater use for potable water supply would require drilling wells at the Landmark Maintenance Facility and SGLF. At each facility, a well with a capacity of 18 gpm (0.04 cfs) is proposed. Separate water rights applications would be submitted for each well, seeking a permit to authorize diversion of 0.04 cfs for domestic and industrial purposes at the Landmark Maintenance Facility, and a permit authorizing diversion of 0.04 cfs for domestic and commercial purposes at the SGLF.

Domestic water use at the truck shop and mill facilities also would be supplied from a potable water system. Perpetua anticipates submitting an application for permit seeking 0.06 cfs of groundwater for this use.

Domestic use at the Worker Housing Facility also would be supplied by groundwater. The authorized point of diversion for water right 77-7141 (0.20 cfs) would be modified for this purpose through an application for transfer. In addition, Perpetua anticipates submitting an application for permit to appropriate and additional 0.20 cfs of groundwater to supplement the currently authorized 0.2 cfs volume authorized under 77-7141.

The effects of groundwater diversion at these rates were incorporated into the impact analyses above while the implications for this groundwater diversion on surface water rights are described in **Section 7.2.2.4**.

#### 7.2.2.4 Surface Water Quantity

This section provides a summary of the methods used to evaluate the potential changes to stream flows and surface water rights in the affected areas. The primary focus of the effects analysis is on predicted stream flows in Meadow Creek between the TSF and Hangar Flats pit; Meadow Creek downstream of the Hangar Flats diversion but upstream of the confluence with the East Fork SFSR; the East Fork SFSR at USGS Gaging Stations 13310800, 13311000, and 13311250; the East Fork SFSR downstream of Sugar Creek; and Sugar Creek at the USGS Gaging Station 13311450.

##### *Changes in Stream Flow Characteristics*

The changes in surface water flow described in this section are compared to those of the simulated existing conditions. Changes in surface water flows in the analysis area are expected to result primarily from:

- stream diversion around mine facilities,
- interception of contact water and other mine-impacted water prior to runoff,
- development and dewatering of three open pits,
- groundwater production for consumptive use,
- stream water diversion above the East Fork SFSR tunnel for consumptive use, and
- discharge of treated water.

These activities have the potential to modify the location and flow rate of stream flows in the analysis area.

Streamflow simulations were performed for various locations potentially affected by mine operations, including locations of the USGS gaging stations in the analysis area (**Figure 6-2**). Stream flows are presented graphically in this report with numerical tabulations of the predicted stream flows available in the appendices to Brown and Caldwell 2021b.

Stream flows in Meadow Creek and East Fork SFSR upgradient of the mine activities would not be affected by the operations because these areas are outside the influence of mine disturbance and dewatering. Predicted monthly changes in stream flows are summarized in **Table 7-5**.

**Table 7-5 Average Monthly Percent Predicted Reductions in Stream Flows during the Mine Operations Period**

| Month | East Fork SFSR above Meadow Creek (13310800) | East Fork SFSR below Meadow Creek (13311000) | East Fork SFSR above Sugar Creek (13311250) | Sugar Creek above East Fork SFSR (13311450) | East Fork SFSR below Sugar Creek (13311500) |
|---|---|---|---|---|---|
| January | - | 7% | 13% | 3% | 9% |
| February | 1% | 6% | 13% | 3% | 9% |
| March | - | 5% | 12% | 3% | 8% |
| April | - | 6% | 8% | 2% | 6% |
| May | - | 4% | 4% | 1% | 4% |
| June | - | 3% | 3% | 1% | 3% |
| July | - | 7% | 14% | 3% | 10% |
| August | - | 9% | 18% | 3% | 12% |

| Month | East Fork SFSR above Meadow Creek (13310800) | East Fork SFSR below Meadow Creek (13311000) | East Fork SFSR above Sugar Creek (13311250) | Sugar Creek above East Fork SFSR (13311450) | East Fork SFSR below Sugar Creek (13311500) |
|---|---|---|---|---|---|
| September | - | 7% | 15% | 3% | 11% |
| October | - | 7% | 15% | 3% | 10% |
| November | - | 7% | 15% | 3% | 10% |
| December | - | 6% | 13% | 3% | 10% |
| Maximum Monthly Reduction | 3% (end of Mine Year 6) | 26% (start of Mine Year 7) | 30% (end of Mine Year 1, start of Mine Year 7) | 3% (Mine Year 12) | 3% (end of Mine Year 1, start of Mine Year 7) |

- indicates a less than 1% change

Source: Brown and Caldwell 2021b, Appendix B (predicted flows in CFS and relative percentage differences)

The model predicts reductions in Meadow Creek flows between the TSF and Hangar Flats pit compared to baseline flows of up to approximately 40 percent during low flow periods (**Figure 7-11**) which depicts the predicted monthly surface flows for the Project compared to the No Action Alternative during the construction and operational period for the SGP. This point of comparison is not associated with a stream gauge location because the current Meadow Creek gauge location would be displaced by construction of the TSF. This section of Meadow Creek is simulated as lined, preventing groundwater from discharging to the creek. However, baseflow depletion is largely offset by the addition of treated water in this portion of Meadow Creek via an IPDES permitted outfall. This offset is anticipated to be substantially effective because the predicted impact is primarily associated with dewatering of the Hangar Flats pit. Therefore, that dewatering is contemporary with the greatest availability of treated water around Mine Years 5 and 6, as dewatering production is a contributing source to the water treatment requirement for that time.

Effects to both seasonal peak and low flows are noted for Meadow Creek below the Hangar Flats diversion, but above the East Fork SFSR (**Figure 7-12**). Minimum flows under the No Action Alternative are approximately 4.9 cfs, compared to 2.9 cfs for the action alternatives (a 40 percent reduction) related to Hangar Flats dewatering interception of groundwater as simulated by the mine operational period model (Brown and Caldwell 2021b). Flow reductions are predicted during the project's operational period with the largest flow reductions (i.e., on the order of 40 percent) occurring during Mine Years 4 through 8 as Hangar Flats pit is being dewatered. Flows recover toward the No Action Alternative condition following the cessation of Hanger Flats dewatering and are near equivalent to the No Action Alternative conditions by Mine Year 12.

Below the confluence of Meadow Creek and East Fork SFSR and in the East Fork SFSR above the confluence with Sugar Creek, late-season stream flow decreases would occur under average climate conditions during the mine operational period (**Figures 7-13** and **7-14**). Upstream of the Yellow Pine pit area, minimum baseflows for the action alternatives based on comparison of model results to the existing condition model would be approximately 6.6 cfs compared to 8.9 cfs (26 percent reduction) for the No Action Alternative attributable to the diversion and capture (contact water) of surface water as well as mine dewatering. Downstream of the Yellow Pine pit area prior to the confluence with Sugar Creek, minimum baseflows for the action alternatives are predicted to be 7.9 cfs compared to 11.3 cfs under the No Action Alternative (30 percent reduction) under the proposed water management scenario and its associated water balance. These reductions are predicted to occur during the project operational period with the largest reductions occurring during the Mine Years 2 through 8 when dewatering product at

Yellow Pine pit and then Hangar Flats pit are at their peak rates. Flows recover toward the No Action Alternative condition at the end of mine operations and are near equivalent to the No Action Alternative conditions by Mine Year 12.

