CHAPTER 3 – AFFECTED ENVIRONMENT

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3.0. AFFECTED ENVIRONMENT

3.1. Introduction

This chapter describes the affected environment for the MMPO and land disposal alternatives. The affected environment is the baseline (reference) condition against which the effects of the MMPO and land disposal alternatives are compared. The description of the affected environment is presented in 16[1] sections:

- 3.2. Geologic Resources and Geotechnical Issues
- 3.3. Soil Resources
- 3.4. Vegetation, Forest Resources, and Invasive and Non-native Plants
- 3.5. Range Resources
- 3.6. Water Resources
- 3.7. Wildlife Resources
- 3.8. Fish and Aquatic Resources
- 3.9. Wetlands, Floodplains, and Riparian Areas
- 3.10. Air Quality, Noise, and Climate Change
- 3.11. Visual (Aesthetic) Resources
- 3.12. Land Use and Recreation
- 3.13. Socioeconomic Factors
- 3.14. Tribal Treaty Rights and Interests
- 3.15. Cultural Resources
- 3.16. Transportation, Access, and Public Safety
- 3.17. Hazardous Materials and Solid Waste

Given the size of the sections for most resources in this chapter and in Chapter 4, the reader may wish to read the sections for each resource by alternating chapters, e.g., Section 3.2., Section 4.2., Section 3.3., Section 4.3., etc. Unless otherwise noted, the *MMPO area* refers to the area of new surface disturbance proposed under each MMPO alternative. The geographic scope of the affected environment (and of the effects analysis in Chapter 4) is the *analysis area*. The analysis area is described for each resource in the introduction of each of the following sections. The information in these sections is summarized from the technical reports for each of the resources (JBR 2012a through JBR 2012p); the technical reports include extensive background information and references. Metric units in their standard abbreviations are used in a few cases in the DEIS, e.g., when the units are standard for a particular parameter such as µg/L for water quality (chemistry) measurements, or when the units are carried forward from original data to facilitate comparisons with the original data.

3.2. Geologic Resources and Geotechnical Issues

The analysis area for geologic resources and geotechnical issues for the MMPO alternatives is the locality of the mine (an area of ~ 14,000 acres between Thompson Creek to the west and

[1] *resource* refers to elements of the human environment including items not commonly viewed as "resources" such as invasive, non-native plants and hazardous materials.

S. [2] Creek to the east, Figure 1.2-1). The analysis area for the land disposal alternatives is the selected and offered lands**.**

The analysis area for paleontological resources for the MMPO alternatives is the MMPO area. The analysis area for paleontological resources for the land disposal alternatives is the selected and offered lands. Paleontological resources are any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth, except that the term does not include any materials associated with an archaeological resource or cultural item. Information concerning the nature and specific location of a paleontological resource may generally not be disclosed to the public (16 USC 470aaa8).

3.2.1. MMPO Area and Selected Land

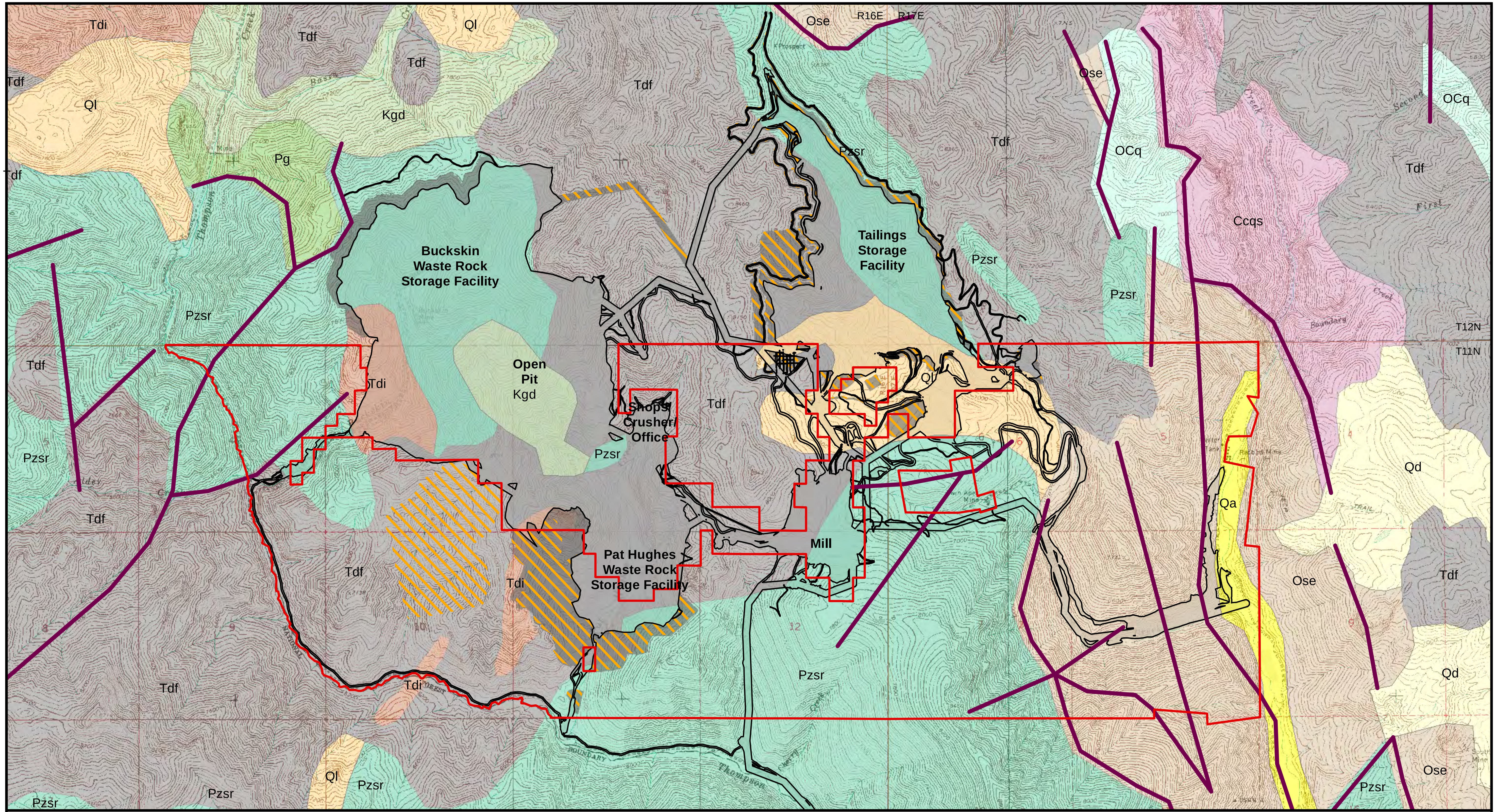
3.2.1.1. Geology

The surficial geology of the analysis area, mapped by Fisher et al. (1992) and Fisher and Johnson (1995), comprises a basement of Paleozoic sedimentary, metasedimentary, and metamorphic rocks (Figure 3.2-1). These rocks were intruded by the Cretaceous Idaho Batholith, and then during the Eocene both of these rock packages were intruded and unconformably overlain by the Challis Volcanic Group. Finally, these rocks were locally overlain by Tertiary and Quaternary deposits of colluvium (gravity deposited, e.g., talus) and alluvium (water deposited, e.g., stream gravel). The early to middle Cretaceous granitic rocks of the Idaho Batholith (Skipp 1987) and/or other Cretaceous granitic plutons (Kiilsgaard and Lewis 1985) cut through most of the thrust plates. These intrusions caused an uplift which resulted in further deformation (VTN 1980b) and were the source of the Thompson Creek molybdenite (MoS_2) deposit.

In general, the regional structure can be characterized by 1) a northeast-trending system of grabens and numerous sub-parallel, high-angle faults, fracture system, and dike swarms; 2) a system of high angle faults trending to the north and northwest; 3) caldera and collapse features associated with the Challis Volcanic Group; and 4) numerous thrust faults in the Paleozoic formations (Fisher 1985, Hobbs 1985, McIntyre et al. 1982).

The thickness of the basement rocks exceeds 37,000 feet in the region (Ekren 1985, Ruppel 1982, Tysdal 2002). The Lost River thrust plate is more than 16,000 feet thick (Skipp 1985). The Precambrian and Paleozoic basement surface, is unconformably overlain by up to 5,000 feet of the Challis Volcanic Group, and has a relief of more than 2,000 feet due to weathering and structural deformation (Siems et al. 1978, Ekren 1985, Hobbs et al. 1991, Sanford 2005, Gardner 2008). The unconformity represents approximately 240 million years ago during which time the Thompson Creek intrusive complex became exposed as an erosional window (Hall et al. 1984).

[2] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.



Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Geologic data from digital geology from Fisher and Johnson supplied by Ken Gardner of BLM.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

Geology

- Qa, Alluvium undivided
- Qd, Quaternary deposits undivided
- Ql, Landslide and related deposits
- Ccqs, Quartzite shale and carbonate rocks of the Squaw Creek area
- Kgd, Biotite granodiorite
- OCq, Quartzite
- Ose, Saturday Mountain Formation Kinnikinic Quartzite and Ella Dolomite undivided
- Pg, Grand Prize Formation
- Pzsr, Salmon River assemblage
- Tdf, Dacitic and rhyodacitic lava
- Tdi, Dikes and plugs of intermediate composition
- Fault

N

1:32,000

0 — 1 Miles

0 — 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.2-1
Surficial geology of the mine and selected land
Thompson Creek Mine EIS

Ore deposits in the region developed during the Paleozoic, Cretaceous (Idaho batholith, Thompson Creek deposit), and Tertiary (Challis Volcanic Group). The Thompson Creek deposit is part of a magmatic intrusive emplaced during late Mesozoic-Tertiary time in western North American from California to Alaska, which hosts many substantial molybdenite stockwork deposits (Theodore and Menzie 1984).

The Thompson Creek stock is elongate from northwest to southeast and is at least 1.5 miles long and approximately 0.6 miles wide (Hall et al. 1984, Hall 1995). The ore body lies in both biotite granodiorite and quartz monzonite, and is approximately concordant with their contact. Molybdenite is strictly confined to a stockwork within the intrusive complex. The mineable ore body (> 0.02 % molybdenum) is 4,500 feet long, 1,900 feet wide, and 2,200 feet thick (Hall et al. 1984, Marek and Lechner 2011). The highest ore grades are at the crest of the quartz monzonite, and the ore grade decreases outward (Figure 3.2-2., Figure 3.2-3). The molybdenite generally occurs as stringers along the margins of narrow quartz veins and veinlets which cut the skarn (i.e., calc-silicate altered argillite) (Schmidt et al. 1991) ("metasediments" in Figure 3.2-2). Silicification and pyrite occur within both host rocks and the intrusive stock. Sulfide minerals other than molybdenite and pyrite are scarce.

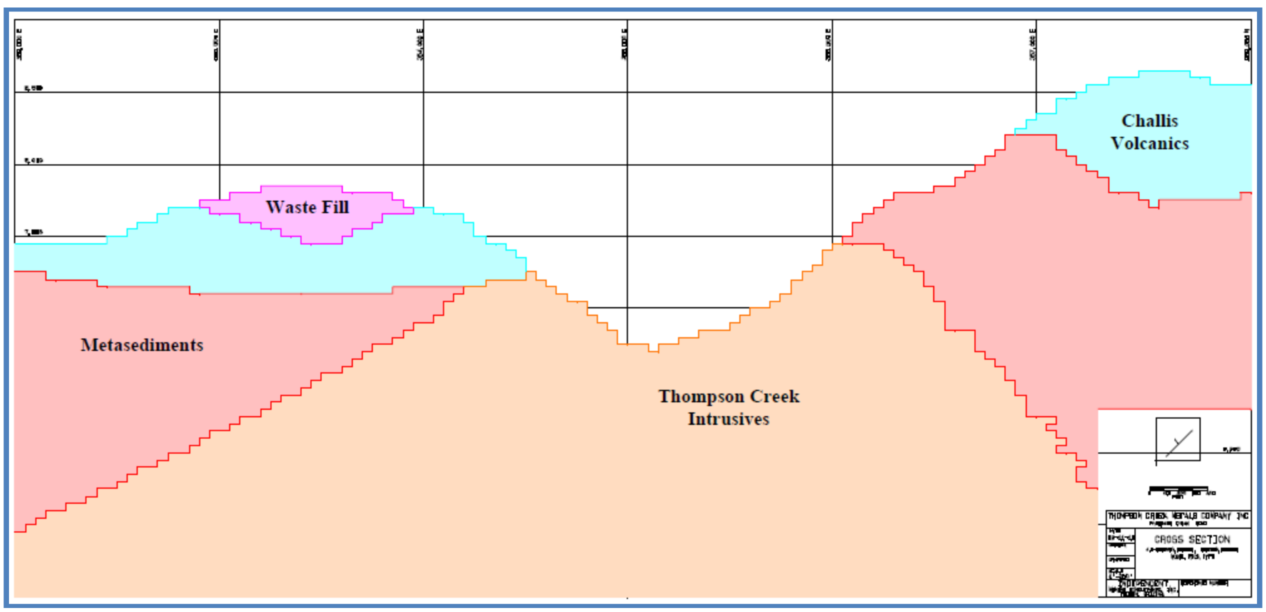


Figure 3.2-2. Cross-section through open pit, view to northwest.
grid spacing = 1,000 feet horizontal, 500 feet vertical (Marek and Lechner 2011)

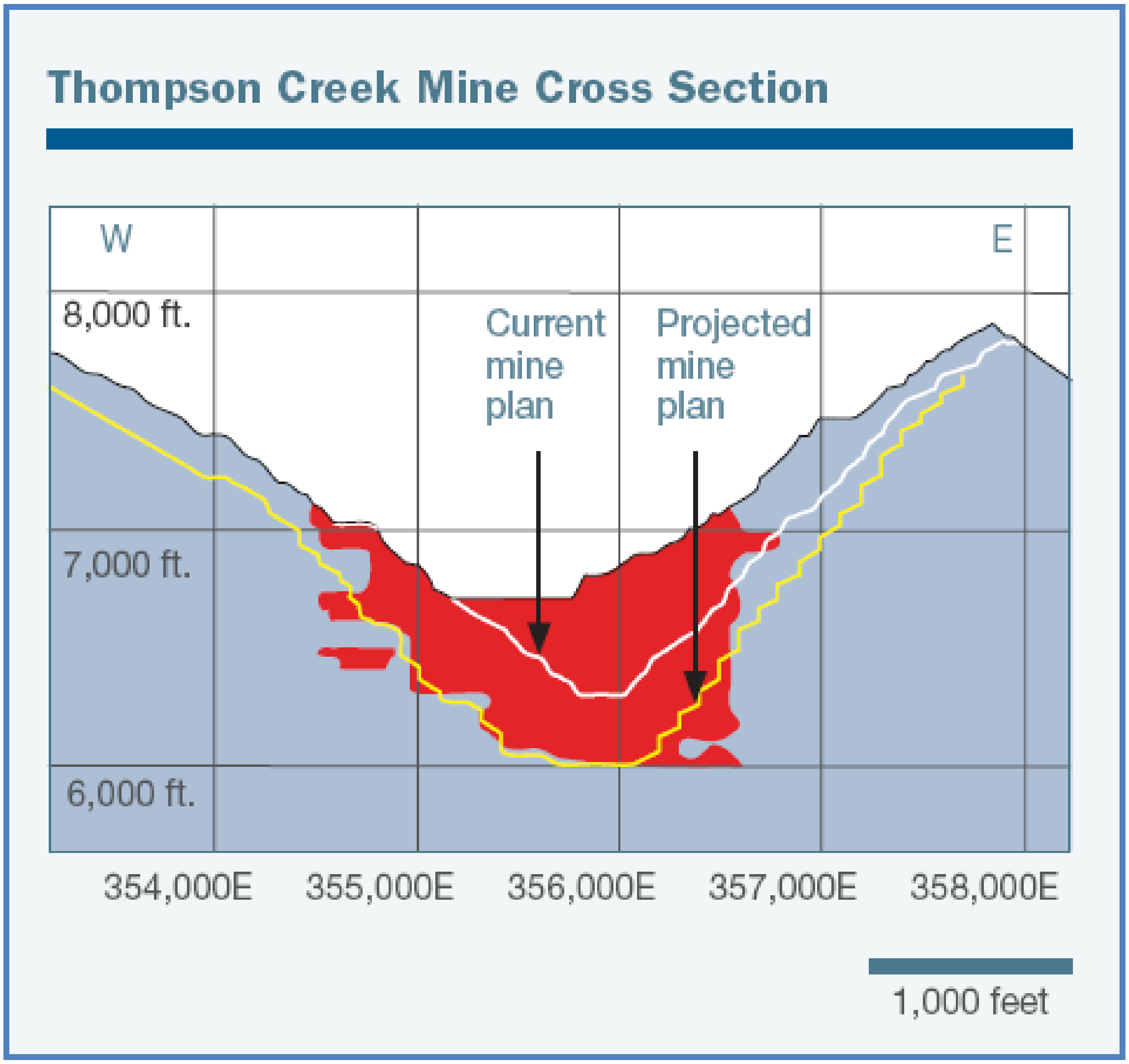


Figure 3.2-3. Schematic cross-section, Thompson Creek molybdenum ore body.
Note that "Current mine plan" is actually the pre-2010 plan (Phase 7) and "Projected mine plan" is the MMPO (Phase 8) (Blue Pearl 2006).

3.2.1.2. Minerals

The Federal Government classifies all minerals as either salable, leasable, or locatable. Salable minerals include common varieties of clay, sand, stone, gravel, cinders, pumice, pumicite, or cinders, i.e., minerals that are generally abundant with low unit value (e.g., $/ton) and ordinary uses. Leasable minerals include coal, phosphate, silicate, or nitrate minerals of potassium and sodium; sulfur in Louisiana and New Mexico; sulfate, carbonate, borate, chloride, oil, oil shale, native asphalt, solid and semi-solid bitumen, bituminous rock, gas, all minerals on the Outer Continental Shelf, and geothermal resources and associated by-products. Locatable minerals are those minerals that are not saleable or leasable, e.g., base and precious metals, gems and semi-precious stones, and certain industrial minerals. Molybdenum is a locatable mineral and is therefore mined on Federal land under the General Mining Laws without purchase or lease from the Federal Government. Any portions of the selected land disposed of by the US would comprise both the surface and mineral estate, i.e., the US would not reserve any mineral rights (and mining claims could no longer be located) on such selected land.

The ore deposit originally contained 193 million tons with an average grade of 0.112 percent molybdenum in 1980 (VTN 1980b), at a cutoff grade of 0.05 percent molybdenum (Schmidt 1991). The reserves in 2006 were 71.1 million tons with an average grade of 0.119 percent molybdenum. The measured and indicated resources were 196.7 million tons with an average grade of 0.094 percent molybdenum, and the inferred resources are 38.0 million tons with an average grade of 0.066 percent molybdenum (Blue Pearl 2006). Subsequent geologic and engineering work increased the proven and probable reserves in 2011 to 150.5 million tons with an average grade of 0.080 percent molybdenum at a cutoff grade of 0.030 percent molybdenum (Marek and Lechner 2011).

The mill can process as much as 31,000 tons per day of ore (Platts 2007) depending on the hardness of the ore, but was designed to process an average of 25,000 tons per day for an annual production of 15 to 20 million pounds of molybdenum in the form of a 90 percent molybdenite concentrate (Neumann and Gibson 1984, VTN 1980b). The mine began production in 1983, and continuously operated until 1992 when low molybdenum prices resulted in a shutdown during 1993. Operations resumed in March 1994 and production has continued uninterrupted since, but with slowdowns during some years due to low molybdenum prices. The mine has produced 388.3 million pounds of molybdenum through 2012, with a record annual production of 25.3 million pounds of molybdenum in 2010.

The majority of the molybdenum concentrates produced by the mill are shipped to a roasting facility in Langeloth, Pennsylvania where approximately 75 percent of the molybdenite is converted to “technical molybdenum” powder or briquettes of molybdenum trioxide (MoO_3) and the remainder is converted to ferromolybdenum. These products are sold to various customers primarily for high-end, metallurgical applications such as specialty (e.g., high temperature and high corrosion resistance) steel production (Finch 2007, IMOA 2007). Since 1989 (Minarik and Gillerman 1990) about 10 percent of the molybdenum concentrates are further purified and size classified at the mill to produce high performance molybdenum solid lubricants. The molybdenite in these lubricants can withstand high temperatures (> 212 °F) unlike petroleum-based fluid lubricants. These molybdenum lubricants typically work well up to 750 °F, or as high as 1,300 °F in dry, oxygen-free environments. The molybdenum lubricants also work well at high pressures (e.g., 50,000 psi) and, unlike graphite, work well in high vacuum conditions (Noria Corporation 2006).

The analysis area is in the southwest portion of the Bayhorse Mining District, which has been explored extensively since 1864. The mineral potential of the selected land was evaluated in detail by Gardner (2008). The mineral potential of the mine site would be the same apart from the known mineral value of molybdenum, all of which is on private land owned by TCMC. The following salable minerals occur on the selected land: fill, building stone, decorative rock, and construction aggregate (sand-size through riprap). The land has high potential for a variety of additional salable minerals. However, the salable mineral value of the land is nominal, with little probability of any large-scale (e.g., 1,000,000 cubic yards) development for salable minerals in the foreseeable future (Gardner 2008).

The analysis area also contains scattered occurrences of calcite, pyrite, and varieties of quartz such as chalcedony, jasper, and opal. These minerals occur primarily in units of the Challis Volcanic Group, but also may occur in most any of the other rock types at the mine and selected land. These minerals are of general “rock hounding” interest, and some of the varieties of quartz (e.g., banded chalcedony “agate”) in the region are of jewelry quality. However, these minerals occur typically as individual fragments a few inches or less in diameter scattered in alluvium, and no deposits of any size (e.g., hundreds of pounds) or of high-quality collection value are known in the locality (Gardner 2008).

There are no known leasable minerals within the analysis area, but the land is prospectively valuable for geothermal resources (high potential), and has low to no potential for all other leasable minerals. However, the potential value of geothermal resources within the analysis area is relatively small. In addition, most of the lands in the region are prospectively valuable for geothermal resources. Therefore, the probability of exploration and development of geothermal resources at the subject land in the foreseeable future is remote, and there is no known leasable mineral value of the land (Gardner 2008).

There are no known locatable minerals at the selected land, but the land has moderate to high potential for the following locatable minerals: antimony, copper, gold, lead, molybdenum, silver, tin, tungsten, vanadium, and zinc (Fisher and Johnson 1995, Gardner 2008). The exploration potential of the selected land for locatable minerals (e.g., 5,140 acres in the Bayhorse mining district) is such that, if the land were privately owned, one or two companies could seek a lease in the foreseeable future to explore, with an option to extract discovered minerals. However, the value of such a lease would be approximately $10,000. Each year TCMC pays approximately $60,000 to the BLM to maintain approximately 500 lode, placer, and millsite mining claims on the selected land. The claims are maintained to provide support areas for the mine (millsite claims) or to prevent nuisance activities from affecting the mine operations. Therefore, the value of such claims is not derived from underlying geologic formations and the claims have no known mineral value. Consequently, the locatable mineral value is considered nominal. Despite the high potential of the land for some minerals, the land has no known mineral values and the potential for mineral discovery would not warrant exploration by the BLM as part of any land disposal action (Gardner 2008).

3.2.1.3. Physiography

The analysis area is in the southern portion of the Northern Rocky Mountains Physiographic Province. The province comprises northeastern Washington, western Montana, northern and central Idaho, and is composed of rugged mountains except for a region of basin-and-range (fault-block), structural overprinting beginning approximately 20 miles east of the mine with the Lost River Valley and the Lost River Mountains. Each physiographic province is a region in which all parts are similar in geologic structure and climate, and whose pattern of relief features or landforms differs substantially from that of adjacent regions.

The analysis area is in the southeastern portion of the East Salmon River Mountains with the White Cloud Peaks to the south on the south side of the Salmon River. The locality consists of rugged mountains deeply dissected by numerous, steep-sided valleys and canyons. Tributaries to the Salmon River have incised dendritic drainage patterns that generally trend north to south and east to west. The topography is extremely rugged and steep (e.g., slopes up to 75 % in places) with all aspects represented but no aspect dominant. There are abundant bedrock outcrops, narrow ridges, and deep, V-shaped valleys, and the ridges are capped by resistant volcanic rocks. Cliffs and rock towers are abundant on the drier and steeper hillsides.

Elevations in the MMPO area range from 5,780 feet at the confluence of Bruno and S. creeks to 9,282 feet at the top of the Buckskin drainage. Elevations at the selected land range from 5,750 feet on S. Creek at the southeast corner of the land to 8,460 feet along a northwest-trending ridge east of Cherry Creek at the south edge of the land.

3.2.1.4. Geotechnical Issues

The geotechnical issues for this DEIS are limited to the stability of mine structures such as fuel storage tanks, buildings, pit walls, the WRSFs, and TSF. Therefore, seismicity is discussed for only the MMPO area and not the selected or offered lands. In addition, only earthquake seismicity is discussed for the MMPO area because blasting has occurred regularly at the mine since 1980 with no damage to any mine structures (and no other structures are near the blasting areas, i.e., the pit).

The MMPO area is in the Central Idaho Seismic Zone (aka Centennial Tectonic Belt). The zone contains high levels of earthquake activity and at least six major faults, including the Lost River and Sawtooth faults in the region of the mine (IBHS 2009). There are also many smaller faults in the region, although most are no longer active. There have been 674 earthquakes (of ≥ Richter magnitude [RM] 3.0) in the region since 1973 (Table 3.2-1). The majority of the earthquake epicenters were concentrated 20 miles east of the mine in and around Round Valley (Challis) and associated with the Lost River fault. The earthquake with the greatest recorded RM in the region was the Borah Peak earthquake in 1983 with RM 6.9 (Table 3.2-1). The epicenter of the earthquake was 27 miles east-southeast of the mine, and the earthquake had a maximum Mercalli intensity of IX (violent) assigned on the basis of surface faulting (NEIC 2012a). However, the maximum intensity at the mine was an intensity of VI; this intensity is characterized by an earthquake that can be "felt by all" and causes slight damage (IBHS 2009). Due to the distance of the mine from the epicenter, the mine experienced only limited ground shaking and some rocks rolling off the pit walls, with no damage to the WRSFs, TSF, fuel tanks, etc. (Doughty 2010b).

Table 3.2-1. Earthquakes of RM ≥ 3.0 within 100 mile radius of MMPO area.

RM	Number
3.0 to < 4.0	594
4.0 to < 5.0	71
5.0 to < 6.0	8
6.0 to < 7.0	1
≥ 7.0	0

NEIC (2012b); -114.528 longitude; 44.308 latitude; 1973 to 09 April 2012

The earliest site-specific analyses established a maximum credible earthquake of RM 5.5 at the mine (VTN 1980b). More recently, highly detailed and site-specific geotechnical evaluations of the TSF through the end of Phase 8 established a maximum credible earthquake of RM 6.5 (5,000 year return period) generating a peak ground acceleration of 30 percent of gravity near the mine (Golder 2007, KP 2013). These recent evaluations considered both the US Geological Survey (USGS) method of determining earthquake probability and hazard and the site-specific methods by URS (2000), and concluded: 1) the hazard in both methods at all return periods greater than 500 years is dominated by background seismicity and not earthquakes occurring on any proximal faults, and 2) the URS (2000) site-specific estimate of the maximum background earthquake of RM 6.5 is more reasonable than the USGS estimate of a single maximum background earthquake of RM 7.0 for the entire Rocky Mountain region (Peterson et al. 2008). Similar rigorous geotechnical evaluations of the WRSFs used the same seismic values (BGC 2011, KP 2011a). In addition, geotechnical evaluations of the pit walls, including through Phase 8, were also recently completed (CNI 2011, KP 2011b).

3.2.1.5. Paleontological Resources

The rocks in the analysis area with the potential to contain meaningful paleontological resources are the Ella Dolomite, Saturday Mountain Formation, and Salmon River Assemblage. The only meaningful paleontological resource known in the analysis area is the graptolite and trilobite assemblage at the mouth of Bruno Creek (AGI 2012, VTN 1980b). The Bruno Creek access road was re-routed to avoid the fossil outcrop during development of the mine in the early 1980s. At that time the outcrop was considered to have potential paleontological value because 1) the fossils were the best preserved in the region, 2) trilobite and graptolite fossils are not commonly found together, and 3) the outcrop might yield additional information on graptolite and trilobite evolutionary history and ecology as well as on the geologic history of the region (VTN 1980b). However, because the site has been collected, studies of the collected fossils have been published, the fossils deposited in the American Museum of Natural History in New York (Churkin 1963), and the outcrop has not been studied in the 50 years since Churkin (1963), there is no longer any need for special protection for the site (Foss 2011).

During the extensive evaluations in the 1970s of cultural resources at the proposed mine site additional fossiliferous sites were located but due to poor preservation were deemed of “little scientific value” (VTN 1980b, p. 5). The entire locality of the mine, including the selected land, was extensively explored by geologists during the 1960s to present times; these exploration reports did not include descriptions of any obviously meaningful fossils (e.g., any vertebrate fossils or any well preserved invertebrate fossils) except for the graptolite and trilobite assemblage described above. No fossils are known to have been exposed during any of the mine operations. No thick ash (tuff) units occur which could host a petrified forest similar to that in the Malm Gulch area located approximately 7 miles to the northeast of the analysis areas. Therefore, the potential of discovering meaningful paleontological resources in the foreseeable future in the Ella Dolomite, Saturday Mountain Formation, or Salmon River Assemblage in the analysis areas is low.

3.2.2. Offered Lands - Broken Wing Ranch

3.2.2.1. Geology

The surficial geology of the Broken Wing Ranch is comprised primarily of Quaternary alluvial deposits with smaller amounts of Quaternary colluvial deposits along the bases of slopes. A large Quaternary landslide deposit occupies some of the eastern margins of the ranch. The western portion of the ranch is underlain by volcaniclastic and sedimentary rocks and mafic lava of the Eocene Challis Volcanic Group, the Ordovician Ramshorn Slate (mostly shale), and Cambrian to Ordovician Quartzite. There are also a number of outcrops of Cambrian to Ordovician Bayhorse Dolomite to the west of the ranch, as well as a variety of faults. A fault is mapped extending south into BWR-1, and another fault is mapped at the southwest corner of the ranch (Fisher and Johnson 1995). The rocks in the locality have outstanding exposure due to abundant cliffs (i.e., differential erosion due to the varied rock types) and sparse vegetation.

3.2.2.2. Minerals

Any portions of the Broken Wing Ranch acquired by the US would comprise both the surface and mineral estates. If acquired by exchange, the mineral estate would become open to mineral entry 90 days following acceptance of title by the US pursuant to 43 CFR 2201.9(b). However, due to the only nominal known mineral value of the ranch and the BLM management goals for the ranch, the BLM might acquire the mineral estate by donation from TCMC. The mineral estate in such case would become open to mineral entry only if the BLM were to publish an order in the Federal Register opening the estate to mineral entry, and the BLM would not intend to publish such an order in the foreseeable future. The bed of the Salmon River up to the ordinary high water mark is owned by the State of Idaho. The ranch is at the western edge of the Bayhorse Mining District.

Salable minerals occur on the ranch including fill, building stone, decorative rock (including river rock), and construction aggregate (sand-size through riprap). Quartzite talus has been sold in the past from below a cliff in the southwest area of the ranch. The talus was sold for $10 per ton and was used as building stone and decorative rock. There is approximately 50,000 tons of quartzite talus remaining at the site but the market for this material is likely less than 50 tons per year (Gardner 2012a). The larger (> 3 feet in diameter) quartzite blocks could be sold for approximately $5 to $15 per ton for riprap, but blocks of this size are limited. The values of other salable minerals at the ranch would be approximately $1 per cubic yard. In general, the salable mineral value of the land is nominal, and there is little probability of any large-scale (e.g., 1,000,000 cubic yards) development of the land for salable minerals in the foreseeable future. The land also likely contains scattered occurrences of small quantities of calcite, pyrite, and varieties of quartz such as chalcedony, jasper, and opal of general “rock hounding” interest (Gardner 2012a).

The ranch is prospectively valuable for geothermal resources (high potential), and has low to no potential for all other leasable minerals. However, the potential value of geothermal resources is relatively small. In addition, most of the lands in the region are prospectively valuable for geothermal resources. Therefore, the probability of exploration and development of geothermal resources at the ranch in the foreseeable future is remote, and there is no known leasable mineral value (apart from nominal lease rates of $40/acre) (Gardner 2012a).

There is low to no potential for all plausible locatable mineral deposits on the Broken Wing Ranch (Fisher and Johnson 1995). In addition, the locality has been extensively explored such that any mineral deposit exposed at the surface has been prospected. There is no known locatable mineral value at the ranch, and the probability of discovering a valuable locatable mineral deposit is remote (Gardner 2012a).

3.2.2.3. Physiography

The Broken Wing Ranch is in the Northern Rocky Mountain Physiographic Province. However, in contrast to the rugged land of the mine and selected land in the East Salmon River Mountains, the ranch primarily occupies a narrow swath of land on the valley floor at the margin of the East Salmon River Mountains to the east, and the Boulder Mountains to the west. The ranch is approximately 3 miles in length, aligned generally north to south, and straddles the Salmon River. Elevations at the ranch range from 5,260 feet along the Salmon River at the north end of the ranch, to 6,200 feet at the southwest corner of BWR-1, with most of the ranch at an elevation of approximately 5,300 feet. The majority of the ranch is relatively flat, river bottom land. However, portions of the western area of the ranch are in foothills to the East Salmon River Mountains. These portions of the ranch are steep (e.g., slopes up to 75 %) with dominantly eastern aspects, and some northern and southern aspects along Lyon Creek.

3.2.2.4. Paleontological Resources

The only fossiliferous formation at the ranch is the Ordovician Ramshorn Slate. A small area of the Ramshorn Slate (mostly shale) occurs at the westernmost portion of BWR-1. In other areas the formation has produced crustaceans, graptolites, and sponge spicules (Digital Atlas of Idaho 2012). The most probable paleontological resources to be discovered at the ranch would be invertebrate plant fossils and petrified wood in the Eocene volcaniclastic and sedimentary rocks. However, no paleontological resources are known at the ranch and the probability that any meaningful paleontological resources would be discovered at the ranch in the foreseeable future is low.

3.2.3. Offered Lands - Garden Creek Property

3.2.3.1. Geology

The northern two-thirds of the property are overlain by large angular blocks of Quaternary talus at the base of cliffs and steep hillsides. The talus appears to overlie one or more members of the Late Proterozoic Pocatello Formation. The southwest portion of the property comprises the undifferentiated Miocene to Pliocene Salt Lake Formation. The southeast corner of the property comprises undifferentiated Middle Cambrian Blacksmith and Bancroft limestones (Platt 1998). There are no major faults mapped within 3 miles of the property (Bond and Wood 1978).

3.2.3.2. Minerals

Any portion of the Garden Creek property acquired by the US would comprise both the surface and mineral estates. The status of the mineral estate would be the same as that of the Broken Wing Ranch, i.e., open to mineral entry 90 days following acceptance of title by the US in a land exchange or closed to mineral entry if the mineral estate were acquired as a donation (Section 3.2.2.2). The property is near the southwest margin of the district known historically for copper and gold. The Fort Hall Mining District has been explored extensively and has numerous prospects, two mines (Marsh Queen and Moonlight) with limited production, and several rock quarries. The property is not in any known oil shale, tar sand, or coal field; is not in any favorable exploration areas of the Western Phosphate Field; and is not in any known geothermal resource area or mineral development interest area.

The property has not been evaluated in detail for mineral potential, but likely has salable minerals suitable for fill or construction aggregate (Gardner 2012a). However, the isolated location of the property and the probable nominal value of such minerals preclude their development, i.e., the property probably has no known salable mineral value. The probability of exploration and development of geothermal or oil and gas resources at the property in the foreseeable future is low, and there is likely no known leasable mineral value at the land (apart from nominal lease rates of $40/acre) (Gardner 2012a). The property might have greater than low potential for some of the metals and industrial minerals (e.g., aluminum clay and silica) known in the Fort Hall Mining District, but probably has no known locatable mineral value. The probability of discovering a valuable locatable mineral deposit at the property is remote (Gardner 2012a).

3.2.3.3. Physiography

The Garden Creek property is in the northeastern portion of the Basin and Range Physiographic Province (Great Basin Section), bounded by the Columbia Plateau Physiographic Province (Snake River Plain Section) to the north, and the Middle Rocky Mountains Physiographic Province (Middle Rocky Mountains Section) to the east. The property is in the northern portion of the Bannock Range in an area of rolling hills. Elevations at the property range from 6,765 feet on the northwest boundary to 7,135 feet at the southeast corner, and the topography slopes overall to the west at 15 to 35 degrees.

3.2.3.4. Paleontological Resources

The only fossiliferous formation at the property is the Miocene to Pliocene Salt Lake Formation, of which some members have yielded rare vertebrate and invertebrate fossils which have been extensively studied since at least the 1940s (Digital Atlas of Idaho 2012). No paleontological resources are known at the property (AGI 2012), and there is a very low potential of discovering meaningful paleontological resources at the property.

3.3. Soil Resources

The analysis area for soil resources for the MMPO alternatives is the surface disturbance associated with the MMPO alternatives. The analysis area for the land disposal alternatives is the selected and offered lands.

3.3.1. MMPO Area and Selected Land

The analysis area is characterized by moderate (20 to 40 %) to very steep (40 to 80 %) slopes, dissected mountain slopes with vegetation ranging from forest, mixed forest, and grassland to bare slopes and rock outcrops. Limited soil occurs on upland benches (5 to 20 % slopes). Mountain and hillside soils are formed in weathered residuum and mixed colluvium, derived mostly from rocks of the Challis Volcanic Group, and to a lesser extent, Paleozoic sedimentary rocks. Soil along some minor and major drainages in the analysis area is formed in mixed alluvium.

Soil on the moderate to steep slopes, as well as slopes with northern aspects, tends to be somewhat deeper and support more coniferous vegetation, relative to soil on the steepest slopes and those with other aspects. Overall, soil depths range from very shallow to very deep, with shallow soil associated with bedrock outcrops and rock rubble. The fine fraction of surface soil horizons has textures between silt loam to sandy loam. Subsoil textures range between sandy clay loams and loamy sands. The content of coarse fragments, consisting of weathered bedrock, colluvium and/or alluvium, ranges between approximately 10 to 80 percent, with many soils, particularly those on steeper slopes, having greater than 40 percent coarse fragments throughout the soil profile. Soil series textures are mostly loamy-skeletal with some minor clayey-skeletal soils. These textures, in conjunction with moderately steep to very steep topography, result in well drained soils with a moderate to severe potential for water erosion across the analysis area.

3.3.1.1. MMPO Area

A Cryoll-Rubble Land-Rock Outcrop complex is the predominant soil map unit associated with the potential expansion areas of the Pat Hughes and No Name (Alternative M3 only) WRSFs (Figure 3.3-1). A similar Forest Service mapped soil (VF21) comprises the majority of the proposed expansion area of the Buckskin WRSF. These two map units typify the characteristics of soils found on the steeper slopes. The soils are shallow to moderately deep, often adjacent to bedrock and/or talus slopes, well-drained, and have a high to severe erosion potential.

The Ezbin-Zeebar-Nielsen complex also occurs in the southeast portion of the potential expansion area of the Pat Hughes WRSF. These soils have a loamy-skeletal texture and share a similar physiographic position with the Lag Very Cobbly loam soils, but occur on somewhat gentler slopes. Ezbin-Zeebar-Nielsen soils are very deep to shallow (Nielsen soil), well drained, and have a moderate potential for water erosion.

The Klug, Low Precipitation-Povey complex occurs on steep, dry, bare- to grass-covered slopes with a southerly aspect in the potential expansion areas of the Pat Hughes and No Name WRSFs. These soils are very deep and well drained with loamy-skeletal texture and severe potential for water erosion.

The Lemco-Friedman complex is south of the TSF on moderate to steep slopes. These soils are on slopes of varying aspect and forest cover. The soils have a clayey-skeletal texture, are very deep, well drained, and have a moderate potential for water erosion.

Soils on the east side of the TSF (Map Units V26 and V28) are similar to the soils of the Cryoll-Rubble Land-Rock Outcrop complex described above. Soils on the west side of the facility (VF43) are moderately deep to deep with a loamy-skeletal texture. The majority of the area along the western side of the facility comprises steep, easterly facing slopes similar to the physiographic setting of soils of the Ketchum complex, mapped southwest of the facility by the Natural Resources Conservation Service (NRCS). These soils are deep, have a loamy-skeletal texture, and are well drained with moderate potential for water erosion.

Soils in the proposed power line corridor (VF43, VF31, and VF03) occur on steep slopes, have a loamy-skeletal texture and range in depth from shallow to deep. The soils have a moderate to severe potential for water erosion. There are no mapped prime farmland or soil units classified as hydric soils in the MMPO area.

Soil for reclamation of the TSF would be excavated from a borrow pit just west of the TSF, and from a borrow pit southwest of the TSF embankment. Both areas contain very deep, clayey-skeletal soils of Lemco-Freidman complex. Soil and alluvial material (~ 8.5 acres) would also be salvaged for reclamation from the Pat Hughes WRSF as part of the construction of the underdrain for the facility.

3.3.1.2. Selected Land

A substantial portion of the selected land comprises the Cryoll-Rubble Land Outcrop complex (1,978 acres), Lemco-Friedman complex (806 acres), Lag Very Cobbly loam (739 acres), and Klug, Low Precipitation-Povey complex (546 acres). Smaller portions of the land are composed of soils of the Ketchum complex and Ezbin-Zeebar-Nielsen complex (Section 3.3.1.1.).

Rock-Outcrop and Rubble Land and a Cryept-Rubble Land-Rock Outcrop complex comprise 207 acres of the selected land. These units are similar to the Cryoll-Rubble Land Outcrop complex, occur on very steep slopes, are shallow to moderately deep, well drained, and have a severe potential for water erosion.

The Gany gravelly loam occurs on moderately steep to steep forested slopes with a northerly aspect in the eastern portion of the selected land. This soil is formed in colluvium derived from limestone and consequently the pH of the subsoil is alkaline. The soil is very deep, well drained, and has a moderate potential for water erosion. Together with the Lag Very Cobbly loams, these soils comprise 379 acres of the selected land.

Parkay-Nurkey complex soils occur on dry, bare to grass-covered slopes with a western aspect on the east side of S. Creek. These soils have a loamy-skeletal texture, are very deep, well-drained, and have a moderate potential for water erosion. They comprise 33 acres of the selected land.

Soil complexes consisting of members of the Biglost, Copperbasin, and Wiskisprings series occur on the flat to gently sloping floodplain of S. Creek near the eastern border of the selected land. These soils formed in mixed alluvium and have silt loam to gravelly sandy loam texture. These soils are very deep, poorly to moderately well drained with low run-off, and a slight potential for water erosion. These soils comprise 77 acres of the selected land. There is no mapped prime farmland on the selected land. The Wiskisprings-Biglost and Wiskisprings-Biglost-Copperbasin complexes are classified as hydric soils.

3.3.2. Offered Lands – Broken Wing Ranch

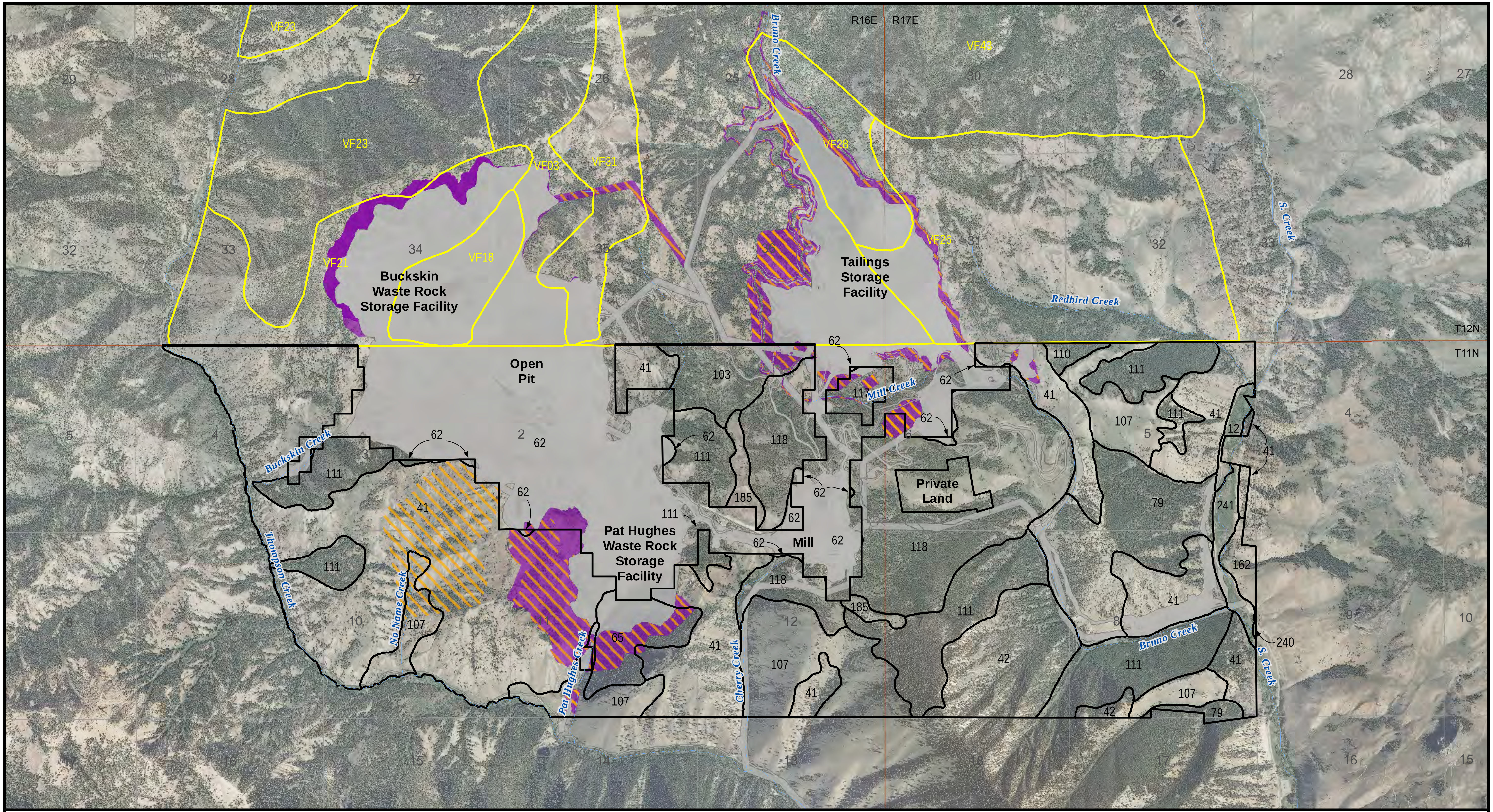
The Broken Wing Ranch is characterized by flat to gentle slopes associated with the Salmon River floodplain and alluvial fan terraces that rise rapidly to steep, dissected hills to the east and west. Floodplain and fan terrace soils are utilized for irrigated and non-irrigated production of grass and alfalfa. The steeper slopes are dry and bare or a mixture of grass and sagebrush. Soil on the floodplains is relatively organic-rich, productive mollisols, or seasonally wet, poorly-drained aquepts and aquents. Soils at the ranch are mapped at a soil complex and soil association level (Figure 3.3-2). Parent material consists of mixed alluvium, colluvium, and residuum derived from the rocks of the Challis Volcanic Group and to a lesser extent Paleozoic sedimentary rocks to the west.

Soil at the ranch is most readily discussed by landform and physiographic position, as these factors, in conjunction with parent material, control soil development to a large extent. Floodplain and stream terrace soils (floodplain soils) were developed in mixed alluvium and colluvium, are very deep, and range in texture from silt loam to sandy loams, typically with a high gravel content in the subsoil. These soils are classified as fine-loamy to sandy-skeletal, are poorly to somewhat poorly drained, and have a slight potential for water erosion. Most of the area along Lyon Creek (52 acres) consists of Cryaquepts (moderately developed, seasonally wet soils). A large portion of the soil along the Salmon River (68 acres) is seasonally wet, carbonate-rich Calcic Cryaquolls and Aquic Haplocalcids of the Bigrant-Thosand-Dickeypeak complex. Minor soil types on floodplains (0 to 3 % slopes) generally have similar characteristics to those described above.

Soils on the gently sloping fan terraces is formed in mixed alluvium and colluvium deposited by tributary streams adjacent to the Salmon River floodplain, including Sink, Birch, Lyon and Unnamed creeks. These soils are very deep with a somewhat coarser texture than the floodplain soils, ranging from sandy clay loams to loams with high coarse fragment subsoil horizons. Texture classes range from fine-loamy to loamy-skeletal. Some subsoil horizons are alkaline. These soils (on 385 acres of the ranch) are typically well-drained and have a slight potential for water erosion due to their gentle slopes. The dry, well-drained, carbonate-rich nature of soils on the fan terraces are typified by the three largest mapped soil units including Xeric Haplargids and Xeric Calciargids of the Pedoli-Dawtonia association (198 acres), the Whiteknob gravelly loam (71 acres), and the Sparmo-Zer complex (Xeric Haplocalcids). Minor soil types on fan terraces (1 to 8 % slopes) generally have similar characteristics to those described above.

Soils on the steeper hillsides and ridge tops on the ranch formed in mixed colluvium and residuum derived primarily from the Challis Volcanic Group rocks and ash. These soils (on 288 acres of the ranch) are well-drained and soil depths range from very shallow on the steepest slopes to deep on somewhat gentler slopes. Soil textures range from clay loam to sandy loam with a high coarse fragment content (loamy skeletal). Water erosion potential ranges from moderate to severe. A complex of talus, rock outcrops, and dry carbonate-rich soils (calcids) comprises approximately half (138 acres) of the soils on the ranch. The clayey-skeletal Haplargids of the Penagul-Rosebriar complex (51 acres) and ashy-skeletal Haplocalcids of the Gradco-Farvant complex (38 acres) are representative of soils on the ranch. Other soils in this landscape position on the ranch share similar physical characteristics as those described above. There is no mapped prime farmland on the ranch, but hydric soil series at the ranch include Typic Cryaquents and series members of the Aquent-Riverwash, Cowbone-Tohobit, Fezip-Lemroi-Redfish and Wiskisprings-Biglost complexes.

Erosion rates from conventionally plowed agricultural fields (≈ 5 tons/acre/year) average 1 to 2 orders of magnitude greater than rates of erosion under natural vegetation (Montgomery 2007).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Forest Service landtypes
- NRCS soils

Map Unit	Soil Name
12, Biglost-Copperbasin complex, 0-4% slopes	
41, Cryolls-Rubble Land-Rock Outcrop complex, 50-80% slopes	
42, Cryepts-Rubble Land-Rock Outcrop complex, 50-80% slopes	
62, Dumps, Mine	
65, Ezbin-Zeebar-Nielsen complex, 20-50% slopes	
79, Gany gravelly loam, 30-60% slopes	
103, Ketchum complex, 20-50% slopes	
107, Klug, Low Precipitation-Povey complex, 25-60% slopes	
110, Lag very cobbly loam, 20-40% slopes	
111, Lag very cobbly loam, 40-70% slopes	
118, Lemco-Friedman complex, 20-50% slopes	
162, Parkay-Nurkey complex, 20-50% slopes	
185, Rock Outcrop & Rubble Land, very steep	
240, Wiskisprings-Biglost complex, 0-3% slopes	
241, Wiskisprings-Biglost-Copperbasin complex, 0-3% slopes	

NOTE: Map Unit designations were manually changed to correspond with Unit designations listed in NRCS Physical Soil Properties report dated 01/29/2008 as needed.

Map Unit	Landtype
VF03, Steep Headlands -Timbered; Moderately Deep-Loamy-Skeletal Soils, 46-66% slopes	
VF21, Moderately Dissected Mountain Slopelands; Shallow to Moderately Deep-Loamy to Sandy-Skeletal Soils, 30-80% slopes	
VF23, Moderately Dissected Mountain Slopelands-Timbered; Shallow to Deep-Loamy-Skeletal and Sandy-Skeletal Soils, 45-80% slopes	
VF26, Strongly Dissected Mountain Slopelands; Shallow to Deep-Loamy-Skeletal to Sandy-Skeletal Soils; 40-70% slopes	
VF28, Strongly Dissected Mountain Slopelands-Timbered; Moderately Deep to Deep-Loamy to Sandy-Skeletal Soils, 40-65% slopes	
VF31, Fluvial Ridgeland–Rocky; Shallow-Loamy to Loamy-Skeletal Soils, 40-70% slopes	
VF43, Unstable Fluvial Slopes–Timbered; Moderately Deep to Deep-Loamy to Loamy- Skeletal Soils, 21-65% slopes	

Note: VF18 falls withthin the existing disturbance and is no longer applicable.