Predicted Sugar Creek flows for the action alternatives are approximately 3 percent less than the No Action Alternative during the operational period (**Figure 7-15**). During the post-closure period when the West End pit lake is forming, predicted Sugar Creek flows decrease by up to 9 percent primarily. Predicted flow reductions of this size persist for approximately 50 years post-closure before decreasing to an approximately 1 percent difference indefinitely compared to the No Action Alternative. Downstream of the East Fork SFSR and Sugar Creek confluence, the average seasonal low flows for the action alternatives are 20.1 cfs compared to 22.1 cfs under the No Action Alternative (9 percent reduction), while the minimum predicted low flow is 15.7 cfs compared to 18.2 cfs (14 percent reduction, **Figures 7-16** and **7-17**). These reductions are attributable to the total of upstream capture of surface water, groundwater dewatering, and water abstraction for consumptive use partially offset by discharge of treated water. Flows fully recover within 10 years from cessation of operations (Brown and Caldwell 2021b).

It appears that the predicted reduction in stream flows due to the SGP are most pronounced within lower Meadow Creek above EFSFSR and EFSFSR above Sugar Creek. The percentage decrease in base flows is moderated by the flow from Sugar Creek. Farther downstream of the confluence of EFSFSR and Sugar Creek, flow reductions are expected to decrease due to incremental inflows of surface water and groundwater along the downstream run of the river that are not impacted by the SGP (e.g., Salt Creek, Profile Creek, Johnson Creek, and others) with predicted flow reductions in the project area equivalent to less than one percent of mean flows downstream of the confluence with Johnson Creek. The effects of changes in stream flow characteristics on ecological receptors are described in companion SGP specialists reports for Wildlife (Forest Service 2022d) and Fish and Aquatic Resources (Forest Service 2022e).

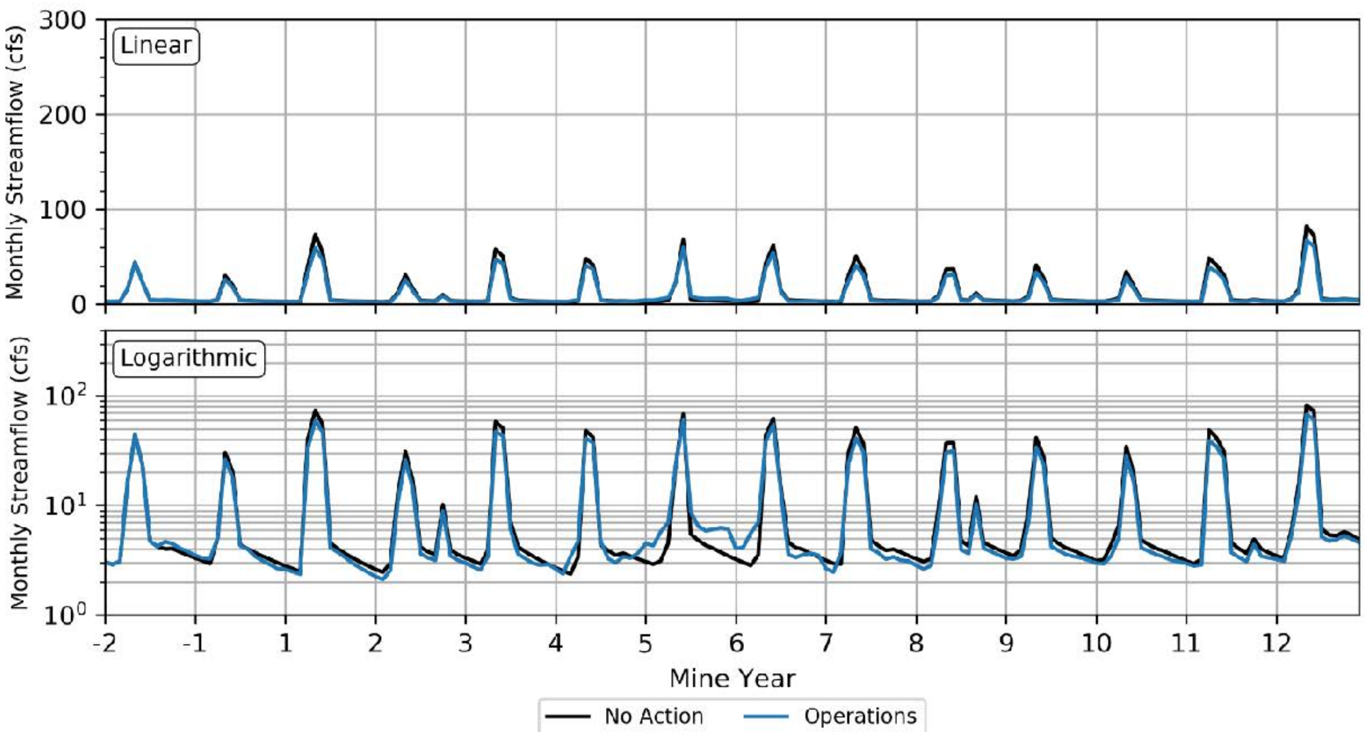
Impacts to stream flow characteristics would be moderate, long-term, and localized.

### *Impacts to Surface Water Rights*

There are no surface water rights located within the analysis area other than Perpetua's.

Additional surface water rights would be needed for the SGP and would be secured through direct permit application for approval of such rights from the IDWR. Perpetua plans to apply for a maximum total diversion rate of 9.6 cfs to maintain ore processing and mining operations. This rate would be for combined groundwater and surface water diversion in addition to existing water rights. Actual production at the maximum rate would be uncommon and limited in duration. Typical rates of surface water diversion during the build-up of project water inventory would be approximately 4 cfs.

It should be noted that no water right with a junior priority date can deplete the water needed to maintain the IWRB maintained minimum streamflow water right on the East Fork SFSR (Water Right 77-14190), unless allowed as a condition of approval of the proposed junior water right. All the existing water rights at the SGP predate the priority date of April 1, 2005, associated with Water Right 77-14190. Any new water rights permits would have a junior priority date, but the minimum stream right (77-14190) on the East Fork SFSR is subordinate to all future domestic, commercial, municipal, and industrial uses, and up to 8.2 cfs of new non-domestic, commercial, municipal, and industrial uses. This would allow authorization of up to 8.2 cfs of new non-domestic, commercial, municipal and industrial water rights to which Water Right 77-14190 would be subordinate.