Soils data from NRCS SSURGO database.
Landtype data from USFS.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

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1:32,000
0 Miles 1
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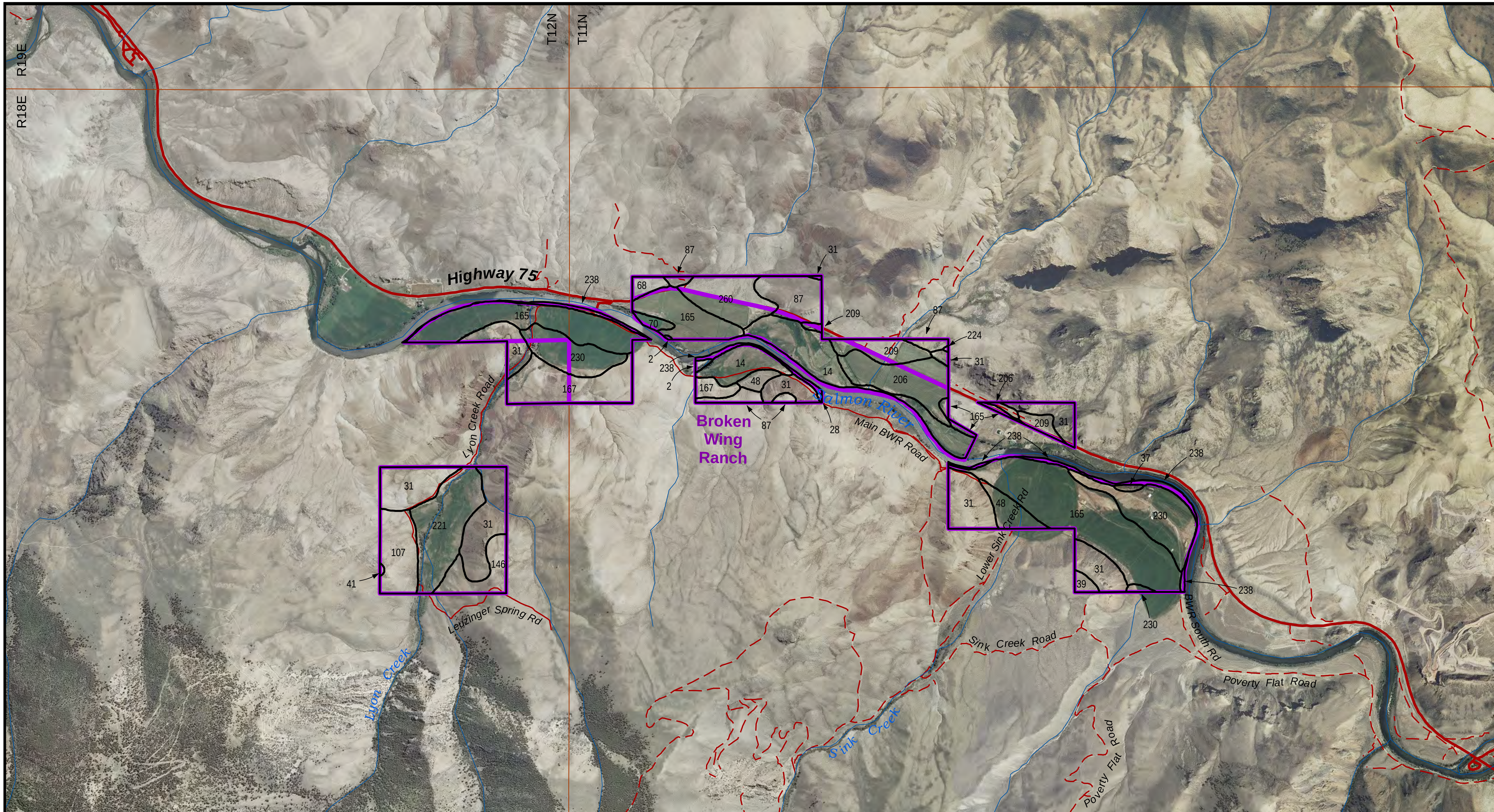
Figure 3.3-1
Soil map, MMPO area and selected land
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- NRCS Soils
- Main Broken Wing Ranch Access
- 2WD road (Highway 75)
- Primitive road
- Stream

Map Unit, Soil Name	Map Unit, Soil Name
2, Aquents-Riverwash complex, nearly level	107, Klug, Low Precipitation-Povey complex, 25-60% slopes
14, Bigrant-Thosand-Dickeypeak complex, 0-4% slopes	146, Nurkey-Dawtonia association, 20-55% slopes
28, Bursteadt-Tohobit complex, 0-3% slopes	165, Pedoli-Dawtonia copmlex, 1-4% slopes
31, Calcids-Rubble Land-Rock Outcrop complex, 50-80% slopes	167, Penagul-Rosebriar complex, 20-60% slopes
37, Cowbone-Tohobit complex, 0-3% slopes	206, Sparmo-Zer complex, 1-5% slopes
39, Cronks-Venum assoication, 6-20% slopes	209, Sprabat-Snowslide complex, 1-8% slopes
41, Cryolls-Rubble Land-Rock Outcrop complex, 50-80% slopes	221, Typic Cryaquepts, 1-3% slopes
48, Dawtonia Gravelly Loam, 4-8% slopes	224, Venum-Rock Outcrop complex, 25-55% slopes
68, Farvant-Badland-Gradco complex, 25-60% slopes	230, Whiteknob Gravelly Loam, 2-8% slopes
70, Fezip-Lemroi-Redfish complex, 0-2% slopes	238, Wiskisprings-Biglost complex, 0-3% slopes
87, Gradco-Farvant complex, 15-30% slopes	260, Zer-Snowslide complex, 5-25% slopes

Soils data from NRCS SSURGO database.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

N

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0 — 4,000 Feet

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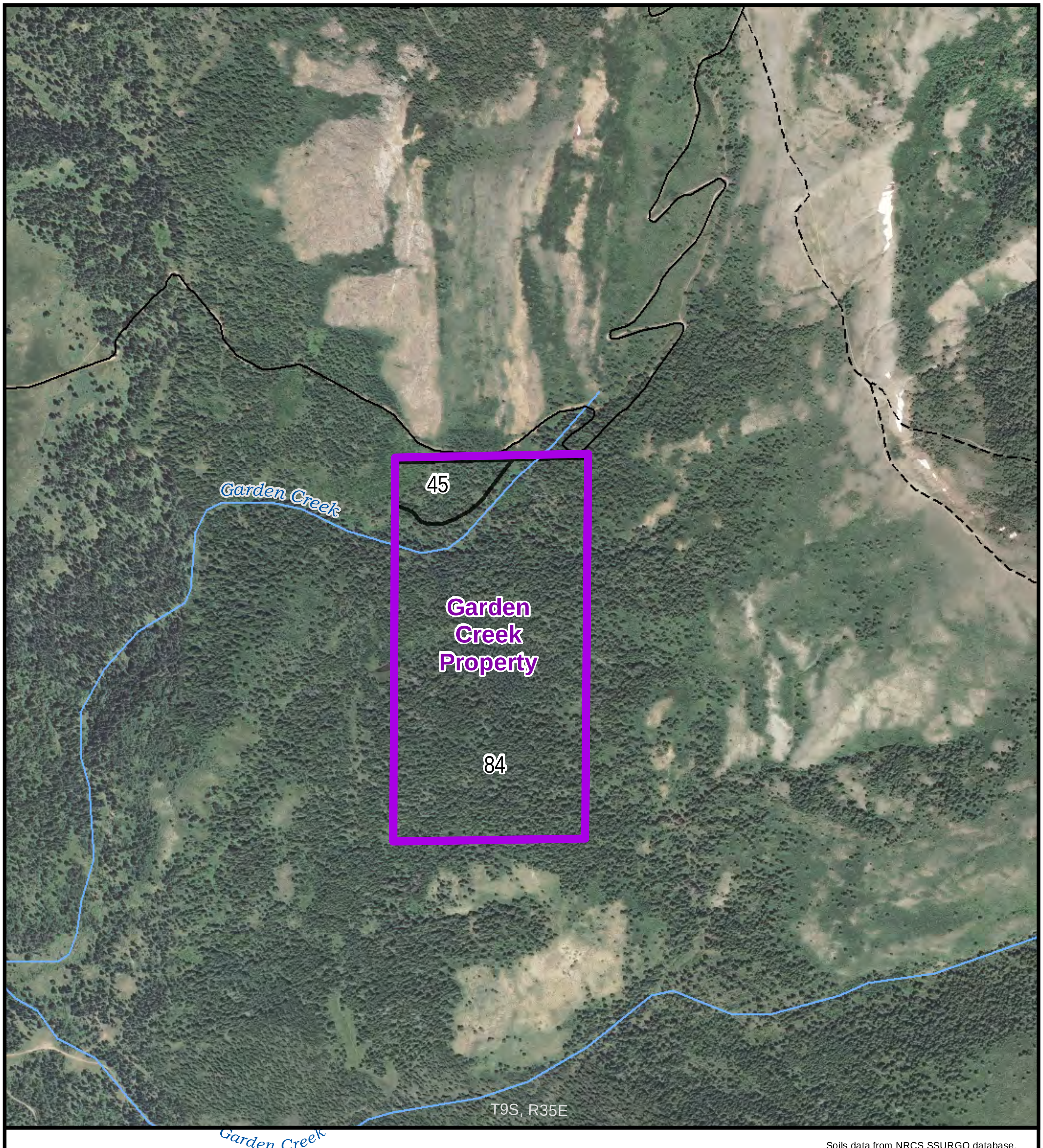
No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.3-2
Soil map, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Offered lands
- Primitive road
- Trail
- Stream

Map Unit	Soil Name
84,	Pavohroo-Sedgway-Toponce complex, 20 to 50 percent slopes
45,	Greys-Pavohroo-Sedgway association, 8 to 20 percent slopes

Soils data from NRCS SSURGO database.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

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Figure 3.3-3
Soil map, Garden Creek property
Thompson Creek Mine EIS

However, erosion rates from the cultivated fields (dense, irrigated grass) at the ranch are relatively low (~ 0.2 tons/acre/year)[3] and would be comparable to typical rates of erosion under natural vegetation for moderate gradient hillslopes of soil-mantled terrain (≈ 0.2 tons/acre/year) (Montgomery 2007). An erosion rate of 0.2 tons per acre per year is an order of magnitude below the typical soil sustainability factors of 2 to 5 tons per acre per year for soils at the ranch (NRCS 2002a).

3.3.3. Offered Lands – Garden Creek Property

Two soil complexes are mapped on the property: the Pavohroo-Sedgway-Toponce complex, found on steeper mountainsides, and the Greys-Pavohroo-Sedgway association, found on mountain footslopes and hillsides (Figure 3.3-3). All of the soils of the two soil complexes are cryoborolls formed in loess, silty alluvium, and/or colluvium derived from loess and/or sedimentary and metasedimentary rocks. Soil textures are gravelly silt loams and silt loams, classified as fine montmorillonitic (clay) to loamy-skeletal. The soils are very deep and well-drained. Run-off is rapid and the potential for water erosion is high to very high. The former comprises 75 acres (94 %) of the property. Dominant vegetation on the site consists of evergreen and mixed evergreen/aspen forest with a small forested riparian corridor. No prime farmland or hydric soil series are mapped on the property, although minor series inclusions of hydric soils may occur along stream terraces (Enochville Silt Loam and Enochville variant gravelly silt loam).

3.4. Vegetation, Forest Resources, and Invasive and Non-native Plants

The analysis area for vegetation, forest resources, and invasive and non-native plants ("weeds") for the MMPO alternatives is the surface disturbance associated with the alternatives. The analysis area for the land disposal alternatives is the selected and offered lands. Special status plant species are also summarized in this section. Special status plant species are those listed as proposed, candidate, threatened, or endangered under the ESA by the US Fish and Wildlife Service (USFWS), or those listed as sensitive by either the BLM or Forest Service. There are no proposed, threatened, or endangered plant species in the analysis area. Whitebark pine (*Pinus albicaulis*) is the only candidate plant species that occurs in the analysis area. There are seven (including whitebark pine) sensitive plant species that occur or have the potential to occur in the analysis areas (Table 3.4-1).

[3] e.g., average slope ≈ 3 %, slope length ≈ 1,000 feet, Pedoli gravelly silt loam 50 %, Custer County precipitation Req_25-28, grass hay, two cuttings, aftermath grazing to 25 % stubble height (RUSLE2 2006)

Table 3.4-1. Presence/absence of special status plant species by jurisdiction.

	MMPO Area	**Selected Land**	**Broken Wing Ranch**	**Garden Creek Property**
SPECIES **Common name** *Scientific name*	**BLM Challis** **Forest Service**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
Challis crazyweed *Oxytropis besseyi* var. *salmonensis*	Yes (BLM and Forest Service)	Yes	Yes	No
Challis milkvetch *Astragalus amblytropis*	Yes (BLM)	Yes	Yes	No
Idaho sedge *Carex idahoa*	No	No	No	Yes
Lemhi milkvetch *Astragalus aquilonius*	Yes (BLM and Forest Service)	Yes	Yes	No
Wavy-leaf thelypody *Thelypodium repandum*	Yes (BLM and Forest Service)	Yes	Yes	No
White eatonella *Eatonella nivia*	Yes (BLM)	Yes	Yes	No
Whitebark pine *Pinus albicaulis*	Yes (BLM and Forest Service)	Yes	No	No

3.4.1. MMPO Area and Selected Land

3.4.1.1. General Vegetation

The major vegetation cover types within the analysis area include upland forests of Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*); riparian forests of cottonwood (*Populus* spp.), aspen (*Populus tremuloides*), and tall shrubs; semi-desert shrublands of sagebrush (*Artemisia* spp.); perennial grasslands; and subalpine meadows. Evergreen forests occupy the majority of the area whereas semi-desert shrublands are the predominant non-forest vegetation cover. Transitional areas, where evergreen forests and semi-desert shrublands overlap, are most prevalent along the western quarter of the selected land where sagebrush shrubs mix with Douglas-fir trees.

Topography (elevation and aspect), historic fire cycles, fire suppression, infestations from mountain pine beetles (*Dendroctonus ponderosae*), western spruce budworm (*Choristoneura occidentalis*), dwarf mistletoe (*Arceuthobium douglasii*), and logging are the factors that interact with and influence successional vegetative processes in the analysis area. Human activities have affected portions of the area including the construction and improvement of roads for mine-related activities, mine facilities, reseeding old roads and disturbed areas with non-native grasses and forbs, fire suppression, and through weed invasion related to these activities.

Fire suppression in the SCNF has occurred since 1910 (BLM 1999). Between 1924 and 2009, four small wildfires (< 10 acres each) caused by lightning strikes have been documented on the selected land. In 1927, a large fire of greater than 100 acres occurred on forested land between the Lower Buckskin WRSF and the Pat Hughes WRSF (Pfeifer 2009, 2010). Post-fire vegetation consists mostly of lodgepole pine, Douglas-fir, sagebrush, and scattered aspen.

Most of the forest in the analysis area has not experienced the thinning and fuel-reducing benefits of non-lethal (i.e., not stand replacing) fires since settlement (pre-1900). Historically, dry Douglas-fir habitat types (e.g., Douglas-fir/mountain snowberry [*Symphoricarpos oreophilus*] and Douglas-fir/pinegrass [*Calamagrostis rubescens*]) typically burned with low-severity, non-lethal fires at least once every 35 years (Crane and Fischer 1986). Lodgepole pine communities were associated with surface fires that burned with low to medium severity every 25 to 50 years (Arno 1980). Subalpine fir habitat types burned with mixed severity fires at least once every 35 to 100 years. Mixed severity fires burn in a mosaic pattern with some areas of fire being non-lethal and other areas being stand-replacement. The longer intervals between fires allow fuel to build up to levels that create high-severity, stand replacing fires (Crane and Fischer 1986).

In older forests (averaging > 150 years in age), Douglas-fir trees are considered the climax species (the species that will occupy a site in a steady state). In general, fire hazards due to overstocking are generally lower in older Douglas-fir forests at low to mid elevations because the sparser understory is limited by moisture. In contrast, near the confluence of Bruno and S. creeks, there is an area that burned less than 150 years ago and has regenerated into an overstocked, vigor-reducing condition that could fuel a stand-replacing fire or insect attack (BLM 1999).

Insect and disease infestations to forest resources were evaluated from 1999 to 2009 within a 4 mile radius of the analysis area by the SCNF Aerial Insect and Disease Detection Survey (USFS 2010). The Douglas-fir beetle was found to be fairly common on adjacent lands to the southwest and northeast, and the largest detections occurred in 2009. Light areas of defoliation (< 50 %) of Douglas-fir and spruce trees by the western spruce budworm were detected in 2009 across the eastern half of the selected land and along the northern property boundary between the TSF and the open pit (USFS 2010). Approximately 45 percent of lodgepole pine and 40 percent of Douglas-fir stands in the SCNF are infected with dwarf mistletoe (BLM 1999). Dwarf mistletoe infestations also occur on trees throughout the analysis area.

Evidence of historic logging occurs on north- and east-facing slopes. On the steep and dry south- and west-facing slopes, logging is not practical. Areas at the mine have historically been logged (liquidation sales) prior to mine development. Between 2003 and 2004 a post and pole harvest sale (8 acres) occurred on the selected land (Baer 2009). Historically logged areas have regenerated mostly with lodgepole pine. Therefore, the reclamation tree seedlings will be lodgepole pine and may include seedlings grown from seeds collected from relatively high elevations and ecosystems similar to that of the pre-mine condition, i.e., preservation of genetic diversity and trees best adapted for local conditions.

3.4.1.2. Vegetation Cover Types

The following subsections describe the cover types and associated vegetation for the analysis area (Figure 3.4-1).

Grasslands

Grasslands cover 229.7 acres or 4 percent of the selected land and 0.8 acres of the MMPO area (Alternative M2) on BLM land. Grasslands refer herein to native, perennial grasslands; areas reclaimed and dominated by grasses with a minor component of woody plants and subalpine meadows.

Semi-Desert Shrublands

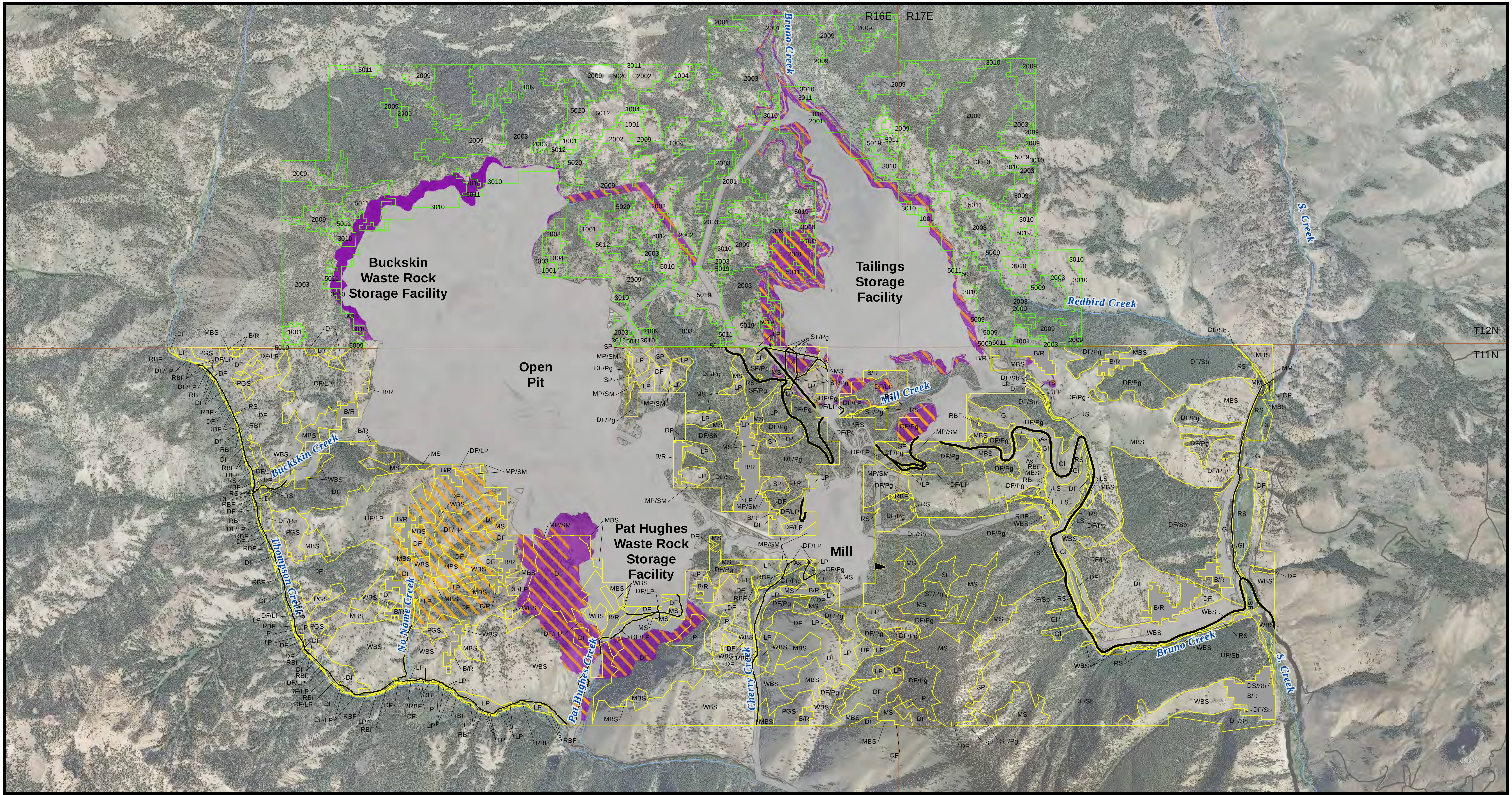
There are four cover types of semi-desert shrublands in the analysis area: mountain big sagebrush, Wyoming big sagebrush, low sagebrush, and mountain mahogany. Semi-desert shrublands cover 1,229.7 acres (24 %) of the selected land and 60.3 acres (13 %) of the MMPO area (Alternative M2) on BLM, Forest Service, and TCMC lands.

Riparian Shrubland

Riparian shrubland covers 48.8 acres (1 %) of the selected land and less than 0.1 acre of the MMPO area (Alternative M2) on BLM land. This cover type occupies the riparian zone where shrubs dominate the upper canopy. The larger stands of riparian shrubland occur in the S., Bruno, Thompson, and No Name drainages at the selected land. Commonly occurring shrub species include alder (*Alnus* spp.), willow (*Salix* spp.), and dogwood (*Cornus sericea*). Other associated species include chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier* spp.), Woods' rose (*Rosa woodsii*), and currant (*Ribes* spp).

Evergreen Forests

There are six communities (all upland) in the evergreen forests cover type in the analysis area: Douglas-fir, Douglas-fir/lodgepole pine, lodgepole pine, subalpine fir, subalpine fir/whitebark pine, and mixed subalpine. Evergreen forests comprise 3,357.1 acres (65 %) of the vegetation at the selected land and 363.9 acres (81 %) of the vegetation at the MMPO area (Alternative M2) (BLM, Forest Service, and TCMC lands).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

USFS Cover Types

Code	Cover Type
1001	Barren
1004	Grass/Forb
2001	Spruce/Fir
2002	Whitebark Pine
2003	Douglas-fir
2009	Lodgepole Pine
3010	Bunchgrass/Fescue
3011	Fescue
5009	Mountain Big Sage
5010	Mountain Big Sage/Fescue
5011	Conifer/Mountain Big Sage
5012	Fescue/Conifer
5019	Conifer/Mountain Big Sage
5020	Conifer/Fescue

BLM Cover Types

Code	Cover Type
As	Aspen
B/R	Barren/Rock
(line)	Disturbed/Road
DF	Douglas-Fir
DF/LP	Douglas-Fir/Lodgepole Pine
DF/Pg	Douglas-Fir/Pinegrass
DF/Sb	Douglas-Fir/Snowberrry
Gl	Grassland
LP	Lodgepole Pine
LS	Low Sagbrush
MBS	Mountain Big Sagebrush
MM	Mountain Mahogany
MP/SM	Montane Parkland/Subalpine Meadow
MS	Mixed Subalpine
PGS	Perennial Grass Slope
RBF	Riparian Broadleaf Forest
RS	Riparian Shrub
SF	Subalpine Fir
SF/Pg	Subalpine Fir/Pinegrass
SF/WP	Subalpine Fir/Whitebark Pine
SP	Subalpine Pine
WBS	Wyoming Big Sagebrush

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 Miles 1

0 Kilometers 1

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-1
Vegetation cover types, MMPO area and selected land
Thompson Creek Mine EIS

Deciduous Forest

Deciduous forest covers 22.5 acres (0.4 %) of the selected land. The cover type occurs in the riparian zone where trees dominate the upper canopy. Perennial streams such as S., Thompson, and Bruno creeks have a denser tree canopy and a wider riparian corridor. Intermittent streams often support a discontinuous riparian community where there are sections of thick tree cover, shrubs, and small trees, alternating with the absence of trees and shrubs. The most common deciduous tree species are black cottonwood (*Populus balsamifera*), aspen, and Pacific willow (*Salix lucida* spp. *lasiandra*). Small groves of aspen were also noted on the edges of talus slopes, in a historic burned area, and in disturbed areas. Engelmann spruce (*Picea engelmannii*) and subalpine fir also occur in the riparian zone.

Developed/Disturbed Land

Developed/disturbed[4] land comprises approximately 70 acres (1 %) of the selected land and none of the MMPO area on BLM land.

Natural Barren Areas/Rock

Natural barren areas/rock covers 197.5 acres (4 %) of the selected land and 22.5 acres (5 %) of the MMPO area (Alternative M2) on BLM and TCMC lands. This cover type includes areas with less than 5 percent cover of vegetation with exposed soil, rock outcrops, talus or scree slopes.

3.4.1.3. Forest Productivity

Three habitat types have been identified within the selected land for merchantable timber. The predominant habitat type is Douglas-fir/mountain snowberry with very low to low timber productivity (20 to 50 cubic feet/acre/year) as the trees regenerate very sporadically. The second largest habitat type is Douglas-fir/pinegrass with low (25 to 50 cubic feet/acre/year) to moderate (50 to 85 cubic feet/acre/year) timber productivity. The third habitat type is subalpine fir/pinegrass with low to moderate (30 to 75 cubic feet/acre/year) timber productivity (Steele et al. 1981). The forested area of the selected land is divided into shallow and steep slopes, which would determine the harvest method (Table 3.4-2). The forested area of the MMPO area (Alternative M2) and selected land is also classified by production capability (Figure 3.4-2).

[4] roads, structures, ditch margins, equipment and material storage areas, areas of concentrated livestock use, etc.

Table 3.4-2. Forested area,[1] selected land.