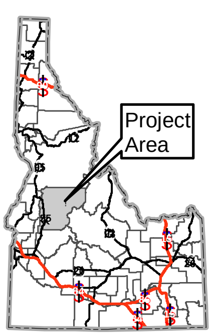
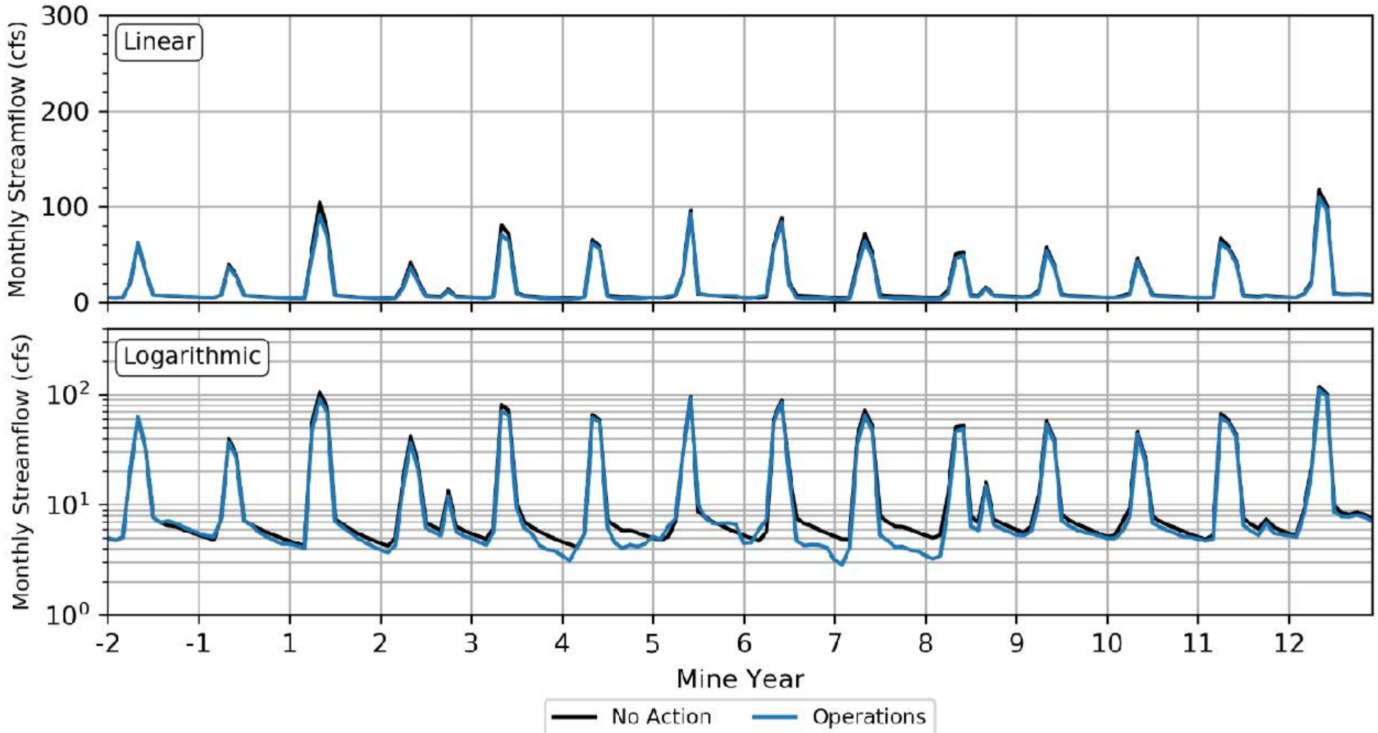




**Figure 7-11**
**Comparison of No Action and Action Alternatives Predicted Meadow Creek Flow between the TSF Buttress and Hangar Flats Pit**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



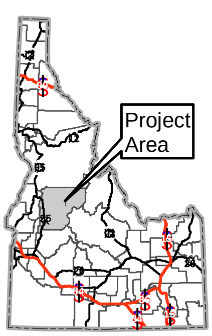
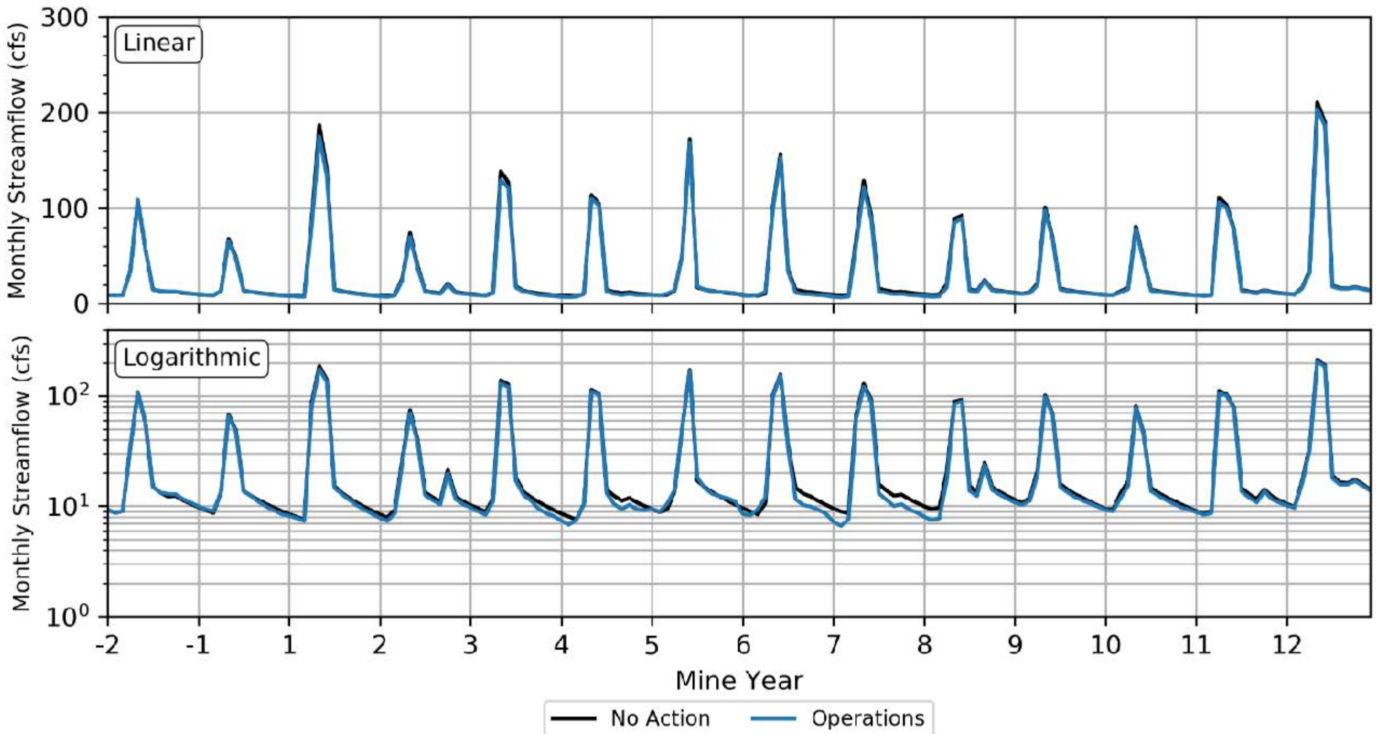




**Figure 7-12**
**Comparison of No Action and Action Alternatives Predicted Meadow Creek Flow above EFSFSR Confluence**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