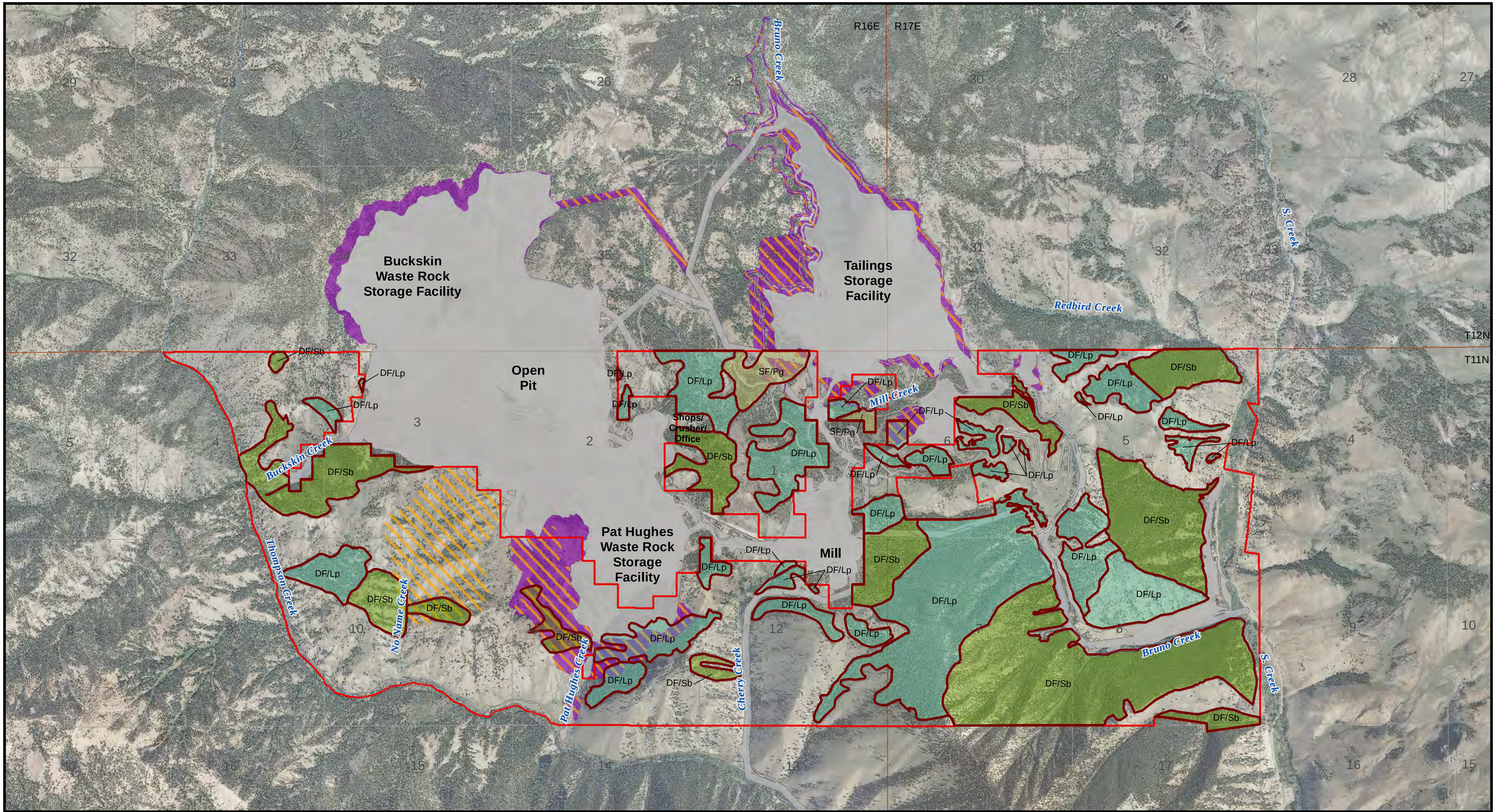
Location	> 45 % Slope (acre)	< 45 % Slope (acre)	Total (acre)
Township 11N, Range 17E			
Parcel 1 (Section 5)	300	0	300
Parcel 2 (Section 6)	100	200	300
Parcel 12 (Section 7)	570	60	630
Parcel 13 (Section 8)	448	0	448
Township 11N, Range 16E			
Parcel 3 (Section 1)	0	300	300
Parcel 4 (Section 2)	124	0	124
Parcel 5 (Section 3)	50	0	50
Parcel 7 (Section 4)	257	0	257
Parcel 8 (Section 9)	74	0	74
Parcel 9 (Section 10)	200	0	200
Parcel 10 (Section 11)	200	0	200
Parcel 11 (Section 12)	120	100	220
TOTAL	**2,443**	**660**	**3,103**

[1] areas from Baer (2009) rounded to whole acres

Currently the commercial demand is low for wood products such as posts and poles (Baer 2009), but the Forest Service frequently receives requests from private individuals seeking post and pole material for noncommercial use (Chilton 2009). There also does not appear to be a market for any appreciable amount of timber (e.g., 500 mbf/year) as the nearest sawmills that would accept raw timber are more than 200 miles from the analysis area.[5] The selected land also lacks a road network sufficient for transporting harvested timber.

Five habitat types have been identified in the MMPO area for merchantable timber. The predominant habitat type is Douglas-fir/elk sedge with low to moderate (30 to 85 cubic feet/acre/year) timber productivity. The second largest habitat type is Douglas-fir/pinegrass with low (25 to 50 cubic feet/acre/year) to moderate (50 to 85 cubic feet/acre/year) timber productivity in the pinegrass habitat type The Douglas-fir/mountain snowberry habitat type has very low to low (20 to 50 cubic feet/acre/year) timber productivity as these trees regenerate very sporadically. The subalpine fir/pinegrass and subalpine fir/elk sedge habitat types have low to moderate (30 to 75 cubic feet/acre/year) timber productivity (Steele et al. 1981).

[5] e.g., Clearwater Forest Industries, Inc., Tamarack mill, New Meadows, Idaho (220 miles); Sun Mountain Lumber, Inc. (low value stud mill), Deer Lodge, Montana (240 miles); Pyramid Mountain Lumber, Inc., Seeley Lake, Montana (292 miles) (Gardner 2012b).



Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
2009 NAIP imagery
Coordinate system UTM Zone 11 NAD 83

Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

Timber Resources Stand/Habitat

- Douglas-Fir/Pinegrass
- Doughlas-Fir/Snowberry
- Subalpine-Firr/Pinegrass

N

1:32,000

0 Miles 1

0 Kilometers 1

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-2
Timber production, MMPO area and selected land
Thompson Creek Mine EIS

3.4.1.4. Old-Growth Forest

Although the definition of *old-growth* forest is complex and can vary according to the source, in general, old-growth forest is a stand of old, large diameter trees relatively undisturbed by humans. There is no old-growth forest in the analysis area. The subalpine fir/pinegrass habitat type (selected land) does contain a few scattered individuals of mature Douglas-fir that are approximately 24 inches in diameter. However, such habitat does not constitute old-growth habitat as defined by Green et al. (1992) and both the BLM and Forest Service believe that old-growth forest is unlikely in the analysis area (Baer 2009, Chilton 2009).

3.4.1.5. Invasive and Non-native Plants

Eight noxious weeds occur in the analysis area: Canada thistle (*Cirsium arvense*), sulphur cinquefoil (*Potentilla recta*), spotted knapweed (*Centaurea maculosa*), yellow toadflax (*Linaria vulgaris*), dalmation toadflax (*Linaria genistifolia* ssp. *dalmatica),* rush skeletonweed (*Chondrilla juncea*), houndstongue or gypsyflower (*Cynoglossum officinale*), and musk thistle (*Carduus* nutans) (Figure 3.4-3). The most prevalent species are spotted knapweed (80 acres) and yellow toadflax (52 acres) infestations (Gionet 2009). The remaining noxious weed infestations are minor (cumulatively < 1 acre). Noxious weeds are generally intermixed with native species and occur primarily along roads and in disturbed areas.

The Forest Service and BLM use a combination of Federal work force and contractors to perform noxious weed control and typically monitor their treatments for a year (Gionet 2009). The TCMC uses a contractor to implement weed control on the mine property, with follow-up site inspections.

3.4.1.6. Special Status Plant Species

Surveys to document the presence or absence of special status plant species in the analysis area have been limited. Therefore, the potential presence and distributions of most special status plant species in the analysis area is inferred from their presence in nearby areas and the presence in the analysis area of habitats where special status plant species are normally found. Incidental observations have verified the presence of some plant species (IDFG 2011a). Six special status plant species occur or may occur in the analysis area: Challis crazyweed, Challis milkvetch, Lemhi milkvetch, wavy-leafed thelypody, white eatonella, and whitebark pine. Suitable soils (Challis Volcanic Group) occur in much of the analysis area. However, the habitat around the mine is unoccupied by these species and there is no historical record of occurrence (IDFG 2011a). Most of the known locations for these species are clustered along the Salmon River or East Fork Salmon River (Section 3.4.2.4.). The elevation range of whitebark pine in Idaho is 7,300 feet to 10,500 feet (USFS 2013a). Whitebark pine could occur in the MMPO area and selected land as scattered individual trees (no stands) at the higher elevations on exposed ridges and in windswept areas. All of these special status plant species are sensitive species, and whitebark pine is also a candidate species.

3.4.2. Offered Lands – Broken Wing Ranch

3.4.2.1. General Vegetation

The vegetation of the ranch is discussed by subparcel (Section 2.2.4., Figure 3.4-4). In the westernmost subparcel (BWR-1) vegetation communities transition from fingers of coniferous forests to grasslands and riparian forest surrounded by sagebrush hills. The eastern subparcels (BWR-2 through BWR-7) are adjacent to the Salmon River and contain areas of irrigated agricultural land, surrounded by xeric foothills dominated primarily by sagebrush and other low growing shrubs with small areas of grasslands. Species composition (apart from agricultural species) is dependent primarily on elevation, aspect, and substrate, all of which influence the temperature and moisture regimes under which plant communities have developed. Superimposed upon this pattern are the effects of land use, primarily grazing by domestic livestock and invasion by noxious weeds. Use of native rangeland by cattle tends to change community composition and dominance as a result of preferential consumption of some plant species, avoidance of other plant species, and direct and indirect effects from trampling and changes in moisture infiltration or run-off related to the lower and sparser cover.

3.4.2.2. Vegetation Cover Types

There are six general classifications of land cover and plant community types at the ranch: agriculture, semi-desert grassland, semi-desert shrubland, deciduous forest, mesic shrubland, and developed/disturbed areas.

Agriculture

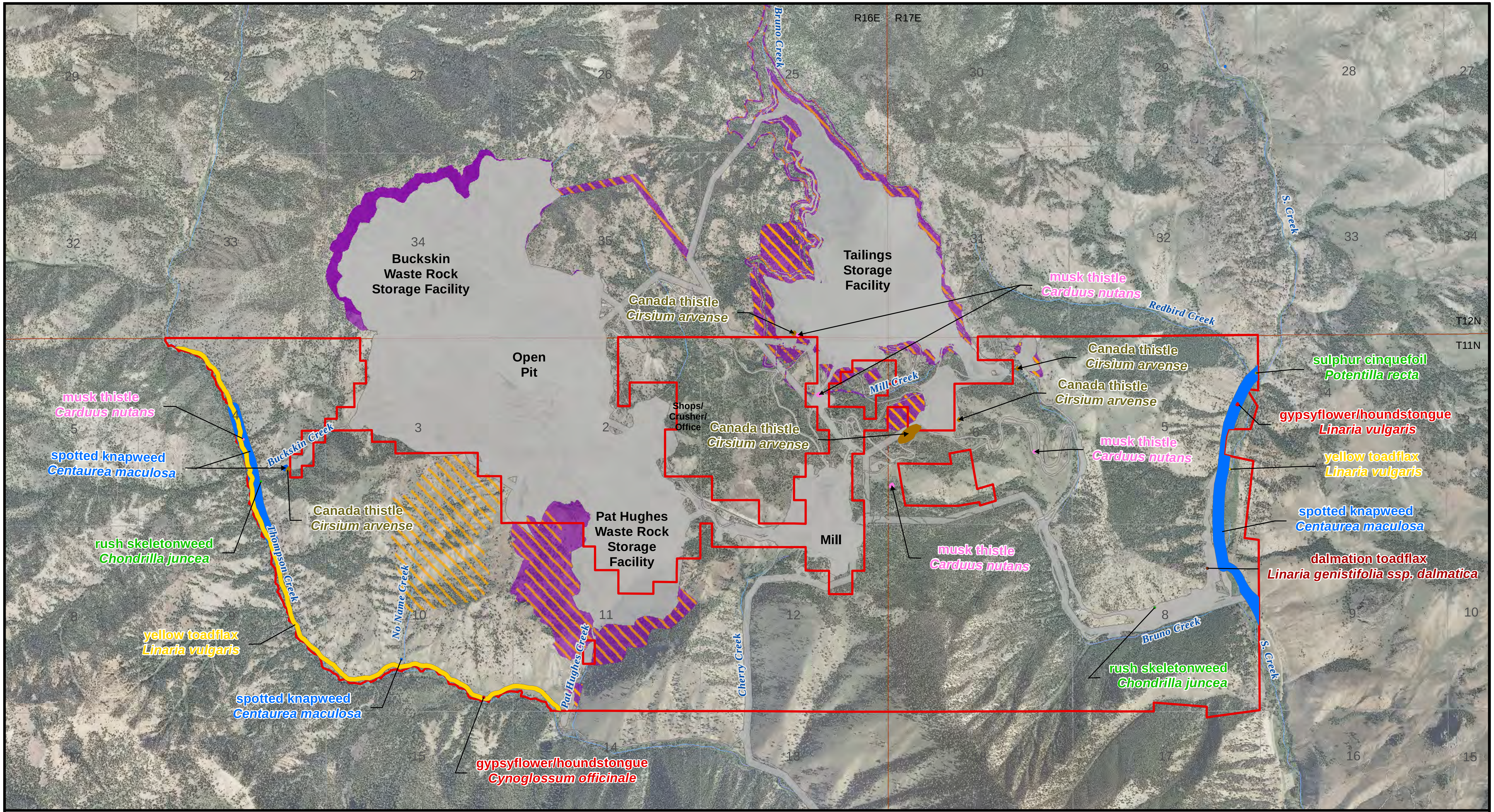
Agricultural land covers 444.5 acres (53 %) of the ranch. Subparcels BWR-4 and BWR-6 have the largest agricultural areas of 150.6 and 144.7 acres, respectively. Agriculture land consists primarily of pasture and hay production including grasses, alfalfa, and mixtures planted for livestock grazing. Most of the agricultural land is irrigated and is on the valley floors adjacent to the Salmon River. These areas are characterized by gentle terrain, relatively deep loamy or gravelly loam soils (NRCS 2007), and availability of water for irrigation. Irrigation methods include the use of furrow or flood systems, wheel lines, and center pivot systems. Portions of the irrigated pastures contain herbaceous wetlands or areas dominated by hydrophytic vegetation (plants that thrive in wet conditions) (Section 3.9.).

Semi-Desert Grassland

Semi-desert grassland (perennial grass slopes) occurs on only BWR-1 and covers 9.5 acres (1 %) of the ranch. Grassland refers to areas dominated (> 50 % cover) by grasses and widely scattered shrubs. Grassland in the region comprise primarily native, drought resistant species such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and Sandberg bluegrass (*Poa secunda*).

Semi-Desert Shrubland

Semi-desert shrubland covers 335.1 acres (40 %) of the ranch. All of the subparcels have at least one or more semi-desert shrubland vegetation communities with the largest areas of semi-desert shrubland on BWR-1 (107.6 acres), BWR-5 (76.8 acres), and BWR-6 (56.8 acres).



Legend

- Selected land
- MMPO areas/Alternative M3
- MMPO areas/Alternative M2
- Existing mining disturbance
- Stream

Noxious Weeds

Common name, Scientific name

- Canada thistle, Cirsium arvense
- yellow toadflax, Linaria vulgaris
- dalmation toadflax, Linaria genistifolia ssp. dalmatica
- gypsyflower/houndstongue, Cynoglossum officinale
- musk thistle, Carduus nutans
- rush skeletonweed, Chondrilla juncea
- spotted knapweed, Centaurea maculosa
- sulphur cinquefoil, Potentilla recta

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Noxious weed data from Natural Resource Information System (NRIS)
Coordinate system UTM Zone 11 NAD 83

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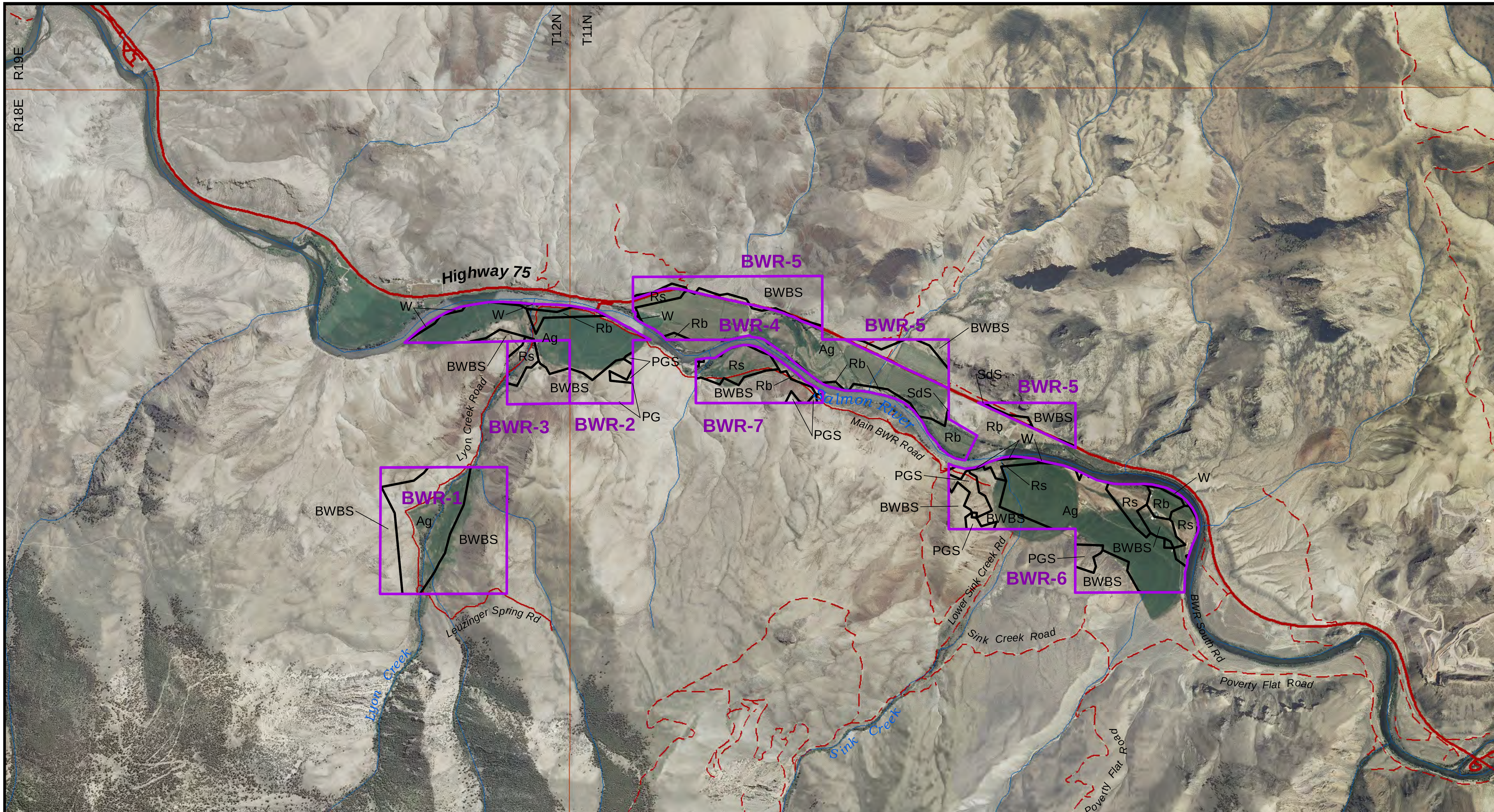
Figure 3.4-3
Noxious weed occurrences, selected land
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream

Vegetation

Map Label	Description	Map Label	Description
Ag	Agricultural	SdS	Salt-desert shrub
BWBS	Basin and Wyoming big sagebrush	W	Water
PG	Perennial grassland		
PGS	Perennial grass slope		
Rb	Riparian - broadleaf		
Rs	Riparian - shrub		

N

1:24,000

0 — 4,000 Feet

0 — 1 Kilometers

Vegetation from BLM
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

Figure 3.4-4
Vegetation cover types, Broken Wing Ranch
Thompson Creek Mine EIS

Deciduous Forest

Deciduous forest covers 25.5 acres (3 %) of the ranch. All the subparcels have deciduous forest except BWR-5. Deciduous forest at the ranch consists primarily of black cottonwood, aspen, and various willow species. Canopy cover and tree density range from sparse to fairly dense. The composition of the understory is variable and most often controlled by the underlying soils. Deep loam soils tend to support a well developed shrub layer whereas stony, coarser textured or shallow soils tend to support an herbaceous understory. Forested riparian corridors occur along Lyon Creek, large irrigation ditches, low banks, old oxbows, or on the outside bends of the Salmon River.

Riparian Shrubland

Riparian shrubland covers 6.8 acres (0.8 %) of the ranch and occurs on BWR-3, BWR-4, and BWR-7. Riparian shrubland corridors are generally found along irrigation ditches or drainages that are subject to seasonal overbank flows and along low banks or terraces of the Salmon River. The density of shrubs and width of the shrub corridor are greatest on the outside meanders of the Salmon River. Ditches and drainages often support a narrow and sometimes discontinuous riparian community, where there are alternating sections of thick tree cover, shrubs, small trees, and the absence of trees and shrubs. The most common shrub species is willow. Other species include alder, chokecherry, dogwood, serviceberry, Woods' rose, and currant.

Developed/Disturbed Land

Developed/disturbed land comprises approximately 20 acres (2 %) of the ranch and is found on BWR-3, BWR-4, BWR-5, and BWR-6. The largest areas are on BWR-4 (7.3 acres) and BWR-5 (8.2 acres). These areas typically contain several weed species (Section 3.4.2.3.).

3.4.2.3. Invasive and Non-native Plants

In general, noxious weeds do not grow well in shaded environments (NDDA 2009). Four Idaho-listed noxious weeds occur at the ranch, particularly adjacent to roads, near water, and in agricultural fields on the ranch:

- Canada thistle: primarily occurs in the western parcel of the ranch as small isolated patches near or along Lyon Creek, along the upper road, and in transition areas between the Lyon Creek corridor and sagebrush slopes;
- Russian knapweed (*Acroptilon repens*): occurs as a small dense patch along the edge of the irrigated pasture in the far northern quarter of the ranch and is likely scattered in other locations across the ranch;
- Musk thistle: occurs in mesic (moderately moist) sites adjacent to Lyon Creek and associated wetlands in the western parcel of the ranch; and
- Oxeye daisy (*Leucanthemum vulgare*): occurs sparsely in mesic sites adjacent to Lyon Creek and associated wetlands in the western parcel of the ranch.

Eight other invasive weeds occur on disturbed/developed land at the ranch: clasping pepperweed (*Lepidium perfoliatum*), Russian thistle (*Salsolia iberica*), saltlover (*Halogeton glomeratus*), cheatgrass (*Bromus tectorum*), tumble mustard (*Sisymbrium altissimum*), tumble pigweed (*Amaranthus albaus*), kochia (*Kochia scoparia*), and common tansy (*Tanacetum vulgare*).

3.4.2.4. Special Status Plant Species

Six special status plant species may occur at the ranch (Table 3.4-3).

Table 3.4-3. Special status plant species, Broken Wing Ranch.

Species (Status)	Occurrence
Challis crazyweed (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
Challis milkvetch (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
Lemhi milkvetch (Sensitive)	**Likely** (Historically observed) Suitable habitat occurs and there are historical records of the species on the ranch (IDFG 2011a).
Wavy-leafed thelypody (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
White eatonella (Sensitive)	**Likely** (Historically observed) Suitable habitat occurs and there are historical records of the species on and northeast of the ranch (IDFG 2011a).
Whitebark pine (Sensitive)	**Not Present** Suitable habitat is not present on the ranch.

3.4.3. Offered Lands – Garden Creek Property

3.4.3.1. General Vegetation

The Garden Creek property is primarily forested land with a narrow riparian wetland bordering Garden Creek. Small, scattered patches of sagebrush and grassland also occur on and adjacent to the property. The tree canopy is composed of a mix of deciduous and coniferous species, co-dominated by aspen and Douglas-fir. The forest is uneven in age with various sizes of timber growth. A shrubby understory occurs underneath the forest layer.

3.4.3.2. Vegetation Cover Types

Four general vegetation types are found on the property: aspen, Douglas-fir, mixed conifer (evergreen), and deciduous (broadleaf) forest. A riparian/wetland corridor occurs along Garden Creek (Table 3.4-4).

Table 3.4-4. Vegetation cover types, Garden Creek property.

Cover Type[1]	Vegetation Community	Area[3] (acre)	(%)
FOREST			
Mixed evergreen deciduous	aspen/conifer mixed forest	15.1	18
Mixed evergreen deciduous	forested riparian corridor[2]	0.8	< 1
Evergreen	Douglas-fir	63.6	80
Deciduous	aspen	0.6	< 1
TOTAL		**80.1**	**100**

[1] BLM (2012b), Idaho Land Cover Classification System (2009)
[2] from Section 3.9.
[3] areas derived from GAP data

Broadleaf species such as Rocky Mountain maple (*Acer glabrum*) and willows are more abundant in moist forests, riparian areas, or along drainages. Common shrubs include snowberry, common juniper (*Juniperus communis*), Woods' rose, white spirea (*Spiraea betulifolia*), and creeping Oregon grape (*Mahonia repens*). Common grasses include pinegrass, Kentucky bluegrass (*Poa pratensis*), common timothy (*Phleum pratense*), blue wildrye (*Elymus glaucus*), bearded wildrye (*Elymus caninus*), and brome (*Bromus* spp.). Common forbs for this area include heartleaf arnica (*Arnica cordifolia*), western yarrow (*Achillea millefolium*), mountain sweet-cicely (*Osmorhiza chilensis*), Richardson's geranium (*Geranium richardsonii*), sticky geranium (*Geranium viscosissimum*), and elk sedge (*Carex garberi*) (Mueggler 1988).

3.4.3.3. Forest Health

In the previous 20 years, the Caribou-Targhee National Forest (CTNF) has no reports of any major fires in the vicinity of the Garden Creek property and there is no evidence of historic fires. No insect or disease infestations or their related effects have been recorded in or near the property (Burts 2010).

3.4.3.4. Forest Productivity

The Pavohroo and Sedgeway soils on the property are well suited to the production of Douglas-fir. On the basis of a 50 year site curve, the average site index for Douglas-fir is 65 feet with a maximum average growth or potential yield of 85 cubic feet per acre per year at 40 years of age. Greys and Toponce soils are well suited to the production of aspen. On the basis of an 80 year site curve, the average site index for aspen is 65 feet with a maximum average growth or potential yield of 36 cubic feet per acre per year at 80 years of age. Most harvested aspen are used for firewood. No information was located on historic logging at the property, but tree stumps from selective tree removal range in size from "Christmas tree" to saw timber.

3.4.3.5. Invasive and Non-native Plants

Field inspections have not identified noxious weeds on the property. In addition, noxious weed infestations in the vicinity of the property are not known by the CTNF or the BLM Pocatello Field Office personnel (Burts 2010, Chipman 2010).

3.4.3.6. Special Status Plant Species

No surveys for special status plant species were made for the Garden Creek property. However, suitable habitat (riparian) for the Idaho sedge occurs on the property and thus, Idaho sedge could occur on the property.

3.5. Range Resources

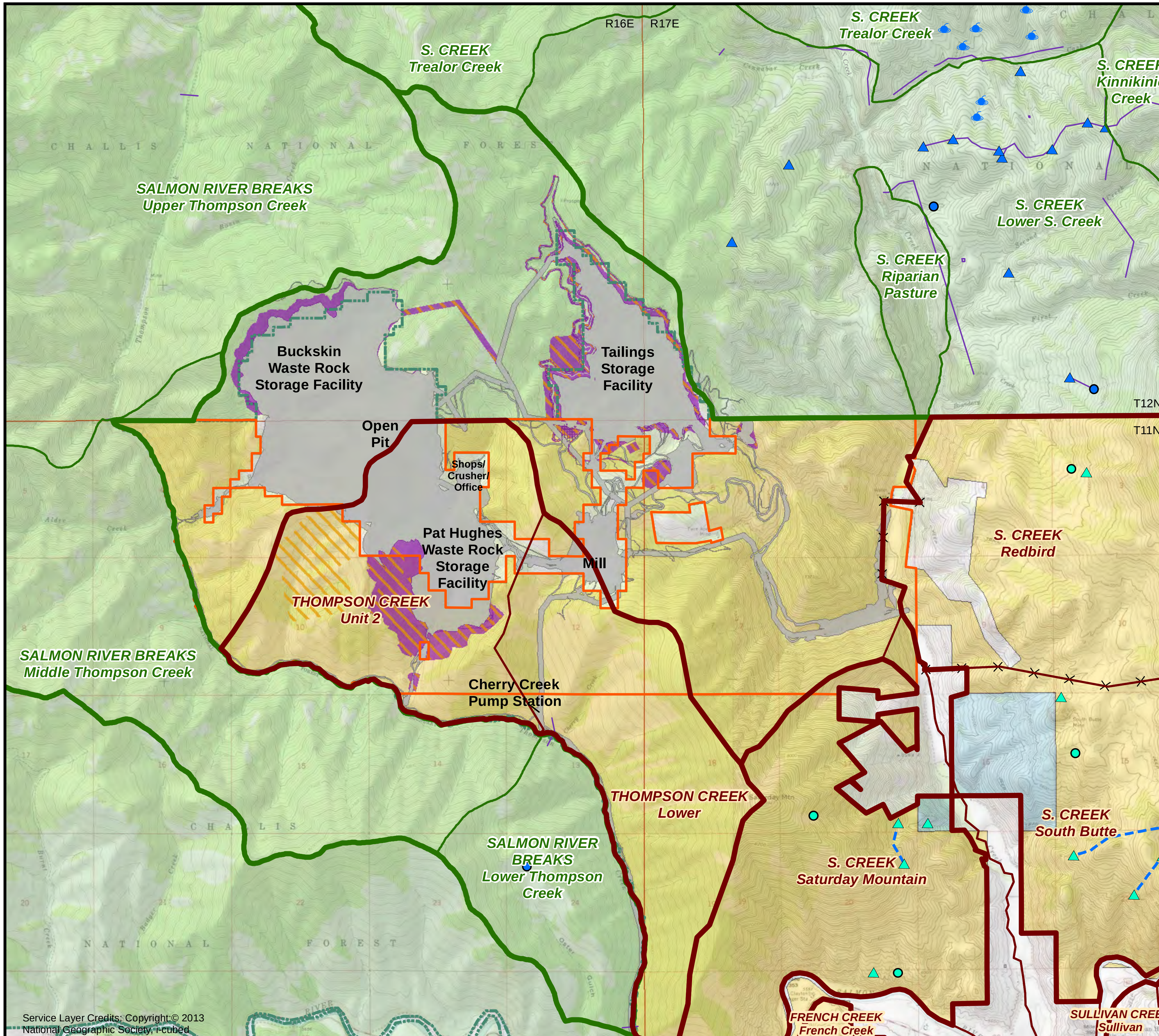
The analysis area for range resources for the MMPO alternatives is the portion of the BLM grazing allotments containing the MMPO area: S. Creek and Thompson Creek allotments. The analysis area for the land disposal alternatives is the selected and offered lands.

3.5.1. MMPO Area and Selected Land

The analysis area has historically been used for livestock grazing in an allotment system. Generally, cattle move through one or more allotments over a year, with part of the year spent on private land. The selected land includes portions of three pastures in the S. Creek Allotment and two pastures in the Thompson Creek Allotment (Figure 3.5-1).

South and west facing slopes above Thompson Creek are made up of rock outcrops and rubble lands, forest cover, and sagebrush-grasslands. Common species found on south and west facing slopes include Idaho fescue, bluebunch wheatgrass, blue wildrye (*Elymus glaucus*), mountain big sagebrush (*Artemisia tridentata* ssp. v*aseyana*), other shrubs such as mountain snowberry (*Symphoricarpos oreophilus*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and forbs such as heartleaf arnica, and arrowleaf balsamroot (*Balsamorhiza sagittata*). Patches of forest occur on north-facing slopes of side drainages; forested areas are mixed Douglas-fir, lodgepole pine, and subalpine fir. Forage production in an average year for this area ranges from near 0 pounds per acre at rock outcrops to about 490 pounds per acre on productive sagebrush-grass areas (NRCS 2007).

North and east facing slopes are mostly forested, with Douglas-fir and sub-alpine fir (*Abies lasiocarpa*) interspersed with mountain meadows. Forested areas provide much less forage than the grassy mountain meadows. These meadows support similar species to those noted above with the addition of mountain brome (*Bromus montanus*). Slopes are also steep in this area. Forage production in an average year for these forest-meadow mosaic areas ranges from near 0 pounds per acre in thick forest to approximately 490 pounds per acre in meadows (NRCS 2007).



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

BLM allotments, pastures, and range improvements

- BLM allotment
- BLM pasture
- Spring
- Trough
- Fence
- Pipeline

Forest Service allotments, pastures, and range improvements

- Forest Service allotment
- Forest Service pasture
- Pond
- Spring
- Trough
- Unidentified improvement

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:48,000 8,000
Feet
0 2
Kilometers

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Allotments, Pastures, and Range Improvements data supplied by BLM and USFS. BLM data updated 2012.
Coordinate system UTM Zone 11 NAD 83

Figure 3.5-1
Allotments and range improvements, MMPO area and selected land
Thompson Creek Mine EIS

3.5.1.1. S. Creek Allotment

The S. Creek Allotment is 9,487 acres, of which 1,401 acres are privately owned, 440 acres are State land, and 7,646 are BLM land. Grazing vegetation species in the allotment include bluebunch wheatgrass and Idaho fescue. In 2002, when frequency studies were conducted, "there was none or very little range considered in poor condition" (BLM 2005b, p. 22).

The allotment has three pastures: Redbird, South Butte, and Saturday Mountain, all of which contain some of the MMPO area or selected land. These pastures are utilized in a deferred rest-rotation system (BLM 2002). There is a fence separating the South Butte and Redbird pastures from one another. Each pasture has at least one spring and several troughs and pipelines installed for livestock use (Figure 3.5-2). None of these springs or troughs are on the selected land. The allotment permittee is authorized to graze 142 cows from May 1 to July 4 and 160 cows from October 1 to October 30 for a maximum of 199 AUMs.

Livestock trailing occurs along S. Creek Road to access the allotment. BLM resource management objectives include not allowing livestock to linger along the road or the adjacent S. Creek. The riparian corridor along the creek is more than 100 feet wide in some locations and is dominated by pasture grasses, several willow species, cottonwood, red-osier dogwood (*Cornus sericea*), and Woods' rose. The riparian corridor and wetland meadows associated with the creek are grazed during the authorized season of use. Livestock are trailed to the uplands to alternative water sources in an effort to keep the cattle away from the creek. Cattle must trail through TCMC land to use the Saturday Mountain Pasture. Informal permission (no written agreement) from TCMC is currently granted on a case-by-case basis to the permittee for this trailing.

There is one designated monitoring area in a riparian area in the Redbird pasture along S. Creek, but cattle seldom use this riparian zone (BLM 2005b). Vegetation in the S. Creek Allotment is "adequate to provide for reproduction and recruitment...as well as provide adequate litter for decomposition to replenish soil nutrients and maintain ecological processes necessary for healthy plant communities" (BLM 2005b, p. 14). The current grazing management of the allotment is meeting the standards for rangeland health and is in conformance with the livestock grazing management guidelines in the *Idaho Standards for Rangeland Health and Guidelines for Livestock Grazing Management* published by the BLM in 1997 (BLM 1997, 2005b).

3.5.1.2. Thompson Creek Allotment

The Thompson Creek Allotment contains 3,329 acres of BLM land and 709 acres of private land. Grazing in the allotment was most recently managed in a two-pasture (Lower Pasture and Unit 2 Pasture) deferred rotation system for 23 days with 67 cows between July 1 and September 30 for a maximum of 51 AUMs. The season of use was greater than 23 days to provide flexibility in timing of grazing in the two pastures. Furthermore, a condition of the permit was that all livestock shall be moved into the upper unit (Unit 2 Pasture) after August 1 each year. This condition was included as specific mitigation to effects on fish species protected under the ESA. However, the grazing permit for the allotment was relinquished in January 2012, and the BLM could only re-issue the permit to provide short term flexibility to other permittees for vegetation treatments or other management actions affecting base permits (BLM 1999).

The physiographic setting of the allotment is steep canyon walls with dry Douglas-fir, and sagebrush-bluebunch plant associations on lower slopes and mixed stands of lodgepole pine and Douglas-fir on high slopes. Two-thirds of the allotment is on areas disturbed by mining or covered by steep limestone mountain mahogany communities, Douglas-fir communities, and subalpine fir communities. Only the remaining one-third of the allotment is suitable for grazing, which is covered by sagebrush/bunchgrass communities (key forage species are bluebunch wheatgrass and Idaho fescue) with a stocking rate of approximately 1 AUM per 20 acres. Cattle reach the allotment via the Thompson Creek Road, and distribute to upland sites to graze through the use of riders and salting practices. However, the topography and the availability of forage along Thompson Creek and the adjacent riparian/bench area are where most grazing occurs. The short duration of use (23 days) and grazing use criteria to trigger movement of livestock limit the current effect to the stream/aquatic habitat/fisheries resources. There are no developed springs or water features on the allotment, but water is available for grazing from Thompson Creek and other drainages.

3.5.2. Offered Lands – Broken Wing Ranch

The ranch contains irrigated areas and unimproved range land, as well as several buildings and houses. Most of the ranch is leased to a rancher who irrigates the fields to grow hay, and winter pastures his livestock on the ranch as a cow-calf operation (BLM 2010a). The ranch is no longer a base property for any BLM grazing permits. On average, each acre of irrigated hay land produces 2 tons of alfalfa/grass hay per acre. Yields could likely be improved if the fields were improved (replanted, re-leveled, etc.) (Baker 2011).

The rancher feeds 300 cows on the ranch and other nearby private land during mid-September through mid-May. Once surrounding rangeland is ready for grazing (usually in May), up to 236 cows move on to the adjacent BLM Bald Mountain Allotment to the west and/or BLM Split Hoof Allotment to the east until approximately June 16 each year (Figure 3.5-2). Most of the cows are then trailed onto the adjacent Forest Service S. Creek Allotment (different from the BLM S. Creek Allotment) until mid-August or October, depending on resource conditions. The cattle then pass back through the BLM allotments for up to 2 weeks, before moving back onto the Broken Wing Ranch. The base property for the BLM grazing permits for these allotments is private land (i.e., not the Broken Wing Ranch) owned by the rancher.

Subparcel BWR-1 straddles Lyon Creek and has 52 acres of sub-irrigated land. Typical forage species are wheatgrasses and fescues, and the meadow ("Graham Field") is composed of Nebraska sedge, Baltic rush, quackgrass, and Kentucky bluegrass. The meadow is flood irrigated between May and September (WSLM 2012) and will produce approximately 3 tons per acre of alfalfa hay, or will support 5 AUMs per acre if used for pasture (NRCS 2007). The meadow in BWR-1 historically has been grazed by 150 to 200 cow/calf pairs between the last week in April and mid-May. However, in 2012 TCMC installed 6,200 feet of riparian post and wire fence with jack post bracing around 42.9 acres of the subparcel to exclude cattle from the meadow, leaving 124.3 acres of unfenced rangeland in the subparcel. Under a conservation plan, the meadow will now be grazed either 1) during 3 to 5 days during the first week in May by 200 cow/calf pairs, or 2) during 3 to 5 days during mid- to late-October or the first week in November (WSLM 2012).

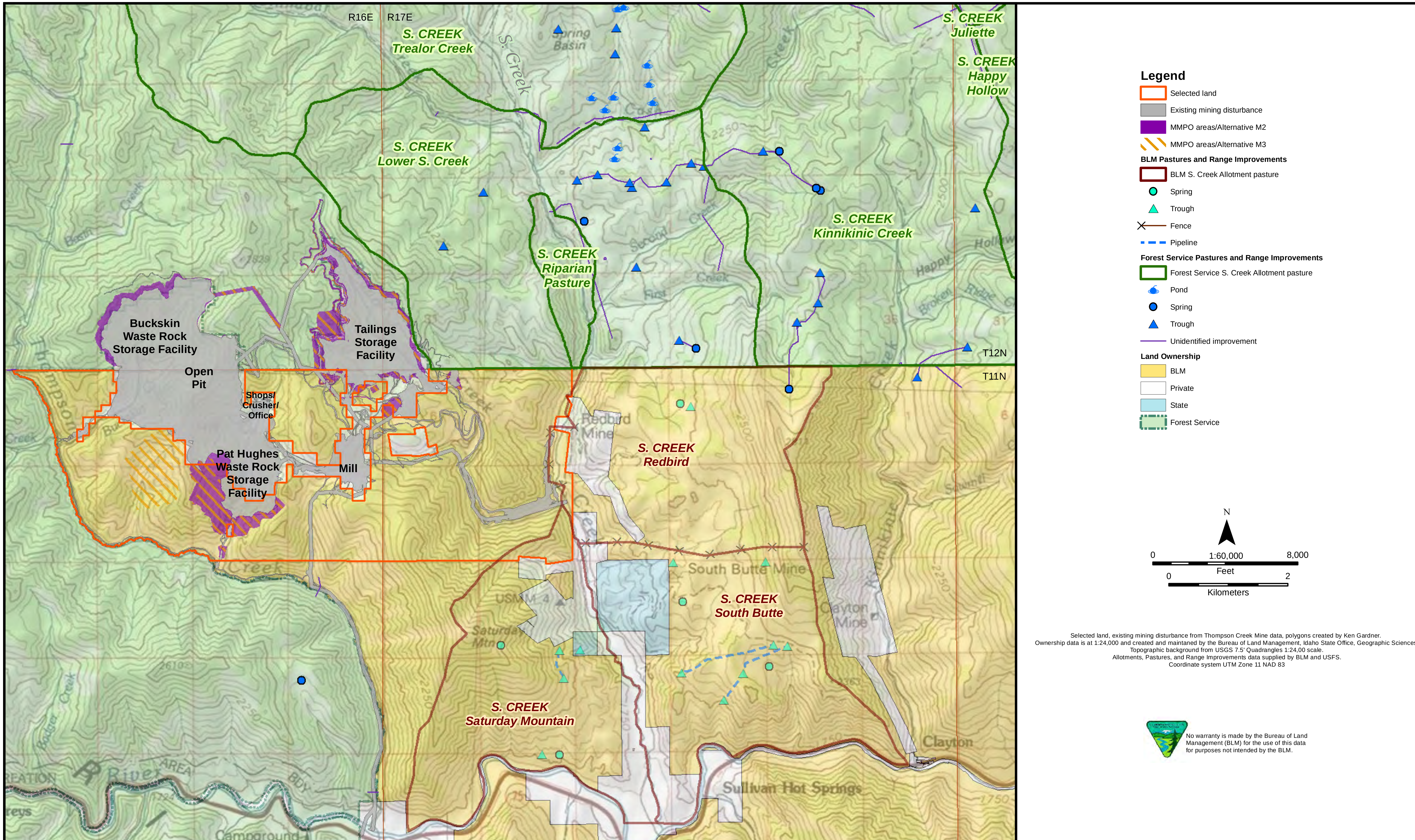
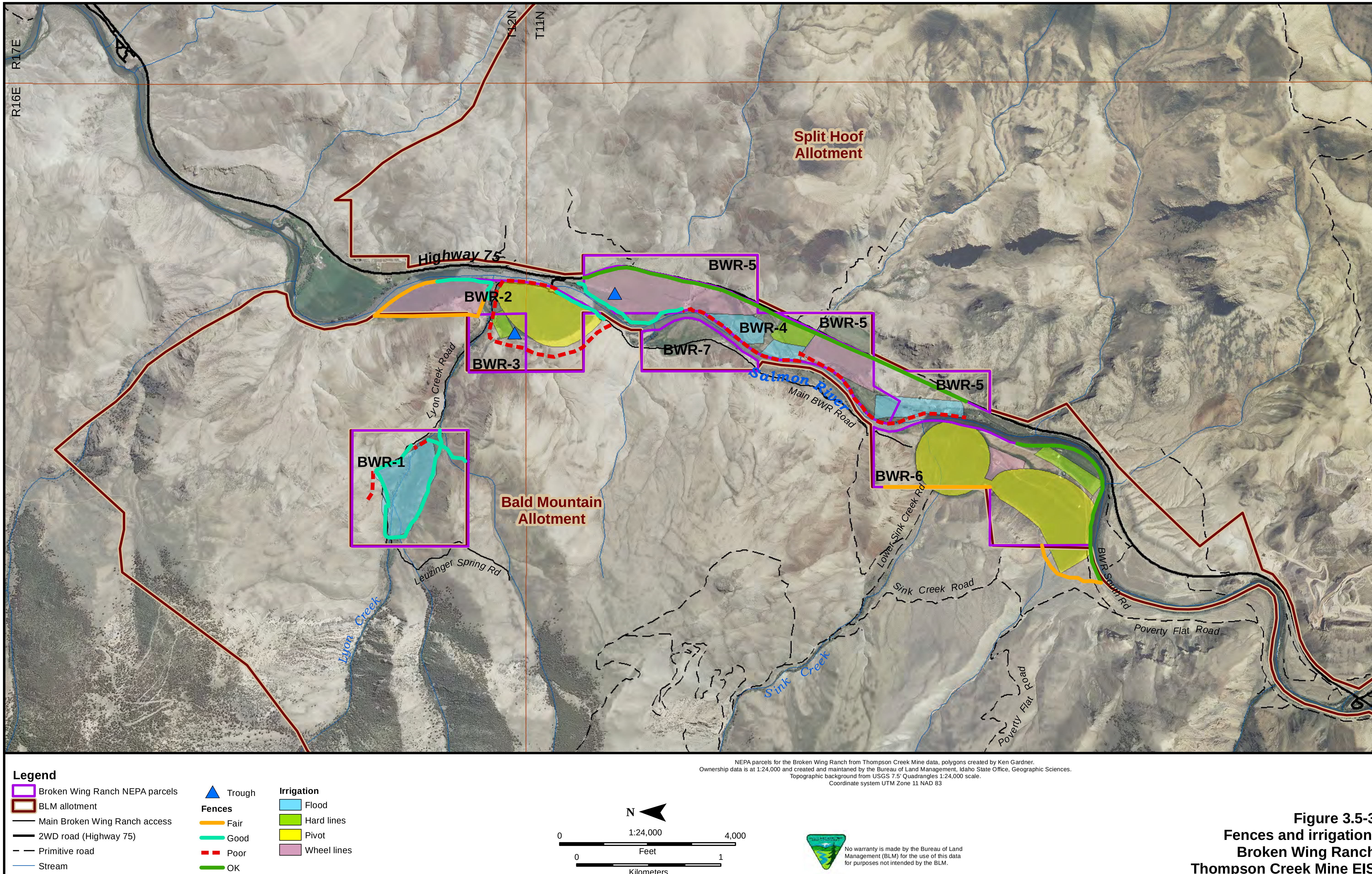


Figure 3.5-2
Range improvements, S. Creek allotment
Thompson Creek Mine EIS



NEPA parcels for the Broken Wing Ranch from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.5-3
Fences and irrigation, Broken Wing Ranch
Thompson Creek Mine EIS

Approximately one-third of BWR-2 is flood-irrigated (~ 35 acres), one-third is irrigated with a pressurized circular irrigation system, and one-third is non-irrigated rangeland. Common grasses are wheatgrasses and fescues. When irrigated, these soils produce 3 to 4 tons per acre of alfalfa or grass hay, and can support approximately 8 AUMs per acre of forage if irrigated (NRCS 2007). In 2011 and 2012, TCMC installed 5,500 feet of riparian jack post and pole fence along the Salmon River, which combined with existing fencing excludes cattle on the north half of the ranch from most of the river (BWR-2, BWR-3, and portions of BWR-4) (WSLM 2012).

Subparcel BWR-3 is almost all native rangeland straddling Lyon Creek. This land produces approximately 400 pounds per acre of dry forage in a typical year if not irrigated. If this subparcel were irrigated, the land would produce approximately 8 AUMs per acre of forage (NRCS 2007). TCMC installed a fish screen in 2012 on a diversion from Lyon Creek on BLM land (under an authorized ROW) approximately 500 feet northwest of the Lyon Creek ranch house. Instead of a leaky diversion ditch, the water is now piped to the irrigation equipment on BWR-2 and BWR-3. In addition, a pipeline was run from a spring near the diversion to a new watering trough on BWR-3 (with the ditch preserved as a cultural resource). The system is passive and designed to be frost free. Cattle now water from the trough instead of Lyon Creek and the Salmon River. Furthermore, the upper portion of the diversion ditch from BWR-1 has been abandoned (WSLM 2012).

Subparcel BWR-4 is in the ancestral floodplain of the Salmon River and includes three old oxbows that are sub-irrigated. Most of the parcel is flood-irrigated and is used for hay production, but native, non-irrigated pasture land is also present. This subparcel, when used as irrigated pasture, produces 5 to 8 AUMs per acre of forage (NRCS 2007). TCMC also installed a second off-stream cattle watering system on BWR-4 in 2012. Cattle now water from a trough supplied by a new well instead of watering in the Salmon River; the system is frost free. The company also installed jack pole and post fence around the historic Maraffio homestead to exclude cattle from the site (WSLM 2012).

Subparcel BWR-5 has both irrigated land (flood irrigation) and rangeland located on outwash plains. This subparcel produces 350 to 700 pounds per acre of forage as rangeland and 3 to 4 tons per acre of grass hay if irrigated. As irrigated pasture, the subparcel produces 5 to 8 AUMs per acre of forage (NRCS 2007).

Subparcel BWR-6 (120 acres irrigated) has two pressurized circular irrigation fields, one pipe-irrigated field, and non-irrigated rangeland (120 acres irrigated, 89 acres non-irrigated). If irrigated, the subparcel would support approximately 8 AUMs per acre (NRCS 2007).

Subparcel BWR-7 includes native sub-irrigated hay land and range land in the Salmon River floodplain next to an un-named, intermittent creek. When irrigated, the subparcel supports 7 AUMs per acre (NRCS 2007).

An irrigation ditch traverses BWR-4 whereas BWR-3, BWR-7, and portions of BWR-4 are naturally sub-irrigated. Most of the pastures and fields at the ranch are fenced (Figure 3.5-3.), with most fences in fair to good condition but some fences in disrepair (Baker 2010).

3.5.3. Offered Lands – Garden Creek Property

The property is partially fenced with the BLM Old Tom Mountain Allotment adjacent to the east and NFS allotments 1156 and 1165 adjacent to the west and north. Therefore, grazing occurs on the property when the adjacent Federal allotments are grazed, and the property is managed integrally with the adjacent BLM and Forest Service allotments. Common range plants include mountain big sagebrush, Idaho fescue, bluebunch wheatgrass, alpine timothy (*Phleum alpinum*), and wood bluegrass (*Poa nemoralis*). Other shrub species include western snowberry antelope bitterbrush (*Purshia tridentata*) and Saskatoon serviceberry (*Amelanchier alnifolia*). Forage production on an average year ranges from approximately 675 pounds per acre to 700 pounds per acre (NRCS 1987) or 0.9 AUM per acre (72 AUMs) (1 AUM = 790 pounds of air dry forage, NRCS 2002b).

The Old Tom Mountain Allotment is currently used for fall sheep grazing. Generally, 1,200 sheep use the allotment during September and October, using approximately 473 AUMs (BLM 2010b). Sheep move freely between the BLM land, NFS land, and Garden Creek property. There are no fences between the BLM land and the property. There is a fence in good condition between the property and NFS land to the north, and a fence in poor condition between the property and NFS land to the east.

3.6. Water Resources

The analysis area for water resources for the MMPO alternatives and for the selected land component of the land disposal alternatives is the water in the potentially affected watersheds and channels:

- The Buckskin and Pat Hughes watersheds, the small watershed in between (which is locally known as "No Name", the small unnamed watersheds east of Pat Hughes, Cherry Creek, and the underlying aquifers (underground layers of rock, sediment or soil that yield water);
- The Thompson Creek channel from the northern boundary of the selected land downstream to the confluence of Thompson Creek with the Salmon River;
- The Bruno Creek watershed, the Redbird Creek watershed (both tributaries to S. Creek), and the underlying aquifers;
- The S. Creek channel from the northern boundary of the selected land downstream to the confluence of S. Creek with the Salmon River; and
- The Salmon River between the mouths of Thompson and S. creeks.

The analysis area for the offered lands component of the land disposal alternatives is 1) the surface water related to the Broken Wing Ranch (Lyon Creek watershed, the ranch, and the portion of the Salmon River channel on the ranch); 2) the groundwater related to the ranch (the ranch and adjacent lands with wells in the IDWR (2012) database); 3) the surface water related to the Garden Creek property (the property and the Garden Creek channel between 1,800 and 1,950 feet elevation); and 4) the groundwater related to the property (the property and adjacent lands with wells in the IDWR (2012) database).

3.6.1. MMPO Area and Selected Land

3.6.1.1. Surface Water

The MMPO area and the selected land are in the Thompson Creek (19,271 acres) and Lower S. Creek (12,159 acres) 6th level watersheds, with hydrologic unit codes (HUC) 170602010903 and 170602010803, respectively. These watersheds drain to the Salmon River basin (170602), which drains to the Lower Snake River subregion (1706). The existing and proposed mine disturbance is/would be in the Buckskin, Pat Hughes, Bruno, and No Name watersheds. Buckskin Creek, No Name Creek, and Pat Hughes Creek all drain to Thompson Creek. Bruno Creek drains to S. Creek, which drains into the upper Salmon River 4 miles downstream of the confluence of Thompson Creek with the Salmon River (Figure 3.6-1). Redbird Creek, a tributary to S. Creek, is northeast of the Bruno Creek watershed.

Stream Characteristics

Thompson Creek

Thompson Creek drains 29.1 square miles and is a second order stream 12.2 miles in length from its headwaters near the mine to the confluence of Thompson Creek with the Salmon River. Thompson Creek is in a narrow canyon with steep, moderately dissected side slopes. This topography constrains the active channel and limits floodplain development. In addition, the public and private sections of Thompson Creek Road constrain the active channel in some locations along Thompson Creek. The average stream gradient is 2.5 percent and average width is approximately 13 feet (GEI 2011). The larger tributaries (by flow) to Thompson Creek include Basin Creek (north of the analysis area), Buckskin Creek, Alder Creek (west of the analysis area), and Pat Hughes Creek (IDFG 2005a). Portions of Thompson Creek upstream of the mouth of Buckskin Creek are more heavily shaded by Douglas-fir than downstream of the mouth where Thompson Creek tends to be more dominated by cottonwood (VTN 1980c).

Buckskin Creek

Buckskin Creek drains 2.5 square miles and is a first order tributary to Thompson Creek. Buckskin Creek has been distinctly affected by the mine, with a large cross-valley-fill WRSF in much of the drainage. As a result, less than ¾ mile of Buckskin Creek remains unburied. Furthermore, the section of stream that remains is not a free-flowing stream, but functions as part of the mine water management system. That is, the only water in the stream is that collected from the toe of the Buckskin WRSF or small amounts of groundwater intercepted due to natural gain. The collected water is either released along a small channel that has been distinctly modified over the years to Thompson Creek via a NPDES discharge point (Outfall 001) at the base of a sedimentation pond, or transmitted via the Thompson Creek pipeline to the Cherry Creek pump station (discussed further under Streamflow Characteristics below).