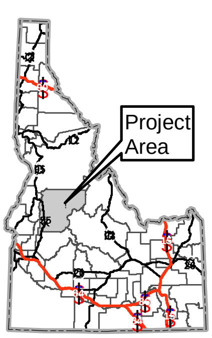
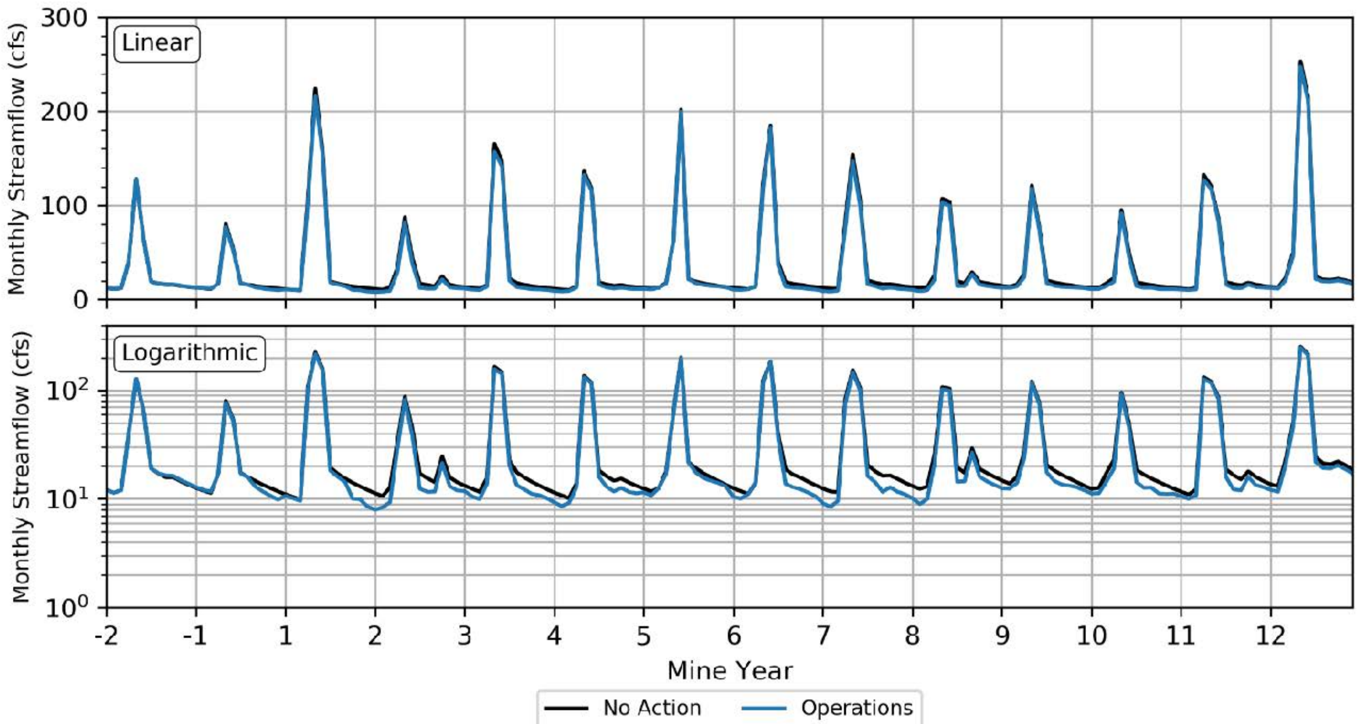




**Figure 7-13**
**Comparison of No Action and Action Alternatives Predicted EFSFSR Flow below Meadow Creek Confluence**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



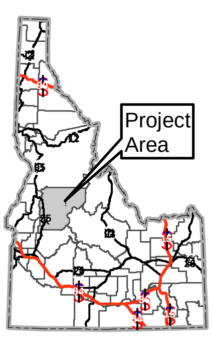
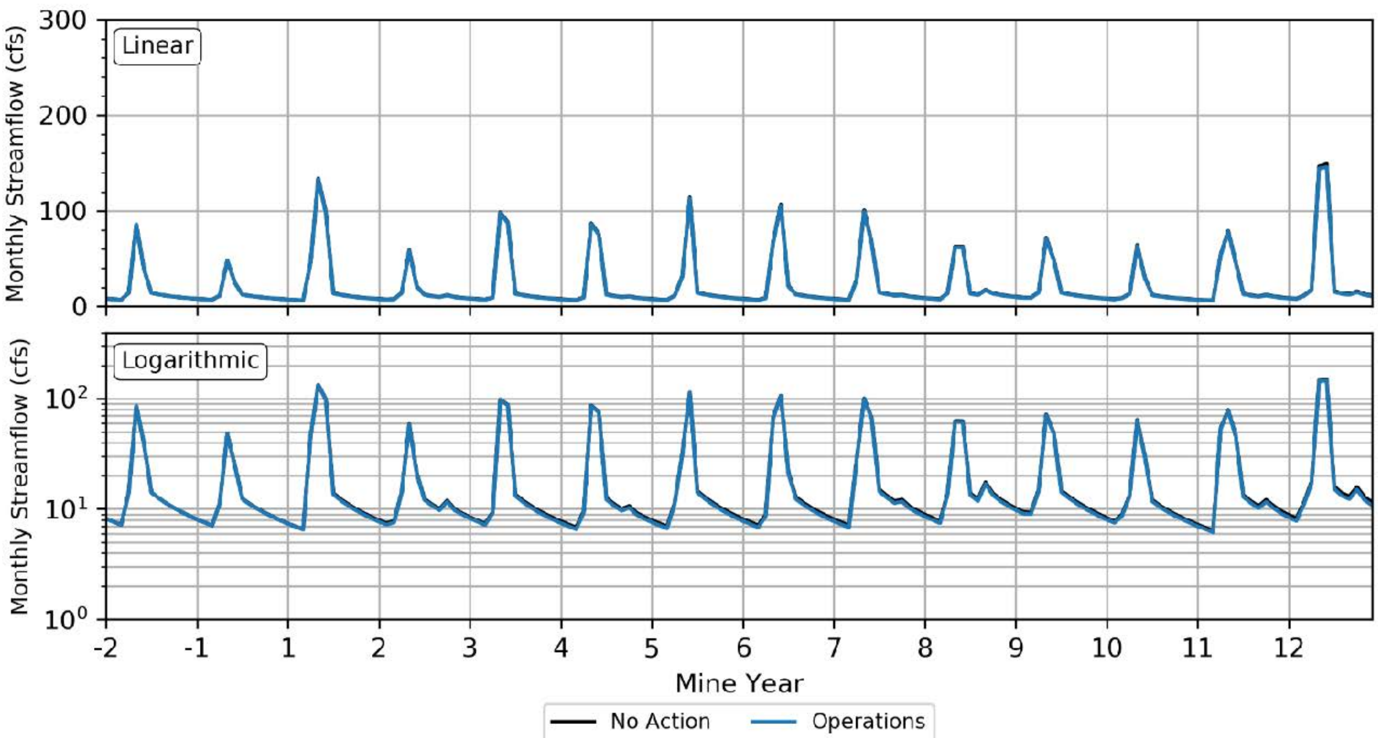




**Figure 7-14**
**Comparison of No Action and Action Alternatives Predicted EFSFSR Flow above Sugar Creek Confluence**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021b)*