Pat Hughes Creek

Pat Hughes Creek drains 2.4 square miles and is a first order tributary to Thompson Creek that has also been distinctly affected by a large cross-valley-fill WRSF in much of the drainage. Similar to Buckskin Creek, the portion of Pat Hughes Creek that remains (< ¾ mile) is not a free-flowing stream, but part of the mine water management system. Water from the toe of the

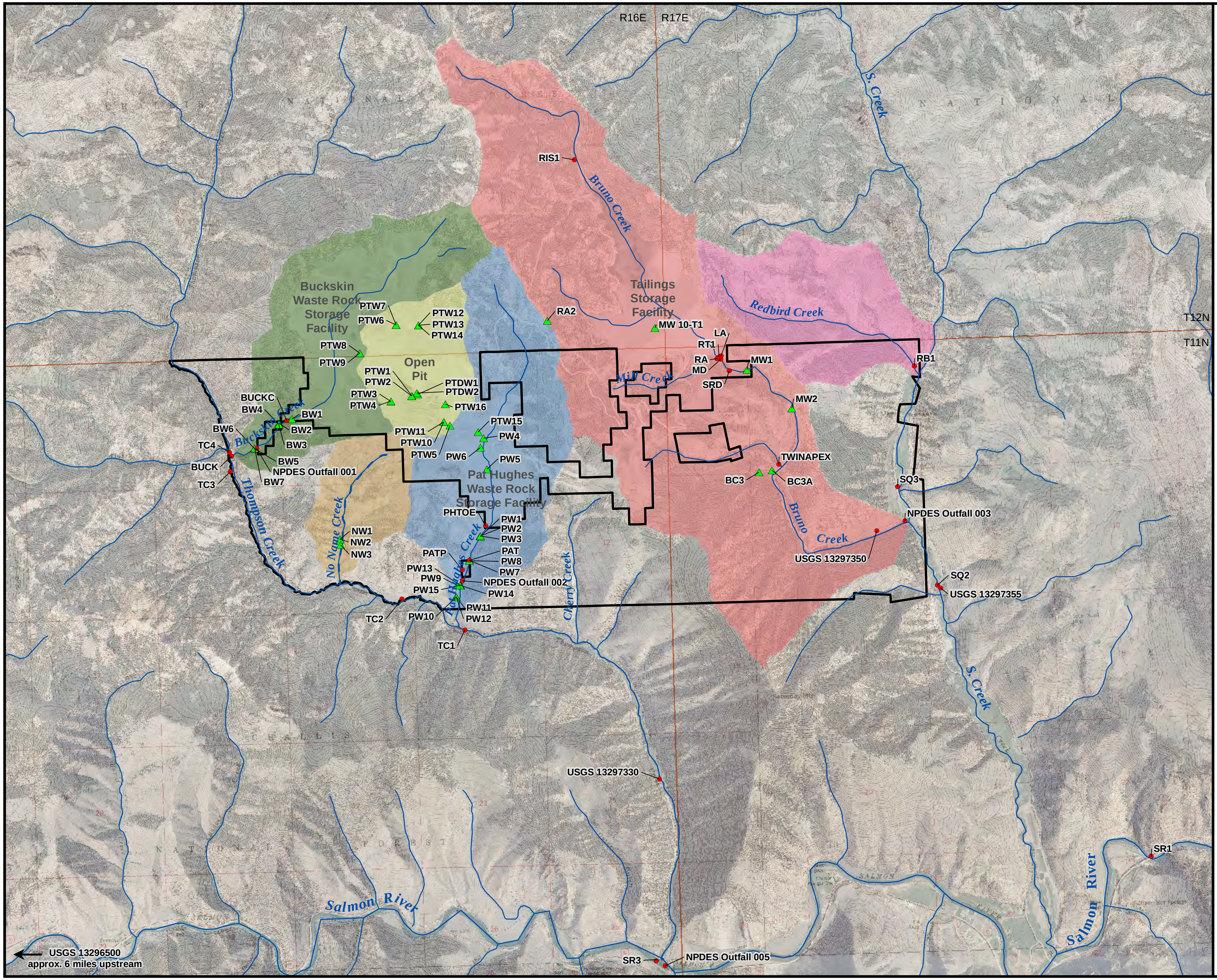
Pat Hughes WRSF, the Pat Hughes diversion pipeline, or intercepted groundwater is either released through a NPDES discharge point (Outfall 002) to Thompson Creek, or transmitted by the Thompson Creek pipeline to the Cherry Creek pump station. Pat Hughes Creek does not provide fish habitat (discussed further under Streamflow Characteristics below).

S. Creek

S. Creek drains 79.2 square miles and is a second order stream 15.5 miles in length from its headwaters north and east of the mine to the confluence of S. Creek with the Salmon River. S. Creek is in a narrow valley with steep, moderately dissected side slopes along much of its length. As a result, floodplain development is also limited along much of its length. Furthermore, S. Creek Road is next to approximately 12 miles of S. Creek from the trailhead at the confluence of Martin Creek with S. Creek to the confluence of S. Creek with the Salmon River, and the road constrains the active channel of S. Creek in some places. However, approximately 1 mile above the confluence of Bruno Creek with S. Creek, the terrain begins to open into a broader valley bottom, with better developed floodplains (IDFG 2004). The average gradient of S. Creek (1.3 %) is lower than that of Thompson Creek (2.5 %), and the average width of S. Creek (~ 20 feet) is wider than that of Thompson Creek (13 feet) (GEI 2011). S. Creek is fed by more than a dozen smaller tributaries on NFS land upstream of the confluence of Bruno Creek with S. Creek; Bruno Creek is the principle S. Creek tributary on the selected land. Portions of S. Creek upstream of the mouth of Bruno Creek have moderate canopy cover of willow, cottonwood, and aspen. Below the mouth of Bruno Creek, riparian vegetation is more open, with some large patches of cottonwood (VTN 1980c).

Bruno Creek

Bruno Creek drains 6.3 square miles and is a second order tributary to S. Creek. Bruno Creek is approximately 6 miles in length from its headwaters near the mine to the confluence of Bruno Creek with S. Creek. Typical of other tributaries in the analysis area, Bruno Creek has a relatively steep gradient within a narrow canyon that limits floodplain development. The construction of the TSF in 2.0 miles of the Bruno Creek drainage has divided Bruno Creek into two separate reaches. Upstream of the TSF, the headwaters of Bruno Creek have not been directly affected by mine activity (i.e., filled by tailings or dewatered by flow diversions). However, the headwaters are fragmented from downstream portions of the creek by the TSF. Also as a result of the TSF and flow diversion, downstream reaches have been distinctly affected by mine activity, primarily through the loss of streamflow (discussed further under Streamflow Characteristics below).



Legend

- Selected land
- Surface water monitoring site
- Monitoring well
- Bruno Creek drainage basin
- Buckskin Creek drainage basin
- No Name Creek drainage basin
- Open Pit drainage basin
- Pat Hughes Creek drainage basin
- Redbird Creek drainage basin

N

1:48,000

0 4,000
Feet

0 1
Kilometers

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-1
Analysis area watersheds and monitoring sites
Thompson Creek Mine EIS

Salmon River

The Salmon River is a seventh order stream that is a major tributary to the Snake River. However, unlike the Snake River, there are no dams on the Salmon River. The Salmon River upstream of the analysis area drains an area of approximately 800 square miles (512,000 acres). The Salmon River is approximately 80 feet wide in the analysis area with very little shading from riparian vegetation or topography (GEI 2011). Riparian vegetation is limited to a narrow strip of dogwood, willow, alder, and sparse cottonwood bounded by steep talus slopes, US Highway 93, and developed private land. As a result, water temperatures are elevated during summer months. Multiple irrigation diversions exacerbate this condition by reducing flows relative to historic levels. Flows in the Salmon River (as measured ~ 11 miles upstream of the analysis area) vary seasonally typical of snowmelt driven systems.

Streamflow Characteristics

The Salmon River, Thompson Creek, and S. Creek are perennial mountain streams whose flows vary greatly both seasonally and annually (USGS 2012c, stream gage data) (Figure 3.6-1). In general, flows in these channels and their tributaries are dominated by seasonal snowmelt run-off. Consequently, the highest flows occur in the late spring and early summer with peak flows typically occurring in June for the Salmon River as the winter snowpack melts in addition to spring rainfall. Flows then decrease in these streams until a regular base flow is established during the fall and winter months.

USGS Station No. 13296500 (Salmon River below Yankee Fork) is approximately 11 miles upstream of the mouth of Thompson Creek. Average monthly flows at this point on the Salmon River vary seasonally by an order of magnitude, with the winter months averaging approximately 400 cfs and the June flow average approaching 3,000 cfs (USGS 2012c).

The USGS (in cooperation with the IDWR) began gaging Thompson Creek near Clayton (USGS Station No. 13297330) in 1972. The gaging station is 1.2 miles upstream of the mouth of Thompson Creek, and downstream of the current open pit, WRSFs, and permitted NPDES Outfall 001 and Outfall 002. As with the Salmon River, Thompson Creek is at its highest in the spring, with flows dropping in late summer into fall (Figure 3.6-2). Thompson Creek generally contributes less than 1 percent of the flow in the Salmon River.

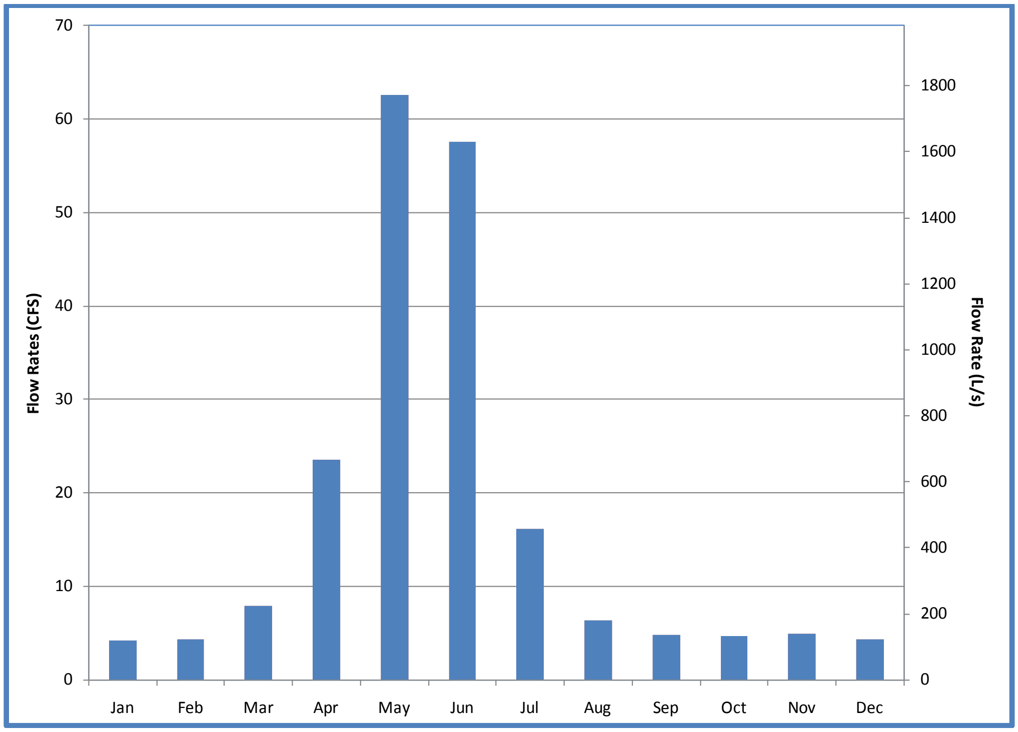


Figure 3.6-2. Distribution of mean monthly flow rates, Thompson Creek.

The USGS-IDWR cooperative stream gaging station on S. Creek (USGS Station No. 13297355) also began operating in 1972. The gaging station is approximately 3 miles upstream from the mouth of S. Creek, and is downstream of the TSF and NPDES Outfalls 003 and 004. With a similar flow distribution as Thompson Creek, the average monthly flows of S. Creek are approximately twice those of Thompson Creek (Figure 3.6-3.) (USGS 2012c).

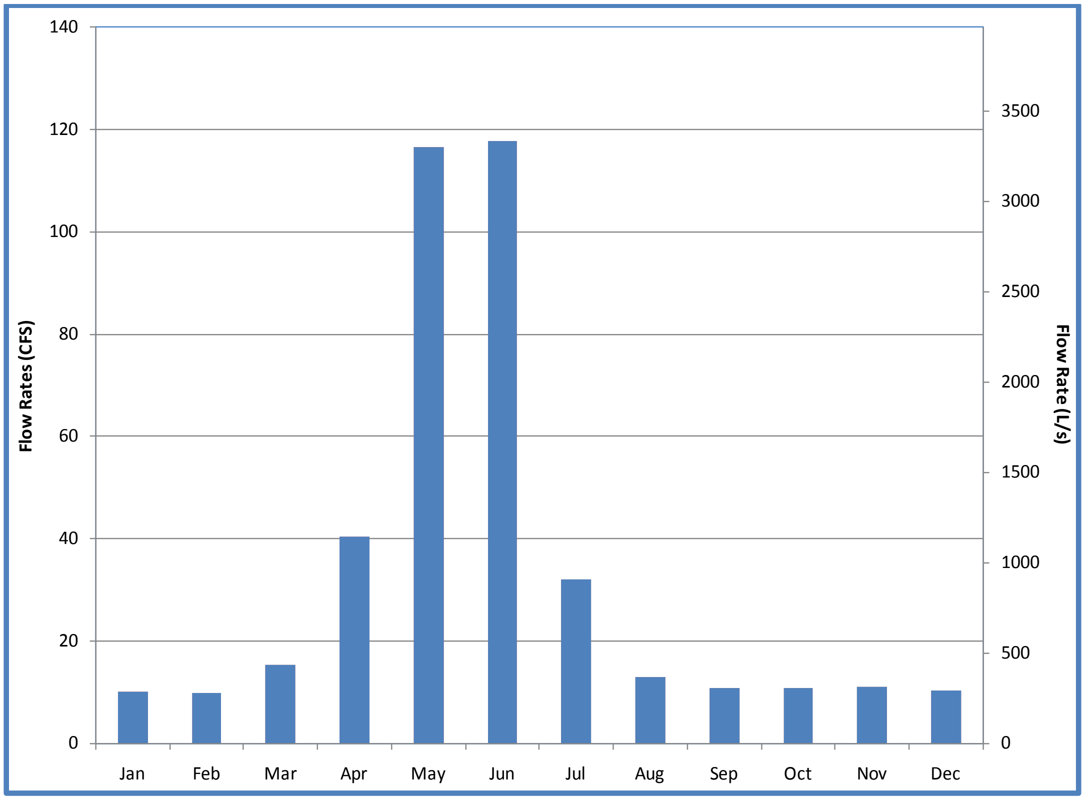


Figure 3.6-3. Distribution of mean monthly flow rates, S. Creek.

As part of the process to determine effluent limitations for NPDES discharges, the EPA derives flow characteristics for receiving streams. Among these characteristics is the 7 day/10 year low flow (lowest 7 day flow that can be expected to occur on average once every 10 years) (7Q10 flow), which is used as a basis for protection of aquatic life from chronic effects. Therefore, the 7Q10 flow represents a much lower flow than average base flow, which is a more regular seasonal low-flow condition. The current effect of the mine is already reflected in the current 7Q10 flow for the Salmon River, Thompson Creek, and S. Creek (Table 3.6-1).

Table 3.6-1. Estimated 7Q10 flows.

Stream	7Q10 Estimate (cfs)
Salmon River	103
Thompson Creek	2
S. Creek	5

As discussed below, some of the streamflow characteristics of smaller watersheds to Thompson and S. creeks have been altered by the mine. In addition, the streamflow characteristics of Buckskin and Pat Hughes creeks upstream of their confluences with Thompson Creek have been altered by the mine.[6] TCMC holds water rights that allow diversion of 20.86 cfs collectively from the Salmon River, Buckskin Creek, and Pat Hughes Creek; the water rights on Buckskin and Pat Hughes creeks effectively allow for dewatering these creeks. In addition, there are one or more sedimentation ponds in the Buckskin and Pat Hughes Creek drainages below the WRSFs. The ponds are designed to collect all flow in the upstream portions of the watersheds. Therefore, the stream channels upstream of these ponds are part of the water management system for mine-affected water and are not naturally flowing streams. Downstream of the WRSFs, these stream channels convey only stormwater run-off from disturbed surfaces at the mine and seepage collected from the base of the WRSFs.

Flow into the lower reaches of these drainages is primarily controlled by the sedimentation ponds. Water from the ponds is discharged to the downstream portions of the drainages only when in compliance with the NPDES permit. Under the NPDES permit, the receiving stream is Thompson Creek and water quality in Thompson Creek must meet Idaho Water Quality Standards (WQS) at the downstream NPDES monitoring locations. However, when discharge occurs under the NPDES permit, water quality in lower Buckskin and Pat Hughes creeks would meet the effluent limits required by the permit. The NPDES permit ensures compliance with the WQS. The probable effects of the mine on the natural flow of Buckskin and Pat Hughes creeks were described in the 1980 EIS for the mine (USFS 1980, p. 5-7).

Most of the Buckskin Creek watershed and channel are a WRSF (i.e., covered by waste rock) or are part of the open pit (i.e., was excavated as part of pit development). The Buckskin Creek flows are thus affected by the mine facilities that intercept run-off, retain run-off, and/or release flows at a regulated rate. Lower Buckskin Creek flows are dominated by regulated discharges from the Buckskin Creek sedimentation pond. In addition to run-off from the mine and from the adjacent undisturbed portions of the watershed, the pond also collects WRSF seepage. Discharge from the pond (via Outfall 001) occurs only when flows in Thompson Creek (measured at a USGS gaging station) are greater than 7 cfs. When not discharged from the outfall, the flows are either retained in the pond or pumped to the mill for reuse. This water is conveyed by the Thompson Creek pipeline and the Cherry Creek pumping station where flows are pumped back to the existing PWTP at the mill and the treated water is used in the mill process. Groundwater and seepage from the Buckskin WRSF contribute flow to Thompson Creek via Buckskin Creek (Section 3.6.1.2.).

Currently, much of the Pat Hughes watershed and channel are a WRSF or are part of the open pit. Unlike the flow in Buckskin Creek, some of the Pat Hughes flow is intercepted above the mine and routed around the Pat Hughes WRSF to the Pat Hughes sedimentation pond. In addition, the pond also collects run-off from the mine shop and vehicle hot start area. Seepage from the Pat Hughes WRSF formerly discharged to the pond. However, in 1999 TCMC stopped allowing this seepage into the pond, and instead began collecting and piping the seepage to the mill via the Thompson Creek pipeline and the Cherry Creek pumping station. As with the Buckskin Creek sedimentation pond, discharges from the Pat Hughes pond occur only when effluent limits at NPDES Outfall 002 can be met. The Pat Hughes watershed also contributes

[6] The probable effects of the mine on the natural flow of Buckskin and Pat Hughes Creeks was described in the 1980 EIS for the mine development (USFS 1980, p. 5-7).

regional (unaffected) groundwater as well as potentially seepage-affected local groundwater to Thompson Creek (Section 3.6.1.2.).

Another small watershed with altered hydrology is Bruno Creek, a perennial stream that is a tributary to lower S. Creek (Figure 3.6-1). The TSF captures run-off from a substantial portion of the Bruno Creek watershed. The headwaters of Bruno Creek can either flow into the TSF and become part of the mine makeup water system, or be diverted around the TSF in a pipeline and re-released to the stream downstream of the TSF. This upstream water source reflects a natural flow regime. Over the 1987 to 2009 period of record, the highest streamflow occurred in June (~ 2 cfs) and the lowest flows occurred in December (~ 0.4 cfs).

Flows in the middle and lower reaches of Bruno Creek are influenced by natural geologic conditions and hydrologic alterations due to the mine (e.g., water management, sediment ponds, tailings water, TSF seepage, and run-off, etc). The Twin Apex abandoned mine (on private land not owned by TCMC) contributes flow to lower Bruno Creek. This portion of Bruno Creek has perennial flow due to the portal discharge, flow from the alluvium and colluvium, and springs issuing from bedrock fractures. The average annual flow in Lower Bruno Creek during the period of record (1971 to 2010) is approximately 1 cfs (UGSG 2012c). According to these same gaging station records (USGS gaging station No. 13297350), the peak flow of record is 42 cfs, recorded in May 1972 prior to the tailings embankment construction. The highest peak flow since the early 1980s was approximately half that amount, when 22 cfs was recorded in June 1986. The lowest daily flows typically occur in the winter months and are only about 1/4 cfs (USGS 2012c).

Redbird Creek flows into S. Creek just upstream of the confluence of Bruno Creek with S. Creek (Figure 3.6-1). The Redbird Creek watershed does not have surface disturbance from the mine, but flows in Redbird Creek are inferred to be affected by the TSF (Section 3.6.1.2). While Redbird Creek streamflows are not often measured, two flow measurements were made at the stream's mouth; they were approximately 0.33 cfs and 0.40 cfs and measured in October 2010 and January 2011, respectively.

Other small watersheds, tributary to either Thompson or S. creeks, are on the selected land e.g. a portion of the Cherry Creek watershed. Flows (ephemeral or intermittent) are not monitored in the Cherry Creek drainage, and there is minor, mine disturbance in this watershed. In addition, No Name Creek (perennial flow) drains a small area between Buckskin and Pat Hughes creeks (Figure 3.6-1). A few small, but unnamed, watersheds on the selected land do not have perennial flow and do not have any appreciable mine disturbance.

Flood events chosen for structure sizing in this area typically come from intense rainfall, rather than snowmelt run-off. During the years in which TCMC was designing and operating the mine, flood flows have been estimated by various methods and entities for the smaller watersheds with planned or implemented mine disturbance. The estimates have varied accordingly, but the current and future precipitation depths that serve as design storms for the mine are 3.46 inches for the 100 year/24 hour storm and 4.05 inches for the 500 year/24 hour storm. Both values are based on the National Ocean and Atmospheric Administration's (NOAA) Hydrometeorological Design Studies Center information (NOAA 2013a). These design storms are applicable to the majority of the water management facilities (Section 4.6). Their frequency (i.e., 100 years, 500 years) and duration (24 hours) is based upon BLM, Forest Service, and/or IDL requirements. For some purposes, where risk from failure is exceedingly high and structures are intended to function perpetually (i.e., the TSF), a recurrence interval approach is not used. Instead a probable maximum precipitation depth is used to calculate a probable maximum flood event. The probable maximum precipitation depth at the mine is 15.32 inches for a 24 hour storm, again using NOAA information and methods.

Regardless of methodology, recurrence interval estimates are probability-based. For example, just because a 100 year event is expected, on average, to occur once every 100 years, it does not mean that it will not occur more – or less – often in any given time period. This is also true for flows on the opposite end of the spectrum, such as the 7Q10. Furthermore, inherent to these methods is the expectation that past conditions are indicative of the future conditions, so the issue of climate change adds uncertainty. For example, the NOAA has not yet identified any statistically significant trends in the annual maximum series of observations used in its precipitation frequency analysis, and the effect of potential changes in climate on precipitation frequency estimates is uncertain (NOAA 2013b). Other parameters related to surface water resources that similarly would be affected by climate change include changes in evaporation and/or evapotranspiration, changes in precipitation variability, changes in timing and type (rain versus snow) of precipitation, and increased occurrence of extreme weather events. However, as for precipitation frequency, the results of computer simulations from climate models for these parameters are still far too uncertain for site-specific analysis in small watersheds, particularly in mountainous terrain (JBR 2012j, Section 4.10.3.4).

These aspects of climate change are not quantifiable either singularly or in combination, but these aspects have the potential to affect surface water resources by increasing the level of uncertainty associated with hydrologic and water quality predictions. Low-frequency events could happen more often, or, alternatively, quantities associated with a low-frequency flood increase, or quantities associated with a low-frequency low flow such as the 7Q10 could become even lower.

Surface Water Quality

Acid Rock Drainage

ARD is the outflow of acidic water with elevated concentrations of metals derived from geologic materials, commonly waste rock or tailings from metal and coal mines. The acidity causes relatively high concentrations of metals to dissolve in the water.[7] The acidity may be neutralized within a few hundred feet of the acidic water entering streams due to dilution and reactions with the atmosphere and substrate, but the metals commonly remain dissolved for many miles downstream. That is, the primary effect of ARD is elevated concentrations of metals.

[7] Acidity is the concentration of hydrogen ions (charged atoms) in water. The hydrogen ions preferentially displace metal ions at the surfaces of rock particles. Alkalinity is the capacity of water to neutralize acidity (consume hydrogen ions). A common neutralizing substance is bicarbonate (HCO_3^-) typically derived from the dissolution of carbonate minerals such as ($CaCO_3$).

ARD occurs when sulfide minerals are exposed to air (oxygen) and water, and there is insufficient capacity (alkalinity) in the water to neutralize the acidity (i.e., hydrogen ions) generated by the oxidation of the sulfide minerals. In undisturbed natural systems the oxidation process occurs at slow rates over geologic time periods. However, when large amounts of rock are fractured (e.g., removed from an open pit and placed in WRSFs, or further crushed in a mill and placed in a TSF), the surface area of the waste material is much greater than when *in-situ*, and thus a greater amount of sulfide minerals are prone to exposure to oxygen and water. If the material contains a sufficient amount of sulfide (acid-generating) minerals and an insufficient amount of carbonate (acid-neutralizing) minerals, water in contact with the material will become acidic. If relatively large amounts of metal ions are available in the material, the concentrations of metals in the water will distinctly increase, particularly for the more soluble metals such as copper and zinc as opposed to lead.

Surface Water in the Analysis Area

Water quality varies throughout the analysis area due to geology, mine influences, and other considerations, but there are several commonalities. First, because streamflows are distinctly influenced by snowmelt run-off, certain aspects of their quality vary with flow rate and season. During the spring snowmelt run-off, the base flow is diluted resulting in lower conductivity, hardness, concentrations of dissolved solids, and concentrations of various dissolved trace metals (i.e., metals naturally present in very small concentrations).

The Buckskin and Pat Hughes stream channels are used as conveyances for run-off from the mine and seepage from the WRSFs. Therefore, these streams have become part of the mine water management system and their surface water chemistry has been altered. Note that for Buckskin and Pat Hughes creeks, the water quality described below is not always typical of the water released from these watersheds to Thompson Creek because much of the Buckskin and Pat Hughes flows are collected and used in the mill. The same situation applies to the description of the water quality in upper Bruno Creek (containing the TSF). This water is not released to lower Bruno Creek/S. Creek. In addition, the water quality of lower Bruno Creek is also affected by the addition of metals from Twin Apex Creek, which is not affected by the mine.

The IDEQ has developed WQSs for surface water based on its defined beneficial uses (IDAPA 58.01.02). Most streams, including those in the analysis area, are designated for beneficial uses of cold water aquatic life, salmonid spawning, and primary or secondary contact recreation. In addition, the Salmon River in the analysis area is designated as a domestic water supply. The defined beneficial uses are part of the WQSs, which also prescribe certain criteria that must be met to ensure the beneficial uses of the water are supported. The criteria may be numeric (parameter-specific) or narrative. Numeric criteria are use-specific, whereas narrative criteria are general applying to all surface water regardless of use. Narrative criteria are statements that describe the desired water quality goal, e.g., free from toxic substances in concentrations that impair beneficial uses.

The WQSs for aquatic life are divided into acute or criteria maximum concentration (CMC) standards and chronic or criterion continuous concentration (CCC) standards. The standards are protective of the environment and include safety factors, i.e., exceeding a standard does not mean that an adverse effect would occur, only that an adverse effect could occur. The standards are protective of the environment if not exceeded more than once every 3 years. The CMC standard is for the 1 hour average concentration and the CCC standard is for the 4 day average concentration. Therefore, only constituents for which a concentration could exceed a WQS are discussed in detail in the DEIS.

Seven of these WQSs apply to elements that are known to be elevated in water that has contacted earth materials at the mine (Table 3.6-2). These are discussed in detail in the DEIS. Other constituents are also known to be elevated in the various mine waters, but are not subject to WQS for aquatic life. These are also discussed in the DEIS. The standard chemical symbols are used for the names of chemicals in all of the tables in the DEIS.