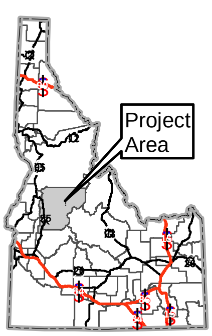
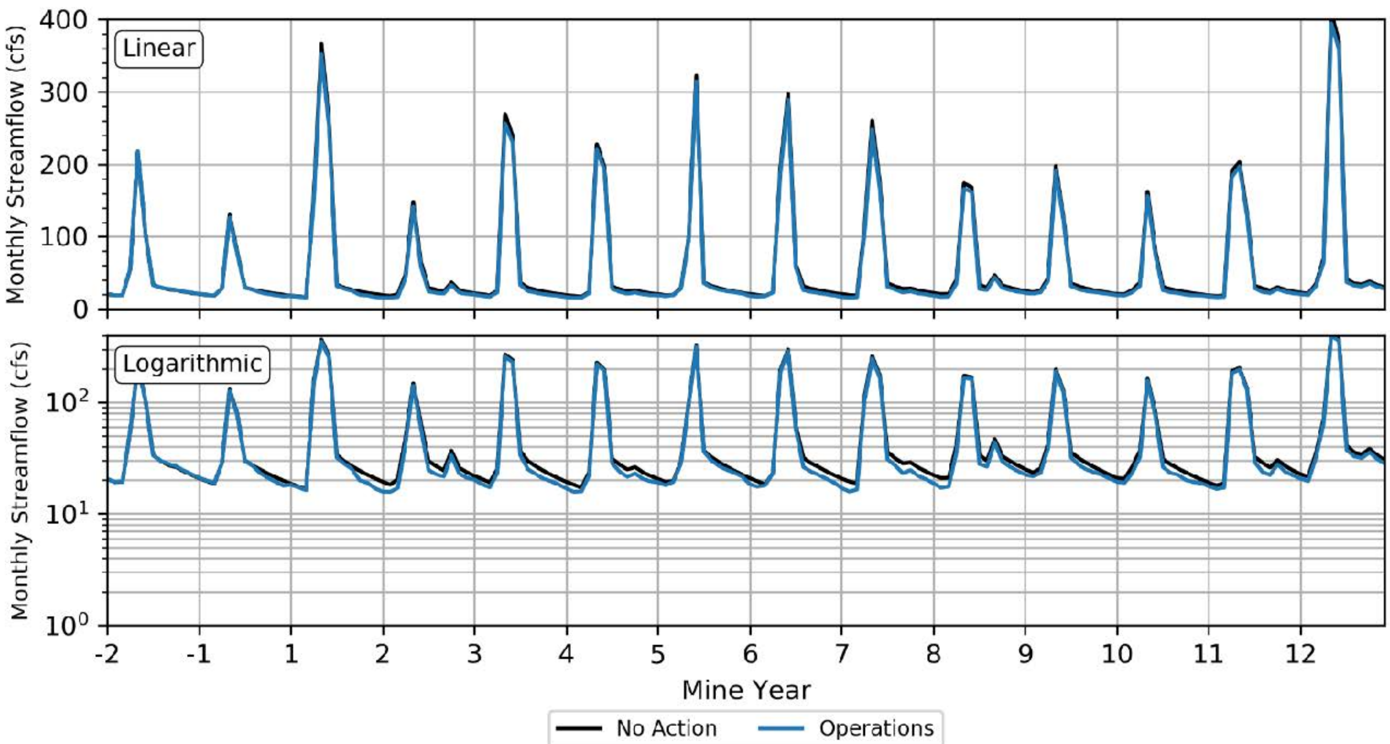




**Figure 7-15**
**Comparison of No Action and Action Alternatives Predicted Sugar Creek Flow above EFSFSR Confluence**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a)*



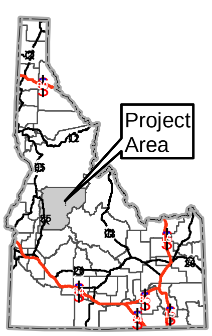
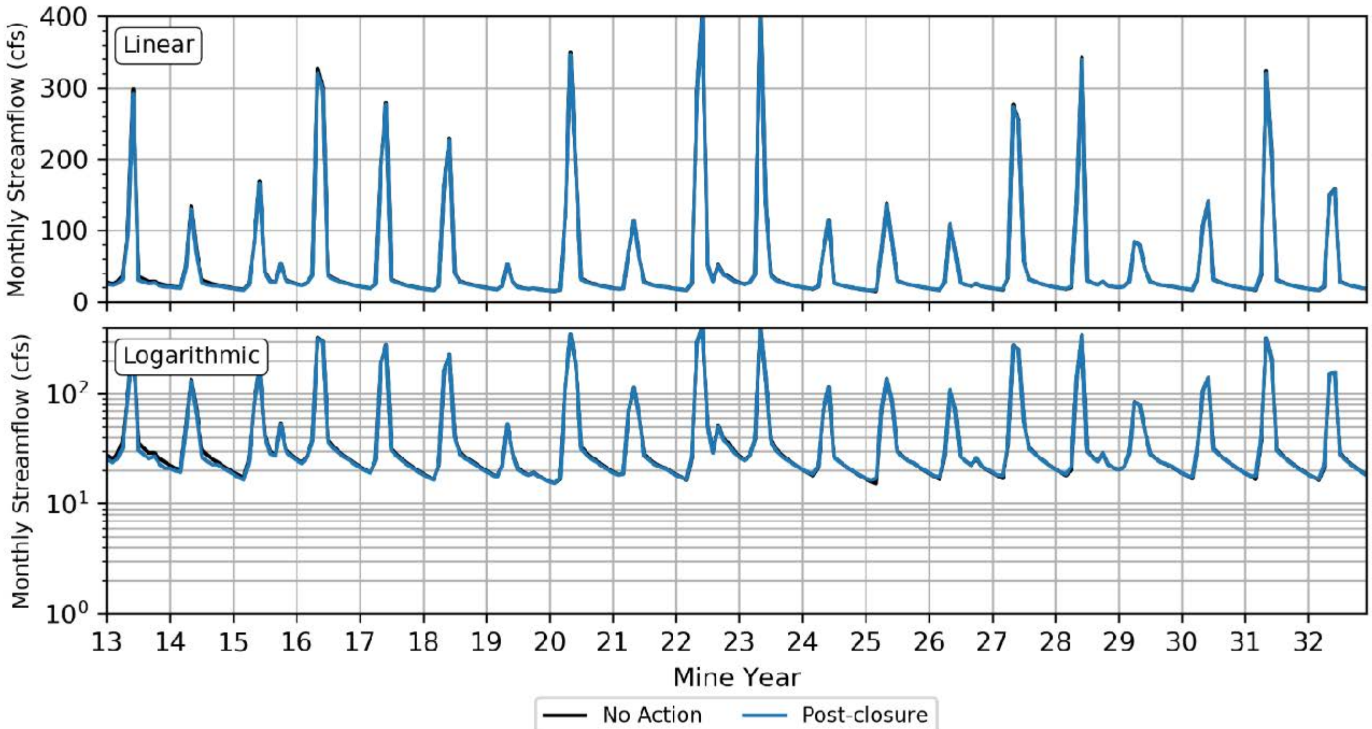




**Figure 7-16**
**Comparison of No Action and Action Alternatives Predicted EFSFSR Flow below Sugar Creek Confluence**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a)*



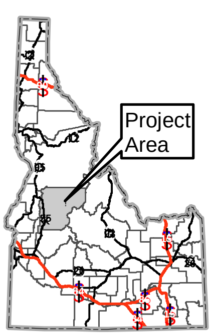




**Figure 7-17**
**Comparison of No Action and Action Alternatives Predicted EFSFSR Flow below Sugar Creek Confluence in the Post-Closure Period**

**Stibnite Gold Project**
**Stibnite, ID**

*Data Sources: (Brown & Caldwell 2021a)*

Base flows in the East Fork SFSR below Sugar Creek are approximately 20 cfs and 60 cfs in Johnson Creek (at gauge location 13313000). The maximum diversion rate under existing and proposed surface water rights is 4.05 cfs, which is approximately 20 percent of the base flow in the East Fork SFSR and five percent of the combined flows of the East Fork SFSR and Johnson Creek.

After a water right application has been filed, IDWR would perform an analysis to determine if the application is made in good faith with sufficient financial resources to complete the project, would reduce the quantity of water under existing rights (including Minimum Stream Flow and Wild & Scenic water rights on the South Fork Salmon River and the Salmon River), would be insufficient for the proposed use, and would not conflict with the local public interest. Instream rights on the South Fork Salmon River are subordinate to 20.6 cfs; maximum diversions proposed by Perpetua from all sources and uses would be 9.68 cfs, within the allowance of the South Fork Salmon River instream rights.

Minimum instream flow in the Federal Reserve Water Rights for the Salmon Wild and Scenic River (75-13316 and 77-11941) at their designated location approximately 64 miles downstream from the SGP area range from 1,200 cfs in early September to 9,450 cfs in early June. IDWR would be responsible for determining the impacts of the water right application. The current seasonal low baseflow in the Salmon River is approximately 4,150 cfs near Shoup gage.

Impacts to surface water rights would be addressed by the water rights authorizations as determined by IDWR via mitigation measures associated with those authorizations. Pending application of the IDWR mitigation measures, effects on surface water rights would be moderate, long-term, and localized.

## 7.3 Uncertainty Associated with Model Predictions

### 7.3.1 Sources of Uncertainty and Approaches to Evaluate such Uncertainties in Water Resources Models

Predictions generated by groundwater and hydrologic models are associated with a degree of uncertainty. General sources of model uncertainty are attributed to a variety of factors, including:

- data characterizing hydraulic properties (over a large enough area), or the hydrologic system's response to changes or stressors on which the model predictions depend;
- conceptual models or model assumptions;
- geometrical representation of a complex system and its heterogeneities;
- variation in the drawdown associated with specific dewatering well and dewatering sump locations and designs as represented in the numerical model by drains;
- impreciseness of spatial interpolations;
- field measurement inaccuracies;
- inadequate interpretation of the collected data;
- misinterpretation of relevant processes that affect the hydrologic system;
- general limitations of the models and numerical methods used; and
- unpredictable natural and human factors.

Uncertainties associated with model predictions can be evaluated and assessed using a variety of approaches, including:

- Sensitivity analysis;
- "Bayesian model averaging" applied to multiple conceptual models and multiple parameter estimation methods;
- Parallel testing of several viable conceptual models, combined with parametric uncertainty analysis carried out for each conceptual model;
- The use of "pilot points" in conjunction with nonlinear parameter estimation software that incorporates advanced regularization functionality;
- "Calibration-Constrained Monte-Carlo," also called "Null Space Monte Carlo"; and/or
- "Subspace Monte Carlo" that allows calibration-constrained random heterogeneity.

Sensitivity analysis is deemed an important part of model uncertainty analysis. Most often such analysis is limited to varying model parameters and noting how such changes affect the model calibration. However, sensitivity analysis alone is not always adequate if the altered model is used for making predictions. This is because varying the values of model parameters often results in a significant model "de-calibration," and de-calibrated models should not be used for predictive simulations.

ASTM International Standard Guide for Conducting Sensitivity Analysis for a Groundwater Flow Model Application (ASTM International 2008) provides the following clear instructions: "For each value of each group of inputs, rerun the calibration and prediction runs [emphasis added] of the model with the new value of the calibrated value" – this means that after varying the value of a given parameter, one needs to calibrate the altered model, before using it for making predictions. This is seldom accomplished with the models developed for industrial applications – completing such systematic analysis would require large budgets and a significant level of effort that many projects cannot support.

Many of the other, more sophisticated approaches listed above for evaluating model uncertainty can be quite involved and, due to limitations of software and hardware, combined with the budgetary and time constraints of most projects, are still not practical outside of the realm of research (Rzepecki 2012).

### 7.3.2 Primary Sources of Predictive Uncertainty for the Hydrologic Model

Parameter value selection for the hydraulic characteristics simulated in the SGP hydrologic model is the primary source of uncertainty in predicting pumping rates associated with open pit dewatering and the nature and extent of potential impacts from project pumping and water management. In particular, the selection of parameter values to represent the bedrock aquifer hydraulic characteristics are important because bedrock-hosted groundwater is extensively present throughout the analysis area.

To address this source of predictive uncertainty for groundwater pumping and its impacts, a sensitivity analysis was performed on the parameter values selected for bedrock hydraulic properties. Model parameter values for hydraulic conductivity and specific storage were evaluated over a range of numerical values within the range of measurements observed during borehole testing. A range of bedrock hydraulic conductivity values between 0.02 and 50 times the model selected values and bedrock specific storage values between 0.5 and 2 times the model selected values were examined. Additional details of the sensitivity analysis are described in Brown and Caldwell 2021e. Parameter value changes by more than a factor of 10 produced a model that did not calibrate to observed conditions. Therefore, the following discussion of sensitivity results relates to a range of bedrock hydraulic conductivity values between 0.02 and 10 times the model selected values.

Dewatering pumping rate predictions were sensitive to increases in bedrock hydraulic conductivity but were insensitive to decreases in bedrock hydraulic conductivity or changes in specific storage. For the Yellow Pine pit dewatering, peak pumping rates associated with the sensitivity analysis ranged up to approximately 2,000 gpm compared to the model predicted rate of approximately 650 gpm. For Hangar Flats pit and West End pit dewatering, the sensitivity analysis peak pumping rate ranged up to approximately 2,400 gpm compared to a predicted value of approximately 1,500 gpm, and approximately 400 gpm compared to 300 gpm, respectively.

If higher than predicted dewatering pumping rates within the sensitivity range were in fact realized, the project would be less reliant on surface water abstraction from the intake above the EFSFSR tunnel or production from groundwater industrial supply wells to meet its consumptive use needs. Therefore, increases in dewatering pumping would be less than the increase in total groundwater pumping by the project because dewatering production could be used to source more of the consumptive use, offsetting pumping from industrial supply wells. However, the increase in total pumping due to increased bedrock hydraulic conductivity only slightly affected the lateral extent of the 10-foot drawdown cone compared to model predictions because that extent is more closely related to drawdown in the more permeable alluvial materials (Brown and Caldwell 2018a, 2021b, 2021e).

With regard to surface waters, the effects of increased groundwater pumping would be largely offset by the associated reduction in surface water abstraction from the intake above the East Fork SFSR tunnel for consumptive use. Therefore, surface water flow rates would be within 0.5 cfs of those predicted by the model, representing the difference between predicted surface flow rate reductions and removing the rate of forecasted withdrawal from the intake above the EFSFSR tunnel, which would no longer be needed. Conversely, decreased dewatering pumping would create a need for more industrial well production or surface water abstraction.

### 7.3.3 Conclusions of Uncertainty Assessment

Groundwater modeling requires simplifying assumptions to represent a complex subsurface hydrologic regime.