Table 3.6-2. Water quality standards.
all concentrations in micrograms per liter (µ/L)

Chemical	Aquatic Life[c]					
	CMC	CCC	CMC	CCC	CMC	CCC
	Thompson Creek with hardness of 47 mg/L[d]		S. Creek with hardness of 157 mg/L		Salmon River with hardness of 62 mg/L	
As	340	150	340	150	340	150
Cd[a]	0.71	0.37	1.96	0.74	0.9	0.43
Cu[a]	8.4	6	26	16.7	10.8	7.5
Pb[a]	28	1.1	105	4.1	38	1.5
Ni[a]	247	27	686	76	312	35
Se[b]	20	5	20	5	20	5
Zn[a]	62	62	172	173	78	79

[a] The criteria for these metals are hardness dependent. The hardness is the median hardness for the 10 year data set from only measurements during low flow measurements.

[b] The selenium criteria apply to the concentration of total (unfiltered) selenium. The criteria for all other chemicals apply to the concentration of the dissolved (filtered) chemicals.

[c] In 1993, EPA determined that metals criteria for aquatic life are most appropriately based upon dissolved (filtered) concentrations because "dissolved metal more closely approximates the bioavailable fraction of metal in the water column than does total recoverable metal" (EPA 1993). However, the selenium (not really a metal) aquatic life criteria is more appropriately based upon total (filtered; specifically, total recoverable) because of variations in how it speciates and how aquatic life uptakes it (EPA 1987).

[d] mg/L = milligrams per liter

The IDEQ documents the status of the quality of the waters in Idaho in an Integrated Report (IR) released every other year under the requirements of Section 303(d) and Section 305(b) of the CWA. The most recent IR is for 2010 (IDEQ 2011a); the 2012 IR has not yet been released. The IR lists the current conditions of all waters, and those waters that are impaired and need a total maximum daily load (TMDL). The latter waters are commonly referred to as 303(d)-listed. In listing the current conditions of the waters, the IR assesses whether or not waters support their defined beneficial uses. Streams are categorized as *fully supporting* all of their assigned beneficial uses; *not supporting* all or some of their beneficial uses; or *not assessed* during the 2 year cycle for some or all of their beneficial uses. Streams with a support status of *not supporting* make up the Section 303(d) list of *impaired* waters. Some beneficial uses for some streams are not assessed in every 2 year cycle, most commonly when no applicable data is available to determine support status.

The IR provides the following information for the receiving streams in the analysis area. Thompson Creek (source to mouth) is fully supporting its beneficial uses. No Name Creek was not specifically assessed, but was considered as within the Thompson Creek unit, and thus is fully supporting. The status of Buckskin and Pat Hughes creeks is somewhat more complicated and is discussed below in more detail. Bruno Creek (source to mouth) does not support its cold water aquatic life or salmonid spawning beneficial uses due to combined biota/habitat bioassessments, but fully supports its secondary contact recreation beneficial use. S. Creek (downstream of Cash Creek) fully supports its aquatic life beneficial uses; salmonid spawning and secondary contact recreation beneficial uses were not assessed. Redbird Creek was not specifically assessed, but was considered as within the S. Creek unit, and thus is fully supporting. Upstream of Thompson Creek, the Salmon River fully supports all of its beneficial uses (i.e., cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply). Between the mouths of S. and Thompson creeks, the Salmon River is 303(d)-listed for not supporting its cold water aquatic life beneficial uses due to sedimentation/siltation and water temperature. Domestic water supply, primary contact recreation, and salmonid spawning beneficial uses were not assessed for the Salmon River. The Salmon River downstream of S. Creek fully supports the cold water aquatic life and primary contact recreation beneficial uses; support for salmonid spawning uses was not assessed (IDEQ 2011a).

The water in Buckskin Creek is well buffered. Throughout the analysis period, the water has been alkaline (~ pH 8.0) with a typical total alkalinity (as calcium carbonate, $CaCO_3$) of approximately 145 mg/L. The hardness (the concentration of dissolved calcium and magnesium) has been steadily increasing since 1999, and is now approximately 800 mg/L. The increase is due to increasing concentrations of calcium in seepage water from the WRSF. The concentrations of sulfate (SO_4^{2-}) in the seepage water have also increased from approximately 600 mg/L in early 2000 to approximately 1,050 mg/L in late 2010.

Buckskin Creek upstream of the sedimentation pond in the drainage has been used to convey all run-off and seepage collected from the Buckskin WRSF since the beginning of mine construction in 1981. Water from the pond can be discharged to lower Buckskin Creek per the NPDES discharge permit or routed to the Thompson Creek pipeline. Seepage from the unlined pond has historically escaped downstream of the pond in the drainage, where the seepage could affect the water quality in lower Buckskin Creek. A pipeline was installed in 2011 that conveys seepage water collected from the Buckskin WRSF directly to the Thompson Creek pipeline. This has improved the water quality in the pond and in Buckskin Creek downstream of the pond. Lower Buckskin Creek downstream of the pond will continue to be the conveyance for water discharged from the pond downstream to the confluence of Buckskin Creek with Thompson Creek, the receiving stream for this outfall (Outfall 001).

Table 3.6-3. Buckskin Creek water quality, monitoring site Buck.

Parameter	Units	Sample count	Median	Mean	95^{th} %	Count < detect.
pH	Standard Units (s.u.)	19	8.16	8.03	8.31	N/A
Alkalinity	mg/L	18	138	141	159	0
Hardness	mg/L	19	690	685	765	0
TSS	mg/L	18	1	4	10	13
NO_3^-/NO_2^-	mg/L	18	12	12	15	0
NH_3	mg/L	15	0.050	0.050	0.050	15
SO_4^{2-}	mg/L	18	887.5	894	994	0
Cl^-	mg/L	18	3	2.9	3.4	0
TOTAL METALS						
Al	µg/L	18	5	14	55	1
As	µg/L	18	1.50	1.4	2.1	1
Cd	µg/L	18	0.55	0.49	0.7	0
Cu	µg/L	18	0.6	1.0	2.5	1
Cr (III/IV)	µg/L	17	0.50	0.51	0.54	16
Fe	µg/L	18	30	145	364.25	16
Pb	µg/L	18	0.050	0.056	0.10	16
Mn	µg/L	18	1	1	2	1
Hg	µg/L	18	0.050	0.050	0.050	18
Mo	µg/L	18	47	47	59	0
Ni	µg/L	17	1.3	1.9	5.3	0
Se	µg/L	18	34.5	35	44	0
Zn	µg/L	18	7	7	13	1
DISSOLVED METALS						
Al	µg/L	19	1	2	4	14
As	µg/L	19	1.50	1.4	2.1	1
Cd	µg/L	19	0.51	0.43	0.58	1
Cu	µg/L	19	0.4	0.7	0.58	0
Cr (III/IV)	µg/L	18	0.50	0.50	0.50	18
Fe	µg/L	19	30	39	47.3	18
Pb	µg/L	19	0.050	0.051	0.052	17
Mn	µg/L	19	1	1	2	4
Hg	µg/L	19	0.050	0.050	0.050	19
Mo	µg/L	16	47	46	58	0
Ni	µg/L	18	1.3	2.1	4.9	0
Se	µg/L	16	33	34	41	0
Zn	µg/L	19	8	8	19	1

The concentrations of metals in lower Buckskin Creek (Buck) are for the most part low. The only metals with elevated concentrations are selenium (35 µg/L), molybdenum (47 µg/L) and sulfate (894 mg/L) (Table 3.6-3). The concentrations of selenium are believed to be at a steady-state concentration after having increased since the early 1990s.

As a general point of comparison, the WQS for aquatic life for the concentration of total selenium is 20 µg/L for the acute (CMC) and 5 µg/L for the chronic (CCC) condition (Table 3.6-2). However, these WQSs do not apply to Buckskin Creek (see below for further discussion of this issue), which serves only to convey discharge from the sedimentation pond via Outfall 001 to Thompson Creek (receiving stream). The median, mean, and 95th percentiles for the concentrations of total selenium at the lowermost site, Buck (Figure 3.6-1., Table 3.6-3.), are all greater than the aquatic life standards. However, as noted previously, this water is actively managed as part of the mine water management system and WQSs do not apply to this stream above its confluence with Thompson Creek. The concentration of molybdenum appears to be increasing as with the concentrations of calcium and sulfate. There is no Idaho WQS for molybdenum.

Some amount of mine-affected groundwater (intercepted from the toe of the Buckskin WRSF) is discharged either to lower Buckskin Creek below Outfall 001 or to Thompson Creek directly. The water from Outfall 001 is subject to effluent limits for various constituents. The NPDES permit conditions contains different effluent limitations for each constituent for this outfall, depending upon whether Thompson Creek flows are greater or less than 7 cfs. The 7 cfs dilution trigger is to ensure there is adequate dilution of Outfall 001 releases, so that stream WQS are met in Thompson Creek.

Effluent limits may be greater than the in-stream standard because the effluent will be diluted by the receiving water. The 7 cfs trigger is a function of the establishment of a mixing zone within a specific distance downstream of the outfall, based upon modeling, to ensure aquatic life is protected even just below the outfall prior to complete mixing. As part of the permitting process, the IDEQ analyzes the mixing zone considering the chemistry of the receiving water, the biological condition of the zone, bioaccumulation factors, fish passage requirements, channel characteristics, and resultant effluent plume dispersion/dilution modeling. The NPDES permit limits are in part based on a 2000 mixing model (IDEQ 2000). Although the NPDES permit allows discharge from Outfall 001 when Thompson Creek flows are less than 7 cfs, not doing so provides additional insurance against in-stream exceedances of the selenium criterion.

Between January 2008 through December 2012, there were controlled discharges from Outfall 001 during 12 separate months. The effluent limits for regulated parameters were met during all discharges except for limits for selenium at Outfall 001 and total suspended solids (TSS) at Outfall 002 (ECHO database, EPA 2012a). Outfall 001 discharges are discussed below. Outfall 002 discharges are discussed in the Pat Hughes Creek section that follows.

In two of those months the concentrations of total selenium exceeded the applicable effluent limits (Table 3.6-4). As previously discussed, TCMC installed a pipeline in late 2011 to collect seepage water, thereby improving the water quality and eliminating exceedances of the selenium

WQS. There was no discharge from Outfall 001 between the time the pipeline was installed and the end of 2012.

Table 3.6-4. All exceedances, Outfalls 001 and 002.

Outfall	Month and Year	Parameter	Average Monthly Concentration		Maximum Daily Concentration	
			Reported Result	Effluent Limit	Reported Result	Effluent Limit
001	June 2009	Se (µ/L)	**53.5**	41	53.5	56
001	June 2011	Se (µ/L)	**60.25**	41	**63**	46
002	May 2008	TSS (mg/L)	9	20	**31**	30
002	Apr 2009	TSS (mg/L)	**43**	20	**111**	30
002	Apr 2012	TSS (mg/L)	**46**	20	**46**	30
002	May 2012	TSS (mg/L)	**44**	20	**44**	30

Values in **bold** indicate an exceedance of the effluent limit.

The WQSs do not list specific beneficial use designations for Buckskin Creek. However, as undesignated waters, cold water aquatic life and secondary contact recreation designated beneficial uses typically apply by default (Section 101, IDAPA 58.01.02). Accordingly, Buckskin Creek is identified as fully supporting its designated cold water aquatic life beneficial use (IDEQ 2011a) based on analyses of samples taken in 1998 under the IDEQ's Beneficial Use Reconnaissance Program (BURP). The analyses were assessed in 2002, and are reflected in the most recent approved IR (IDEQ 2011a). However, the BURP protocols are for perennial streams and are not appropriate for streams with low or intermittent flow. Therefore, the IDEQ intends to administratively correct the status of Buckskin Creek in the 2014 IR by placing the stream assessment units in Category 4c: streams impaired by pollution, not *pollutants* (Saffle 2013). Such assessment precludes further assessment (beneficial use support) of the assessment unit, and does not require development of TMDLs. A TMDL is only established for pollutants such as sediment or temperature and not for pollution such as flow or habitat alteration. In summary, Buckskin Creek is considered by TCMC and the IDEQ to be a permanently highly perturbed, flow-altered stream whose flow and water quality is a result of mine operations in compliance with the NPDES permit (Saffle 2013).

The water quality in lower Pat Hughes Creek improves below the toe of the WRSF where seepage surfaces (site PH TOE, Section 3.6.1.2.). Water quality data for the watershed is from two surface water monitoring locations: PAT which represents water flowing into the sedimentation pond, and PATP which represents water in the pond. Comparing the medians of parameters analyzed from PATP with those from BUCK shows that hardness, alkalinity, and the concentration of sulfate are lower at PATP than at BUCK. The concentrations of selenium and molybdenum are also lower at PATP, as are the concentrations of several other trace metals (or metalloids), which at least in part indicates that water management strategies in the Pat Hughes watershed are generally meeting design objectives. The concentration of total selenium is often higher than the CCC at PAT and PATP, but such concentrations are in water actively managed by TCMC (Figure 3.6-1., Table 3.6-5).

Table 3.6-5. Pat Hughes Creek water quality, monitoring sites PAT and PATP.

		PAT						PATP					
Parameter	**Unit**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**
pH	s.u.	7.68	7.8	6.8	8.11	522	0	7.95	8.04	6.9	8.95	207	0
Alkalinity	mg/L	98.1	100	62.6	127	52	0	71.3	71	34.2	133	25	0
Hardness	mg/L	312	332	96.7	479	75	0	344	356	218	447	27	0
Turbidity	NTU	10.5	1	0	28.4	474	1	15.9	1.53	0	43.6	178	1
TSS	mg/L	27.8	10	1	19.2	59	45	11.3	10	10	19.6	27	19
TDS	mg/L	569	587	200	873	53	0	622	612	368	833	26	0
Cl^--T	mg/L	14	9.9	3.22	33.9	52	0	15.5	10	6	42.4	26	0
F^--T	mg/L	0.18	0.19	0.1	0.29	43	1	0.242	0.21	0.16	0.41	18	0
SO_4^{2-}	mg/L	326	334	102	505	538	0	347	328	185	548	209	0
NO_2^-/NO_3^-	mg/L	1.89	1.64	0.44	4.24	52	0	1.95	1.84	0.19	4.76	26	1
CONCENTRATIONS OF TOTAL METALS													
Al	µg/L	872	64	7	1000	53	0	209	62.5	10.3	670	26	0
As	µg/L	1.39	0.5	0.1	1.34	53	8	0.808	0.75	0.1	1.65	26	5
Ba	µg/L	58.4	54	20.6	85	53	0	52.2	49.2	24.4	75	26	0
Ca	mg/L	101	106	34.4	149	53	0	105	110	66.2	134	25	0
Cd	µg/L	0.31	0.07	0.02	1.52	53	15	0.312	0.16	0.05	1.56	26	5
Co	µg/L	1.21	0.4	0.1	6.1	44	1	0.883	0.45	0.2	3.13	18	0
Cr	µg/L	1.55	0.5	0.5	7.08	44	28	1.02	0.5	0.5	2.87	18	11
Cu	µg/L	2.7	0.9	0.1	5.72	53	4	2.13	1.95	0.67	4.4	26	1
Fe	µg/L	969	77	30	905	53	14	208	107	30	743	26	8
Hg	µg/L	0.05	0.05	0.05	0.1	53	52	0.057	0.05	0.05	0.1	26	25
K	mg/L	1.45	1	1	2.67	12	1	2.75	3	1.3	3.85	4	0
Mg	mg/L	18.7	20	7.2	29.8	53	0	21.1	22	11	26.8	25	0
Mn	µg/L	110	17.7	2.73	558	53	0	111	45	16.8	488	26	0
Mo	µg/L	12.3	8.05	4.47	18.1	53	0	13.8	12.4	5.84	35.5	26	0
Na	mg/L	43.1	45	18.4	68.1	53	0	51.4	51	31	68.8	25	0
Ni	µg/L	2.35	1.45	0.2	7.56	44	3	2.1	1.6	0.58	4.19	18	0
Pb	µg/L	3.08	0.15	0.05	2.27	53	15	0.59	0.27	0.05	1.76	26	3
Sb	µg/L	0.24	0.2	0.09	0.48	44	4	0.265	0.23	0.11	0.46	18	1
Se	µg/L	5.32	5	1	11.4	53	1	6.62	6.5	2.25	12	26	1

		PAT						PATP					
Parameter	**Unit**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**
Zn	µg/L	24	5	2	93	53	1	17.2	11.3	2.85	63.2	26	0
CONCENTRATIONS OF DISSOLVED METALS													
Al	µg/L	8.87	4	1	30.5	54	14	12.5	6	1	48.2	28	4
As	µg/L	0.45	0.45	0.1	0.73	54	5	0.66	0.55	0.14	1.4	28	3
Ba	µg/L	48.4	51.2	15	74.7	54	0	48.4	48.5	17.9	66.6	28	0
Ca	mg/L	79.2	74	27	112	21	0	97.6	110	53.4	120	13	0
Cd	µg/L	0.42	0.05	0.05	1.64	54	31	0.31	0.06	0.01	1.29	28	12
Co	µg/L	0.74	0.2	0.1	1.7	45	10	0.565	0.3	0.1	2.09	20	0
Cr	µg/L	0.50	0.5	0.5	0.5	45	44	1.8	0.5	0.5	1.81	20	19
Cu	µg/L	0.76	0.60	0.10	2	54	7	1.6	1	0.2	4	28	1
Fe	µg/L	30.4	30	30	30	54	52	30	30	30	30	28	28
Hg	µg/L	0.05	0.05	0.05	0.05	51	51	0.05	0.05	0.05	0.05	26	26
K	mg/L	1.25	1	1	2	12	2	3	3	1.4	4.6	5	0
Mg	mg/L	14.7	13	5	23	21	0	21.3	22	9	38	13	0
Mn	µg/L	76.4	4.37	0.21	318	54	3	58	16	0.4	328	28	0
Mo	µg/L	8.48	8.42	4.43	11.9	21	0	18.4	13	9.18	45	13	0
Na	mg/L	34.9	37	17	58	21	0	48.4	49	23.2	64.2	13	0
Ni	µg/L	1.32	0.9	0.1	3.84	45	4	1.54	1.05	0.58	4.11	20	1
Pb	µg/L	0.05	0.05	0.05	0.107	54	48	0.062	0.05	0.05	0.07	28	24
Sb	µg/L	0.17	0.14	0.05	0.288	45	4	0.18	0.15	0.05	0.30	20	2
Se	µg/L	5.87	5	1	13.8	23	2	7.38	7	3.4	12.4	13	1
Zn	µg/L	15.4	4	2	63.2	54	7	12.1	4	1.3	46.6	28	3

During the most recent regulatory period (January 2008 through December 2012), there were controlled discharges from Outfall 002 (lower Pat Hughes Creek) during 11 separate months. The effluent limits for regulated parameters were met during all discharges except for TSS during four of the months (ECHO database, EPA 2012a) (Table 3.6-4). Pat Hughes Creek is listed as not having been assessed in the latest IR (IDEQ 2011a). Like Buckskin Creek, Pat Hughes Creek is considered to be a permanently highly perturbed, flow-altered stream whose flow and water quality is the result of mine operations in compliance with the NPDES permit (Saffle 2013). Accordingly, the IDEQ intends to administratively correct the status of Pat Hughes Creek in the 2014 listing by placing the stream assessment units in Category 4c: streams impaired by pollution, not *pollutants* (Saffle 2013).

Thompson Creek is the receiving stream for both Buckskin and Pat Hughes creeks. TCMC has monitored the water quality of Thompson Creek upstream of Buckskin Creek (i.e., upstream of all of the mine operations), as well as at several downgradient sites (Figure 3.6-1). Site TC4 is the upgradient site. Water at this site has good quality, except that unlike most trace metals, the background concentrations of molybdenum are above the laboratory detection limit. The concentration varies seasonally, averaging 0.7 µg/L during snowmelt run-off, and 2.3 µg/L during base flow. The concentrations of selenium are almost always 1 µg/L or less, but on occasion have reached 2 µg/L. Total dissolved solids (TDS), conductivity, hardness, and the concentrations of sulfate, nitrate, barium, molybdenum, and selenium are all higher at TC3 than at TC4 (Table 3.6-6). The higher values for these parameters are attributed primarily to contributions previously noted in the mine-affected tributary (Buckskin Creek).

Of these parameters, only the concentration of selenium at TC3 has exceeded the water quality criteria for aquatic life (the concentration of selenium at TC4 is consistently at or below the detection limit of 1 µg/L). The concentration of selenium at TC3 has increased to a mean of 4.4 µg/L during the baseflow season since 2000, and at TC1 (the lowermost site on Thompson Creek) the concentration decreases to between 2 µg/L and 4 µg/L. At TC3 the concentration of selenium equaled or exceeded the CCC of 5 µg/L during low flow periods during 2000 to 2004. However, since 2005, when TCMC implemented the previously mentioned water management strategy of discharging from Outfall 001 only when flow in Thompson Creek is at least 7 cfs, the concentration of selenium at TC3 has not exceeded the CCC of 5 µg/L. Concentrations of selenium equal to 5 µg/L were measured in samples from TC3 during three sampling events (August 2006, October 2006, and October 2009) during 2005 to 2010. All other measured concentrations of selenium were between 2 µg/L and 4 µg/L at TC3. The median concentration of selenium at TC3 is 3 µg/L (Table 3.6-6).

As previously noted, the water quality of Thompson Creek is not impaired upstream or downstream of the mine. The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses for Thompson Creek. The most recent approved IR considers Thompson Creek as fully supporting its cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses (IDEQ 2011a).

Table 3.6-6. Thompson Creek water quality, TC3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	128	0	7.8	8.2
Alkalinity	mg/L	1	54	0	51	61
Hardness	mg/L	1	54	0	88	141
TDS	mg/L	5	54	0	165	255
Conductivity[5]	µS/cm	1	119	0	234	381
Nutrients						
NH_3	mg/L	0.05	14	13	0.05	0.06
NO_3^-	mg/L	0.05	54	0	0.63	1.24
Anions						
Cl^-	mg/L	1	54	43	1.0	1.3
F^-	mg/L	0.1	46	23	0.1	0.1
SO_4^{2-}	mg/L	1	54	0	61	121
Metals						
Al-total (T)	µg/L	1	54	0	40	552
Al-dissolved (D)	µg/L	1	53	5	5	111
As-T	µg/L	0.1	54	6	0.5	1.0
As-D	µg/L	0.1	54	4	0.5	0.7
Cd-T	µg/L	0.05	53	26	0.05	0.14
Cd-D	µg/L	0.05	53	38	0.05	0.07
Cr-T	µg/L	0.5	46	33	0.5	1.3
Cr-D	µg/L	0.5	46	45	0.5	0.5
Cu-T	µg/L	0.1	54	7	0.4	2.0
Cu-D	µg/L	0.1	54	11	0.3	0.6
Fe-T	µg/L	30	54	25	37	500
Fe-D	µg/L	30	54	42	30	73
Pb-T	µg/L	0.05	54	38	0.05	0.32
Pb-D	µg/L	0.05	53	51	0.05	0.05
Mn-T	µg/L	0.05	53	1	1.10	12.60
Mn-D	µg/L	0.05	54	9	0.20	0.89
Mo-T	µg/L	0.1	54	0	3.97	6.48
Mo-D	µg/L	0.1	21	0	3.82	5.24
Ni-T	µg/L	0.1	46	3	0.5	1.1
Ni-D	µg/L	0.1	46	5	0.4	0.8
Se-T	µg/L	1	58	2	3.0	6.0
Se-D	µg/L	1	21	2	3.0	6.0

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Zn-T	µg/L	2	54	12	3.0	7.3
Zn-D	µg/L	2	54	20	2.0	4.0

[1] Most common detection limit. Some detection limits changed between sample events.
[2] number of data points
[3] number of results below their detection limit
[4] Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
[5] field measurements

Water in the TSF (tailings pond and tailings solids) has elevated hardness and elevated concentrations of sulfate, chloride, molybdenum, iron, manganese, and arsenic. It is important to note that water managed in the TSF has no surface discharge to middle or lower Bruno Creek. In addition, the water quality in lower Bruno Creek is believed to be influenced by non-TCMC mining activity, i.e., water discharged from the Twin Apex mine has elevated concentrations of antimony, cadmium, lead, and zinc (based upon a single sample).

Although the tailings water is not discharged via the surface to Bruno Creek, some seepage from the TSF may be entering Bruno Creek. Seepage is inferred to be migrating underground from the TSF eastward into Redbird Creek (Section 3.6.1.2.). Water quality data for Redbird Creek and Bruno Creek (Outfall 003) show no exceedances of WQSs at either of these sites at the 95th percentile (Table 3.6-7., Table 3.6-8). However, molybdenum concentrations in Redbird Creek have increased roughly by a factor of two since 2000 (data collection began at the end of 1998), current concentrations in Redbird Creek are typically between 2 to 3 µg/L. Sulfate concentrations in Redbird Creek have increased by a factor of approximately three, to values approaching 200 mg/L over the previous 10 + years. These and other data support the inference that seepage began influencing Redbird Creek in 1999 or 2000. Water quality data for the SQ3 and SQ2 sites complies with all applicable WQSs (Table 3.6-9., Table 3.6-10).

The WQSs do not list specific beneficial use standards for Bruno or Redbird creeks. However, as undesignated waters, cold water aquatic life and recreation designated beneficial uses apply by default. Bruno Creek is 303(d)-listed for not supporting cold water aquatic life or salmonid spawning due to combined biota/habitat bioassessments (IDEQ 2011a). The 1980 EIS described a number of probable significant effects to Bruno Creek and its aquatic resources (USFS 1980, pp. 5-13, 5-14). For example, the EIS described how the TSF would cause substantial reductions in flow in Bruno Creek downstream with a corresponding increase in water temperature. Such changes would result in the loss of the aquatic resources in Bruno Creek downstream of the TSF. TCMC mitigated these losses by supporting development of anadromous fish habitat in S. Creek. Note that these losses were not due to any of the pollutants (e.g., elevated metals) discussed above.

As with Thompson Creek, the water quality of S. Creek has been monitored for a number of years, both upstream (SQ3) and downstream (SQ2) of the mine operations (Figure 3.6-1). Water quality data indicate slightly alkaline water (~ pH 8.0). Concentrations of constituents vary with flow and are higher during base flow and lower during spring snowmelt (Table 3.6-9., Table 3.6-10). The water quality is not impaired upstream or downstream of the mine.