As a result of data limitations and simplifying assumptions, all predictive models, no matter how well constructed and calibrated, contain uncertainty. The main sources of uncertainty for the Brown and Caldwell model are:

- Typical limitations of data derived from localized, short-term hydraulic tests to characterize an aquifer at a field-scale;
- Predictive sensitivity to various possible degrees of hydraulic transmissivity of the fault zones, only one of which has been explicitly represented in the model; and
- Putative inability to directly observe the effects of long-term hydraulic stresses on the bedrock aquifer as attempted deep bedrock pumping tests have not been completed due to the inability to sustain groundwater production from a pumping well.

Although alternative conceptual and numerical models likely could be developed, an undertaking of this magnitude is not realistic, and in any case, would have been unlikely to produce significantly different predictive results or to significantly reduce the uncertainties associated with the model predictions.

## 7.4 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 are in addition to the Forest Service requirements and EDFs (**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.

**Issue:** Mine-induced drawdown of water levels could impact flows in springs that were hydrologically connected with the aquifer.

**Monitoring Measure - Water Resource Monitoring Plan Implementation:** A focused water resources monitoring plan for the SGP would be implemented by the proponent. The mine owner/operator would be responsible for the implementation of a Water Resources Monitoring Plan focused on confirming the predicted groundwater drawdown within allowance for model uncertainty and its relationship to discharges at proximal surface water resources. The plan would include surface water, groundwater, and meteorological monitoring requirements for the approved project. Water quantity measurements would include diversion rates from groundwater pumping, water levels in groundwater monitoring wells and piezometers located within the Operations Area Boundary, and flow rates of streams and springs at USGS monitoring stations as well as spring locations characterized in the baseline program within the predicted 10-foot drawdown contour. Monitoring results would be provided to the Forest Service on a quarterly basis and summarized in an annual report. The mine owner/operator would be responsible for continued monitoring and reporting of changes in groundwater levels and surface water flows prior to, and during, operation and for a period of time in the post-reclamation period. The plan would be reviewed and approved by the Forest Service and implemented prior to the commencement of mining. State authorizations may also have monitoring requirements and these requirements along with monitoring already conducted or proposed could be applied to satisfy the needs of this mitigation measure.

**Effectiveness:** This monitoring measure would provide for identification of potential flow-related impacts that deviate outside uncertainty of model forecasts to groundwater and surface water resources as a result of mine-related water management activities. Implementation of this monitoring measure in conjunction with associated mitigation measures is anticipated to mitigate potential adverse impacts to surface water resources resulting from mine-related drawdown during the mining and post-mining period. If such deviation is observed, actions may consist of additional investigation and evaluation, including additional monitoring as necessary, to determine effective management practices and prevent adverse impacts.

**Issue:** Despite the best efforts at calibration and validation, predictive modeling of groundwater flow and stream flow entails uncertainty and future field conditions may vary from predictions.

**Monitoring Measure - Groundwater Modeling Validation and Update:** Since there is uncertainty in the numerical groundwater model developed for the project, a work plan would be developed to revise the model and update it as necessary one year after mining intercepts the groundwater table and then again whenever monitoring data demonstrates a change in conditions that would significantly influence prediction and recognition of potential mine impacts. The model update would be based on the actual observed changes in groundwater elevations and additional hydrogeologic or groundwater-related data collected during operation. The Forest Service's annual review of monitoring results combined with the updated groundwater modeling, if necessary, would provide early warning of potentially unanticipated, undesirable impacts to water resources to allow for implementation of appropriate mitigation measures.

**Effectiveness:** Implementation of this monitoring measure is expected to be effective in sustaining predictive models as usable evaluation tools that reflect site conditions and monitoring data for the purpose of predicting impacts and developing effective management practices.

## 7.5 Cumulative Effects

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

The cumulative effects analysis area for surface water and groundwater quantity that could be directly or indirectly affected by the SGP consists of the area where activities associated with the action alternatives could affect stream flows and/or the quantity of groundwater in storage, groundwater levels, and groundwater transmission. The analysis area is described in **Section 5.0** and shown on **Figure 5-1**.

Cumulative effects associated with the SGP consider the range of existing and foreseeable activities and their potential effects with respect to surface water and groundwater quantity. Past and present actions that may have impacted water quantity through short-term water use include historical mining and reclamation activities in the area, as well as the Golden Meadows Exploration Project, which requires water for borehole drilling and other purposes.

The active Valley County Quarry (located near the village of Yellow Pine and about 7 miles to the west of the SGP area) also may require some degree of groundwater consumption, but since the quarry is located in a different sub-watershed from the SGP that is outside the analysis area, it would not contribute to cumulative groundwater quantity impacts.

There are no reasonably foreseeable future actions that have or would affect surface water and groundwater quantity in the analysis area. In making this determination, a number of other nearby projects that have the potential to affect surface water and groundwater quantity were considered. These include Big Creek area's small-scale hydroelectric projects plus the Morgan Ridge Exploration Project and Golden Stallion Horse Heaven Project. Although these projects could affect the surface water and groundwater systems within their respective watersheds, activities identified to date are located within a different sub-watershed from the analysis area of the SGP and lack direct communication via waterways to combine and result in cumulative water quantity effects.

## 7.6 Short-term Uses and Long-term Productivity

### 7.6.1 No Action Alternative

Under the No Action Alternative, SGP activities would not be implemented. Consequently, no short-term use would occur that would affect surface water or groundwater quantity, and no change in long-term productivity would occur.

### 7.6.2 2021 Modified Mine Plan and Johnson Creek Route Alternative

Implementation of the SGP would result in long-term impacts to surface water quantity at the SGP through groundwater withdrawal and stream diversions. The duration of predicted impacts on streamflow includes the mine operational period, and the early post-closure period. After that period, the system would return to a stable seasonal pattern similar to existing conditions.

Apart from triggering some changes in groundwater quality characteristics (Forest Service 2022b), implementation of the action alternatives would potentially have indirect effects on surface water discharges associated with changes in groundwater levels. Post-mining, groundwater wells could still be installed within the SGP area and used to produce groundwater at rates similar to those under existing conditions. Saturated thickness of alluvial deposits and their groundwater transmissive properties would remain similar to baseline conditions except in the three open pit areas where the alluvial deposits were removed during the mining period.

## 7.7 Irreversible and Irretrievable Commitments of Resources

### 7.7.1 No Action Alternative

Under the No Action Alternative, the current mine plan would not be approved and the mining activities proposed under it would not take place. Perpetua could still propose to exercise its mining rights in the future. Under the No Action Alternative, no change would occur in the current surface water and groundwater flow conditions in the analysis area, and no change to the current commitment of these resources would occur. Therefore, there would be no irreversible or irretrievable commitments of water resources beyond those already realized as a consequence of historical mining activities conducted within the analysis area.

### 7.7.2 2021 Modified Mine Plan and Johnson Creek Route Alternative

Surface water, in terms of its flow rate characteristics, is a renewable resource, and therefore the action alternatives are not expected to have permanent flow impacts. The duration of the predicted impacts on streamflow includes the mine construction and operational period, and up to another 10 years through the post closure period, before returning to a stable, long-term seasonal pattern under natural conditions. Impacts to surface stream flow rates from the SGP would be irretrievable commitments of these resources.

However, the SGP would irreversibly alter the terrain of the analysis area by the development of the TSF, by eliminating the existing Yellow Pine pit lake (and reconstructing the East Fork SFSR through its present location), while creating a pit lake at West End and the Stibnite Lake feature atop the backfilled and reclaimed Yellow Pine pit.

Meadow Creek would be routed over the reclaimed TSF with its natural flow rate but its gradient would be permanently altered over the TSF. The seeps and springs under the TSF that would be collected and routed out from under the site within pipes would be permanently carried by these systems. These would be irreversible commitments of these resources.

Mining of ore would result in the formation of mine pits, which would fill during a post closure period, forming inundated pit backfills in the Yellow Pine and Hangar Flat pits and a pit lake in the West End pit. The Yellow Pine, Hangar Flats, and existing Midnight pits would be backfilled with development rock to reduce the amount of development rock placed in surface development rock storage facilities and facilitate reclamation of the East Fork SFSR. Mining of the pits and filling them with rock would result in the groundwater system achieving a new flow regime through the rock backfill instead of the baseline aquifer conditions but the groundwater levels in the backfills are expected to reach approximate baseline elevations as influenced by the revised groundwater flow in the backfills. These would be irreversible commitments of the groundwater system in these locations.

The West End pit lake would be situated primarily in bedrock and therefore would not receive substantial groundwater inflows. Model simulations show that the primary sources of water for filling the lake are direct precipitation and surface water runoff. The lake is predicted to fill slowly over 41 years, with a seasonal pattern of increased lake stage from spring runoff followed by seasonal declines as water evaporates and flows from the lake back into local bedrock groundwater (Brown and Caldwell 2018b, 2021a, 2021b).

Long-term, groundwater levels would be locally affected by the geosynthetic covers that would be placed over the TSF and TSF Buttress during closure activities plus the geosynthetic covers placed over the Yellow Pine pit and Hangar Flats pit backfills. These covers are intended to significantly reduce infiltration of recharge from precipitation which would permanently limit groundwater recharge rates over the areas occupied by these structures. In these areas, precipitation would not recharge groundwater but instead would remain in the shallow subsurface where it would be available for evapotranspiration and discharge to surface water in the East Fork SFSR. This would be an irreversible commitment of the groundwater resource in these locations.

## 7.8 Summary

The SGP would result in stream flow impacts under all alternatives except the No Action Alternative. Low flow would be reduced at some locations during some periods of the SGP operations up to 14 percent in East Fork SFSR (at USGS Gaging Station 13311250) and up to 40 percent in Meadow Creek (downstream of the Hangar Flats diversion but upstream of the confluence with East Fork SFSR due to water table depression from dewatering of the Hangar Flats pit).

Dewatering of the pits would lower groundwater levels in the alluvial and bedrock formations during the mining and post closure periods and would reduce flows in surface water streams that receive groundwater discharge. Additional seep and spring locations fed primarily by groundwater discharge from the dewatered aquifer may also observe flow reductions as an indirect effect of dewatering.

The TSF and TSF Buttress proposed to be located in the Meadow Creek valley would lower groundwater levels and permanently remove six delineated wetland areas with GDEs present within the footprint of the TSF and Buttress (**Figure 7-10**). The permanent reduction in local groundwater levels would be due to the installation of liner and cover systems to inhibit meteoric recharge through the mined materials. These systems would divert more than 95% of meteoric water from subsurface recharge to surface runoff and evapotranspiration. The cover systems placed over the Yellow Pine pit backfill and the Hangar Flats pit backfill would have a similar effect on groundwater levels near those locations.

**Table 7-6** provides a comparison of surface water and groundwater quantity impacts estimated to result from implementation of the various alternatives.

**Table 7-6 Comparison of SGP's Surface Water and Groundwater Quantity Impacts by Alternative**

| Issue | Indicator | Baseline Conditions | No Action Alternative | 2021 Modified Mine Plan | Johnson Creek Route Alternative |
|---|---|---|---|---|---|
| The SGP may cause changes in quantity of surface water and groundwater in all drainages within the analysis area. | Stream flow characteristics (daily, seasonal, annual). | Surface waters include: the East Fork SFSR, Rabbit Creek, Meadow Creek, East Fork Meadow Creek (also known as Blowout Creek), Garnet Creek, Fiddle Creek, Midnight Creek, Hennessy Creek, West End Creek, and Sugar Creek.<br>Monthly average seasonal low flows:<br>Meadow Creek between TSF and Hangar Flats pit = 2.7 cfs<br>Meadow Creek below the diversion and above East Fork SFSR (mine years 7-10) = 3.8 cfs | Same as Baseline Condition | Low flow would be reduced at some locations during some periods of the SGP operations up to 14 percent in East Fork SFSR (at USGS Gaging Station 13311250) and up to 40 percent in Meadow Creek (downstream of the Hangar Flats diversion but upstream of the confluence with East Fork SFSR).<br>Surface flows are generally predicted to recover to pre-mine conditions within approximately 3 years after operations cease. | Same as the 2021 MMP. |
| | The extent, magnitude, and duration of groundwater level changes. | Groundwater flow in the analysis area occurs primarily in the Quaternary unconsolidated deposits filling the valleys and through the unconsolidated deposits covering the mountainsides. | Same as Baseline Condition | Dewatering of open pits lowers groundwater levels in alluvial and bedrock formations during operations and post-closure periods. These lower levels reduce flows in streams that receive groundwater discharge.<br>There are 93 seep and spring locations within the area of groundwater drawdown that could be affected by lower water levels to the extent that any of these specific seeps or springs are receiving discharge from the aquifer affected by groundwater pumping.<br>In most areas, groundwater levels recover within 10 years. However, groundwater levels below and directly downgradient from facilities lined as part of mine closure (the TSF, TSF Buttress, Yellow Pine pit backfill, and Hangar Flats pit backfill) would be permanently lower due to reduced local recharge. | Same as the 2021 MMP. |

| Issue | Indicator | Baseline Conditions | No Action Alternative | 2021 Modified Mine Plan | Johnson Creek Route Alternative |
|---|---|---|---|---|---|
| The SGP may affect water rights. | Change in water rights availability in the SGP area. | Four existing water rights at the SGP owned by Perpetua. | Same as Baseline Condition; no changes in water rights availability. | No changes in water rights availability in the SGP area.<br>May affect downstream water rights. | Same as the 2021 MMP. |
| | New water rights needed. | Existing water rights held by Perpetua:<br>77-7285 - Groundwater right for storage and mining with diversion of 0.5 cfs for a maximum total usage of 39.2 acre-feet<br>77-7141 – Groundwater right for domestic with diversion of 0.2 cfs for a maximum total usage of 11.4 acre-feet<br>77-7293 – Surface water right for storage and mining for diversion of 0.25 cfs and a maximum total usage of 20 acre-feet.<br>77-7122 – Surface water right for storage and mining for diversion of 0.33 cfs for a maximum total usage of 7.1 acre-feet. | Same as Baseline Condition; no new water rights required. | Up to an additional 9.6 cfs of water rights needed to support ore processing.<br>An additional total of 0.28 cfs of groundwater rights needed for potable water supply at the Stibnite Worker Housing Facility, Landmark Maintenance Facility, and SGLF. | Same as the 2021 MMP. |

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