Table 3.6-7. Redbird Creek water quality, RB1.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	30	0	8.2	8.5
Alkalinity	mg/L	1	28	0	161	183
Hardness	mg/L	1	28	0	331	365
TDS	mg/L	5	28	0	456	505
Conductivity[5]	µS/cm	1	25	0	358	828
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	28	25.0	0.05	0.05
Anions						
Cl^-	mg/L	1	27	0	32.0	39.2
F^-	mg/L	0.1	21	0	0.2	0.2
SO_4^{2-}	mg/L	1	27	0	133	194
Metals						
Al-T	µg/L	1	28	1	74	231
Al-D	µg/L	1	28	10	1	32
As-T	µg/L	0.1	28	9	0.4	0.5
As-D	µg/L	0.1	28	3	0.4	0.6
Cd-T	µg/L	0.05	28	23	0.05	0.11
Cd-D	µg/L	0.05	28	28	0.05	0.05
Cr-T	µg/L	0.5	21	17	0.5	3.0
Cr-D	µg/L	0.5	21	21	0.5	0.5
Cu-T	µg/L	0.1	28	6	0.7	3.0
Cu-D	µg/L	0.1	27	9	0.2	0.9
Fe-T	µg/L	30	28	9	45	143
Fe-D	µg/L	30	28	28	30	30
Pb-T	µg/L	0.05	28	9	0.07	0.64
Pb-D	µg/L	0.05	28	25	0.05	0.06
Mn-T	µg/L	0.05	28	0	2.83	6.06
Mn-D	µg/L	0.05	28	14	0.20	0.68
Mo-T	µg/L	0.1	27	0	1.91	2.56
Mo-D	µg/L	0.1	19	0	2.04	2.26
Ni-T	µg/L	0.1	21	4	0.2	5.3
Ni-D	µg/L	0.1	21	10	0.1	2.1
Se-T	µg/L	1	27	27	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Zn-T	µg/L	2	28	9	2.0	10.9
Zn-D	µg/L	2	28	14	2.0	4.0

Footnotes – see Table 3.6-6.

Table 3.6-8. Bruno Creek water quality, Outfall 003.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	127	0	7.9	8.1
Alkalinity	mg/L	1	28	0	228	271
Hardness	mg/L	1	108	0	353	395
TDS	mg/L	5	28	0	420	452
Conductivity[5]	µS/cm	1	123	0	528	792
Nutrients						
NH_3	mg/L	0.05	10	10	0.05	0.05
NO_3^-	mg/L	0.05	28	5.0	0.07	0.16
Anions						
Cl^-	mg/L	1	28	0	27.0	39.2
F^-	mg/L	0.1	19	0	0.3	0.3
SO_4^{2-}	mg/L	1	28	0	99	128
Metals						
Al-T	µg/L	1	28	2	3	12
Al-D	µg/L	1	27	18	1	3
As-T	µg/L	0.1	27	0	1.2	1.6
As-D	µg/L	0.1	28	0	1.2	1.5
Cd-T	µg/L	0.05	22	3	0.10	0.38
Cd-D	µg/L	0.05	28	17	0.05	0.11
Cr-T	µg/L	0.5	19	12	0.5	4.4
Cr-D	µg/L	0.5	19	17	0.5	1.0
Cu-T	µg/L	0.1	22	9	0.1	0.5
Cu-D	µg/L	0.1	26	9	0.3	0.5
Fe-T	µg/L	30	28	23	30	43
Fe-D	µg/L	30	28	28	30	30
Pb-T	µg/L	0.05	23	0	0.30	0.93
Pb-D	µg/L	0.05	27	19	0.05	0.18
Mn-T	µg/L	0.05	28	0	8.65	15.28
Mn-D	µg/L	0.05	28	2	5.33	9.79
Mo-T	µg/L	0.1	23	0	10.70	11.58
Mo-D	µg/L	0.1	19	0	10.50	12.13
Ni-T	µg/L	0.1	19	0	2.0	3.1
Ni-D	µg/L	0.1	19	0	1.8	2.6

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Se-T	µg/L	1	23	14	1.0	2.0
Se-D	µg/L	1	20	15	1.0	2.0
Zn-T	µg/L	2	22	0	16.0	19.0
Zn-D	µg/L	2	28	0	12.0	18.1

Footnotes – see Table 3.6-6.

Table 3.6-9. S. Creek water quality, SQ3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	117	0	8.0	8.2
Alkalinity	mg/L	1	49	0	83	108
Hardness	mg/L	1	49	0	108	169
TDS	mg/L	5	49	0	175	246
Conductivity[5]	µS/cm	1	111	0	210	405
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	49	38	0.05	0.09
Anions						
Cl^-	mg/L	1	49	2	7.9	13.0
F^-	mg/L	0.1	42	7	0.1	0.2
SO_4^{2-}	mg/L	1	49	0	31	64
Metals						
Al-T	µg/L	1	49	0	161	1530
Al-D	µg/L	1	48	8	7	202
As-T	µg/L	0.1	49	2	0.6	1.5
As-D	µg/L	0.1	49	2	0.6	0.8
Cd-T	µg/L	0.05	49	43	0.05	0.07
Cd-D	µg/L	0.05	49	48	0.05	0.05
Cr-T	µg/L	0.5	42	28	0.7	2.0
Cr-D	µg/L	0.5	42	36	0.5	0.6
Cu-T	µg/L	0.1	49	5	0.4	3.2
Cu-D	µg/L	0.1	47	13	0.2	0.7
Fe-T	µg/L	30	49	11	143	1102
Fe-D	µg/L	30	49	27	30	139
Pb-T	µg/L	0.05	49	0	0.39	1.53
Pb-D	µg/L	0.05	49	32	0.05	0.13
Mn-T	µg/L	0.05	49	0	7.65	29.76
Mn-D	µg/L	0.05	49	1	1.36	3.88
Mo-T	µg/L	0.1	49	0	1.29	1.87
Mo-D	µg/L	0.1	19	0	1.29	2.13

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Ni-T	µg/L	0.1	42	0	0.7	1.8
Ni-D	µg/L	0.1	42	2	0.5	1.1
Se-T	µg/L	1	49	49	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0
Zn-T	µg/L	2	49	14	2.0	6.2
Zn-D	µg/L	2	46	24	2.0	3.0

Footnotes – see Table 3.6-6.

Table 3.6-10. S. Creek water quality data, SQ2.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	123	0	8.0	8.3
Alkalinity	mg/L	1	47	0	94	122
Hardness	mg/L	1	47	0	128	186
TDS	mg/L	5	47	0	191	258
Conductivity[5]	µS/cm	1	117	0	235	439
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	47	35	0.05	0.08
Anions						
Cl^-	mg/L	1	47	0	9.0	14.3
F^-	mg/L	0.1	40	5	0.1	0.2
SO_4^{2-}	mg/L	1	47	0	36	69
Metals						
Al-T	µg/L	1	47	0	126	1287
Al-D	µg/L	1	47	10	7	187
As-T	µg/L	0.1	47	5	0.6	1.3
As-D	µg/L	0.1	47	0	0.6	0.9
Cd-T	µg/L	0.05	47	39	0.05	0.08
Cd-D	µg/L	0.05	47	45	0.05	0.05
Cr-T	µg/L	0.5	40	14	0.7	4.0
Cr-D	µg/L	0.5	40	35	0.5	0.9
Cu-T	µg/L	0.1	47	4	0.6	3.2
Cu-D	µg/L	0.1	46	6	0.3	0.6
Fe-T	µg/L	30	47	12	121	844
Fe-D	µg/L	30	47	31	30	105
Pb-T	µg/L	0.05	47	0	0.43	2.01
Pb-D	µg/L	0.05	47	30	0.05	0.13
Mn-T	µg/L	0.05	47	0	6.40	25.03
Mn-D	µg/L	0.05	47	1	1.02	2.44
Mo-T	µg/L	0.1	47	0	1.78	2.79

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Mo-D	µg/L	0.1	19	0	1.98	2.68
Ni-T	µg/L	0.1	40	0	0.8	1.7
Ni-D	µg/L	0.1	40	2	0.4	1.2
Se-T	µg/L	1	47	48	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0
Zn-T	µg/L	2	47	5	3.0	6.7
Zn-D	µg/L	2	45	20	2.0	3.8

Footnotes – see Table 3.6-6.

The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses for S. Creek. The stream, as it flows past Redbird Creek and Bruno Creek to its (S. Creek) mouth, fully supports its designated cold water aquatic life beneficial uses (IDEQ 2012a). Salmonid spawning and secondary contact recreation were not assessed in the 2010 IR (IDEQ 2011a).

The Salmon River is also monitored upstream (SR3) and downstream (SR1) of the mine, i.e., upstream of the mouth of Thompson Creek and downstream of the mouth of S. Creek (Figure 3.6-1). Only the concentrations of sulfate and barium are slightly higher in the Salmon River at SR1 compared to their concentrations at SR3. For example, upstream of the mouth of Thompson Creek, the concentrations of sulfate at SR3 typically fluctuate between 4 µg/L and 6 µg/L; downstream of the mine, the concentrations of sulfate at SR1 fluctuate between 5 µg/L and 9 µg/L. Based upon these data, the water quality at both of the Salmon River monitoring sites meets all WQSs (Table 3.6-11., Table 3.6-12).

The WQSs list cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply as designated beneficial uses for the Salmon River downstream of Thompson Creek. The most recent approved IR considers the Salmon River downstream of S. Creek to fully support the cold water aquatic life and primary contact recreation beneficial uses of the Salmon River; support for salmonid spawning uses was not assessed (IDEQ 2011a). Between the mouths of Thompson and S. creeks, the Salmon River is 303(d)-listed for not supporting its cold water aquatic life beneficial uses due to sedimentation/siltation and water temperature (IDEQ 2011a). The ability of this section of the Salmon River to support the beneficial uses of domestic water supply, primary contact recreation, and salmonid spawning has not been assessed to date. Upstream of Thompson Creek, the Salmon River fully supports all of its beneficial uses (i.e., cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply) (IDEQ 2011a). The TSS and turbidity monitoring data collected from samples of Thompson Creek downstream of Pat Hughes Creek indicate that the mine is not contributing sediment to the Salmon River downstream of Thompson Creek.

Table 3.6-11. Salmon River water quality, SR3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	14	0	7.9	8.4
Alkalinity	mg/L	1	14	0	52	60
Hardness	mg/L	1	14	0	52	62
TDS	mg/L	5	14	0	74	92
Conductivity[5]	µS/cm	1	14	0	131	152
Nutrients						
NH_3	mg/L	0.05	2	2	0.05	0.05
NO_3^-	mg/L	0.05	14	12	0.05	0.07
Anions						
Cl^-	mg/L	1	14	8	1.0	2.4
F^-	mg/L	0.1	14	0	0.6	0.8
SO_4^{2-}	mg/L	1	14	0	5	7
Metals						
Al-T	µg/L	1	14	0	170	1263
Al-D	µg/L	1	14	0	11	80
As-T	µg/L	0.1	14	0	1.9	2.1
As-D	µg/L	0.1	14	0	1.4	1.6
Cd-T	µg/L	0.05	14	11	0.05	0.31
Cd-D	µg/L	0.05	14	14	0.05	0.05
Cr-T	µg/L	0.5	14	3	0.7	2.2
Cr-D	µg/L	0.5	14	13	0.5	0.7
Cu-T	µg/L	0.1	14	2	0.6	1.8
Cu-D	µg/L	0.1	14	6	0.2	0.4
Fe-T	µg/L	30	14	2	137	894
Fe-D	µg/L	30	14	11	30	73
Pb-T	µg/L	0.05	14	1	0.17	0.90
Pb-D	µg/L	0.05	14	3	0.05	0.09
Mn-T	µg/L	0.05	14	0	8.35	38.40
Mn-D	µg/L	0.05	14	3	0.55	1.75
Mo-T	µg/L	0.1	14	0	2.62	3.03
Mo-D	µg/L	0.1	2	0	2.46	2.77
Ni-T	µg/L	0.1	14	2	0.4	0.9
Ni-D	µg/L	0.1	14	8	0.1	0.6
Se-T	µg/L	1	14	14	1.0	1.0
Se-D	µg/L	1	2	2	1.0	1.0
Zn-T	µg/L	2	14	3	4.0	6.4
Zn-D	µg/L	2	14	9	2.0	4.0

Footnotes – see Table 3.6-6.

Table 3.6-12. Salmon River water quality, SR1.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	14	0	8.0	8.4
Alkalinity	mg/L	1	14	0	53	62
Hardness	mg/L	1	14	0	57	64
TDS	mg/L	5	14	0	78	101
Conductivity[5]	µS/cm	1	13	0	139	158
Nutrients						
NH_3	mg/L	0.05	2	2	0.05	0.05
NO_3^-	mg/L	0.05	14	13	0.05	0.05
Anions						
Cl^-	mg/L	1	14	8	1.0	2.4
F^-	mg/L	0.1	14	0	0.6	0.7
SO_4^{2-}	mg/L	1	14	0	7	9
Metals						
Al-T	µg/L	1	14	0	171	1638
Al-D	µg/L	1	14	1	8	83
As-T	µg/L	0.1	14	0	1.9	2.1
As-D	µg/L	0.1	14	0	1.4	1.6
Cd-T	µg/L	0.05	14	12	0.05	0.20
Cd-D	µg/L	0.05	14	14	0.05	0.05
Cr-T	µg/L	0.5	14	4	0.6	1.5
Cr-D	µg/L	0.5	14	14	0.5	0.5
Cu-T	µg/L	0.1	14	3	0.5	2.6
Cu-D	µg/L	0.1	14	3	0.2	0.6
Fe-T	µg/L	30	14	2	125	1095
Fe-D	µg/L	30	13	10	30	71
Pb-T	µg/L	0.05	14	2	0.22	1.60
Pb-D	µg/L	0.05	14	9	0.05	0.09
Mn-T	µg/L	0.05	14	0	8.32	45.10
Mn-D	µg/L	0.05	14	2	0.46	1.40
Mo-T	µg/L	0.1	14	0	2.57	2.94
Mo-D	µg/L	0.1	2	0	2.58	2.87
Nil-T	µg/L	0.1	14	1	0.5	1.2
Ni-D	µg/L	0.1	14	8	0.1	0.7
Se-T	µg/L	1	14	14	1.0	1.0
Se-D	µg/L	1	2	2	1.0	1.0
Zn-T	µg/L	2	14	3	4.0	8.1
Zn-D	µg/L	2	14	8	2.5	4.7

Footnotes – see Table 3.6-6.

The aforementioned 10 year data set for the receiving streams, was used to establish a conservative baseline water chemistry (95th percentile of the data collected in the low flow season of September through March, Table 3.6-13.) against which to compare predicted water quality. Three monitoring sites were used to best rep resent receiving stream conditions. TC4 (in Thompson Creek) and SR3 (in the Salmon River) are upstream of and presumably unaffected by the mine. SQ2 (in S. Creek) is downstream of Redbird and Bruno creeks and could be influenced by the mine. Although SQ3 is further upstream than SQ2 (also in S. Creek), it is still downstream of Redbird Creek, thus there are no true background sites for the S. Creek analysis. Use of SQ2 is likely more conservative because it is further downstream.

Table 3.6-13. Baseline water quality in Thompson Crk., S. Crk., and Salmon R.

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL[1]**	**N[2]**	**95th %[3]**	**N**	**95th %**	**N**	**95th %**
Field measurements								
mol/L		0.1	72	8.2	71	8.3	3	8.0
Conductivity	µS/cm	1	63	148	65	454	3	155
Turbidity	NTU	0.05	64	48.5	65	23.8	3	0.8
Physical								
Alkalinity-T	mg/L	1	19	50	17	123	4	64
Hardness-T	mg/L	1	19	52	17	190	4	62
TDS	mg/L	5	19	92	17	262	4	89
TSS	mg/L	10	19	10.0	17	10.0	4	10.0
Nutrients								
NH_3	mg/L	0.05	8	0.05	6	0.05	1	0.05
NO_2^-	mg/L	0.01	6	0.01	6	0.01	1	0.01
NO_3^-	mg/L	0.05	19	0.081	17	0.148	4	0.076
P-T	mg/L	0.01	19	0.030	17	0.047	4	0.016
Major ions								
Ca^{2+}	mg/L	1	19	16.2	17	46.4	4	21.9
Mg^{2+}	mg/L	0.5	19	3.0	17	18.2	4	2.0
K^+	mg/L	1	8	1.7	6	2.0	1	1.0
Na^+	mg/L	1	19	6.0	17	12.2	4	5.9
Br^-	mg/L	0.5	8	0.50	6	0.50	1	0.50
Cl^-	mg/L	1	19	1.00	17	15.04	4	1.00
F^-	mg/L	0.1	15	0.11	14	0.20	4	0.70
SO_4^{2-}	mg/L	1	19	14.10	17	75.40	4	8.55
Metals								
Al-T	µg/L	1	19	86.5	17	175.4	4	179.0
Al-D	µg/L	1	19	8.8	17	25.8	4	10.6

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL[1]**	**N[2]**	**95th %[3]**	**N**	**95th %**	**N**	**95th %**
Sb-T	µg/L	0.05	15	0.10	13	0.13	4	0.16
Sb-D	µg/L	0.05	15	0.06	13	0.11	4	0.12
As-T	µg/L	0.1	19	0.85	17	1.44	4	1.77
As-D	µg/L	0.1	19	0.51	17	0.96	4	1.57
Ba-T	µg/L	0.5	19	6.79	17	32.42	4	6.53
Ba-D	µg/L	0.5	19	6.51	17	31.08	4	5.91
Be-T	µg/L		8	1.00	6	1.00	1	1.00
Be-D	µg/L		8	1.00	6	1.00	1	1.00
Cd-T	µg/L	0.05	19	0.050	17	0.080	4	0.050
Cd-D	µg/L	0.05	19	0.050	17	0.050	4	0.050
Cr-T	µg/L	0.5	15	1.76	14	2.03	4	1.85
Cr-D	µg/L	0.5	15	0.50	14	1.01	4	0.50
Co-T	µg/L	0.1	15	0.10	13	0.20	4	0.10
Co-D	µg/L	0.1	15	0.10	13	0.14	4	0.10
Cu-T	µg/L	0.1	19	0.85	17	2.04	4	1.07
Cu-D	µg/L	0.1	19	0.81	16	0.53	4	0.40
Fe-T	µg/L	30	19	64.7	17	123.6	4	138.3
Fe-D	µg/L	30	19	30.0	17	30.0	4	30.0
Pb-T	µg/L	0.05	19	0.118	17	0.778	4	0.190
Pb-D	µg/L	0.05	19	0.075	17	0.102	4	0.050
Mn-T	µg/L	0.05	19	2.12	17	6.48	4	8.98
Mn-D	µg/L	0.05	19	0.48	17	2.51	4	1.87
Hg-T	µg/L	0.0001	7	0.00064	7	0.00077	2	0.00070
Hg-D	µg/L	0.05	0		0		0	
Mo-T	µg/L	0.1	19	2.18	17	2.83	4	2.87
Mo-D	µg/L	0.1	10	2.07	10	2.80	1	2.80
Ni-T	µg/L	0.1	15	0.66	14	1.28	4	0.60
Ni-D	µg/L	0.1	15	0.46	14	1.34	4	0.60
Se-T	µg/L	1	22	1.95	17	1.00	4	1.00
Se-D	µg/L	1	11	2.00	10	1.00	1	1.00
Ag-T	µg/L	0.03	15	0.072	14	0.074	4	0.056
Ag-D	µg/L	0.03	15	0.051	14	0.055	4	0.030
Tl-T	µg/L	0.5	8	0.50	6	0.50	1	0.50
Tl-D	µg/L	0.5	8	0.50	6	0.50	1	0.50
U-T	µg/L	1	8	1.00	6	1.00	1	2.00
U-D	µg/L	1	8	1.00	6	1.00	1	2.00
V-T	µg/L	1	8	2.00	6	2.00	1	1.00
V-D	µg/L	1	8	2.00	6	2.00	1	1.00

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL**[1]	**N**[2]	**95th %**[3]	**N**	**95th %**	**N**	**95th %**
Zn-T	µg/L	2	19	6.01	17	4.02	4	5.70
Zn-D	µg/L	2	19	3.00	16	2.50	4	3.70

[1] detection limit
[2] number of samples
[3] 95th percentile

In addition to the numeric WQSs, an antidegradation policy is also relevant to TCMC receiving streams. As part of the WQSs (IDAPA 58.01.02.051) three categories (Tiers I, II, and III) of waters are recognized. Tier II is the category relevant to Thompson Creek, S. Creek, and the Salmon River. Tier II waters are streams where the current water quality is better than the quality necessary to support beneficial uses. Under the existing antidegradation policy, point-source discharges may only lower water quality in Tier II waters after a public review of the social and economic tradeoffs of doing so. In other words, even if there is enough assimilation capacity to allow water quality degradation and still meet a stream's beneficial use standards, it is not necessarily allowable to do so. Where possible, the intent is to maintain the highest water quality and conserve assimilation capacity. The antidegradation policy is addressed under the NPDES permit program (as well as other CWA requirements including Section 401c and Section 404). Point-source discharges must undergo antidegradation review whenever there is an application for a new or renewed NPDES permit. The antidegradation policy would also apply to any applications for 404 permits for the mine.

The above discussions have generally focused upon base flow conditions during which there is less dilution capacity and thus the potential for highest concentrations of trace elements. However, the concentration of TSS tends to increase during the run-off season and is also subject to NPDES effluent limitations (10 mg/L). Weekly TSS monitoring at Outfalls 001, 002, and 003 indicates that concentrations of TSS are almost always reported as less than 10 mg/L. Concentrations greater than 10 mg/L are reported even more rarely at these sites (see previous discussion in this section). Turbidity is also generally low at these outfalls. Together, this information indicates that TCMC has been successful at controlling sediment generated by the mine, typically minimizing TSS contributions to, and turbidity in, Buckskin, Pat Hughes, and Bruno creeks. The few exceedances that have occurred were during spring run-off when all streams in the region were carrying relatively high amounts of sediment.

Monthly TSS and turbidity records for the upstream Thompson Creek site (TC4) show concentrations of TSS at less than 10 mg/L and turbidity averaging 6.5 nephelometric turbidity units (NTUs). The records for sites in lower Thompson Creek show similar results and indicate excellent control of sediment at the mine. The records for the site for S. Creek also show that TSS is most often less than 10 mg/L and turbidity averages 7.4 NTUs. Monthly records of the concentration of TSS and the turbidity in the Salmon River show values similar to those for the tributary streams (Thompson Creek and S. Creek).

Surface Water Rights

There are numerous water rights for streams in the analysis area, many of which are owned by TCMC or the BLM. TCMC has water rights for a portion of the flow in Buckskin Creek (72-07552, combined with 72-07553 into 72-7193 in 2006), Pat Hughes Creek (72-07553), Thompson Creek, Bruno Creek, S. Creek, and the Salmon River (72-7193, 1981), and two springs in the Buckskin watershed. These three water rights allow for the effective de-watering of Buckskin Creek and Pat Hughes Creek. The three water rights total 20.86 cfs with the allowable beneficial uses as industrial and irrigation (IDWR 2012a).

The BLM water rights are for a portion of the flow in Buckskin Creek, Pat Hughes Creek, the unnamed drainage channel east of Pat Hughes Creek, Thompson Creek, and the Salmon River. The water is used for stock watering. The Forest Service has water rights for stock watering along upper Thompson Creek and S. Creek. Idaho has water rights for a portion of S. Creek for fish propagation. There are numerous privately owned water rights for water from near the mouths of Thompson Creek and S. Creek as well as from the Salmon River for irrigation.

Most BLM land, including the selected land, is subject to Executive Order *Public Water Reserves [PWRs] No. 107*. Under the Executive Order, the BLM reserves a limited quantity of water from natural springs and water holes found on such lands for public uses for domestic human consumption and stock watering. A PWR cannot be transferred, even if the land on which it occurs will leave Federal ownership; instead, a PWR must be revoked. The BLM has inventoried the selected land for public water reserves, and all of the reserves were revoked (76 FR 38206).

3.6.1.2. Groundwater

In general, the higher elevation portions in the north of the analysis area are groundwater recharge areas, and the lower elevations in the south are groundwater discharge areas. Consequently, groundwater movement is generally from north to south. Bedrock geology controls groundwater movement in the analysis area. The porosity of a geologic unit is the amount of void space available. The permeability of a geologic unit is the ability of the unit to allow fluids to pass through it. The hydraulic conductivity of a geologic unit is a measure of how easily water moves through it, a function of the permeability of the unit and the properties of the fluid.

The bedrock in the analysis area has primary porosity from the space between the particles that make up the rock, and considerable secondary porosity from space due to fractures. However, in general, groundwater is limited to depths of less than 2,500 feet from the ground surface due to the weight of the overlying rock which does not allow fractures to open (e.g., Nelson 2011). Most groundwater movement in the analysis area is through fractured bedrock, particularly along the contacts between rock units. However, there is also substantial groundwater movement through the relatively thin (but highly permeable) colluvium and alluvium found at the surface or, in some cases, between bedrock formations.

The Copper Basin Formation (metasedimentary rock underlying the entire analysis area except where intruded by the Thompson Creek intrusive complex and the Challis Volcanic Group) has an estimated mean hydraulic conductivity of 2.7 feet per day. The Thompson Creek intrusive complex has an estimated mean hydraulic conductivity of 1.5 feet per day. The Challis Volcanic Group, the youngest rocks in the area, is locally continuous, and follows the topography where present. These rocks have an estimated mean hydraulic conductivity of 0.56 feet per day. The hydraulic conductivity has not been estimated for the Saturday Mountain Formation (metasedimentary rock, same depositional setting as that of the Copper Basin Formation). A thin veneer of alluvial and colluvial deposits overlies these bedrock units in places. The thickness of the alluvial and colluvial deposits is greatest in the valley bottoms where the deposits are the primary aquifers. These deposits have an estimated mean hydraulic conductivity of 20.3 feet per day.

Buckskin Creek Basin

The Buckskin WRSF is the primary storage site for non-acid-generating waste rock (Type 1), but some potentially acid-generating waste rock (Type 2) is also in the WRSF. A perforated underdrain was constructed under the WRSF to promote rapid lateral drainage of seepage from along the base of the facility to minimize infiltration of the seepage into groundwater. A relatively thin layer of unconsolidated colluvium and alluvium covers the surface of the middle and lower Buckskin watershed. Below the downgradient face of the WRSF and downgradient of the sedimentation pond there are places where volcanic rocks (Challis Volcanic Group) are just below the unconsolidated deposits. Both of these units are underlain by metasedimentary rocks (Copper Basin Formation), except for a small area below the upper section of the WRSF underlain by a thin lens of Thompson Creek intrusive rock (Figure 3.6-4). Seepage from the WRSF enters the sedimentation pond via the colluvium, which is hydraulically connected to the underdrain system. The pond is unlined, so some water in the pond infiltrates to groundwater (Figure 3.6-4). However, the pond will be lined in the future to prevent such infiltration (Section 2.4.1.6).

There are seven wells in the Buckskin Creek watershed to monitor groundwater associated with the Buckskin WRSF (Figure 3.6-4., Figure 3.6-5). Artesian flow in BW1 and BW3 demonstrates upward groundwater flow from deep bedrock. In wells with final depths in the colluvium, the groundwater flow is approximately horizontal, mimicking the gradient of the topography. There is a slight downward groundwater flow between the colluvium and intermediate-depth bedrock aquifers between BW2 and BW4. Downstream of the sedimentation pond, observations from BW5, BW6, and BW7 indicate equalization between the units, with a very slight upward groundwater flow above the confluence of Buckskin and Thompson creeks. These groundwater flow patterns function as a hydraulic trap that limits downgradient groundwater flow, i.e., seepage through the waste rock stays in the local, shallow aquifer that discharges to Thompson Creek and does not enter the deeper, regional aquifer. Both surface and groundwater flows through the colluvium and metasedimentary rock in the Buckskin watershed vary seasonally, as expected in a snowmelt driven system (Table 3.6-14).

Table 3.6-14. Buckskin watershed mean annual groundwater flow rates.

Geologic Unit	Hydraulic Conductivity (feet/second)	Flow Rate (gpm)
Colluvium	2.2 x10^{-4}	12.7
Metasedimentary rocks	1.1 x 10^{-6}	1.6

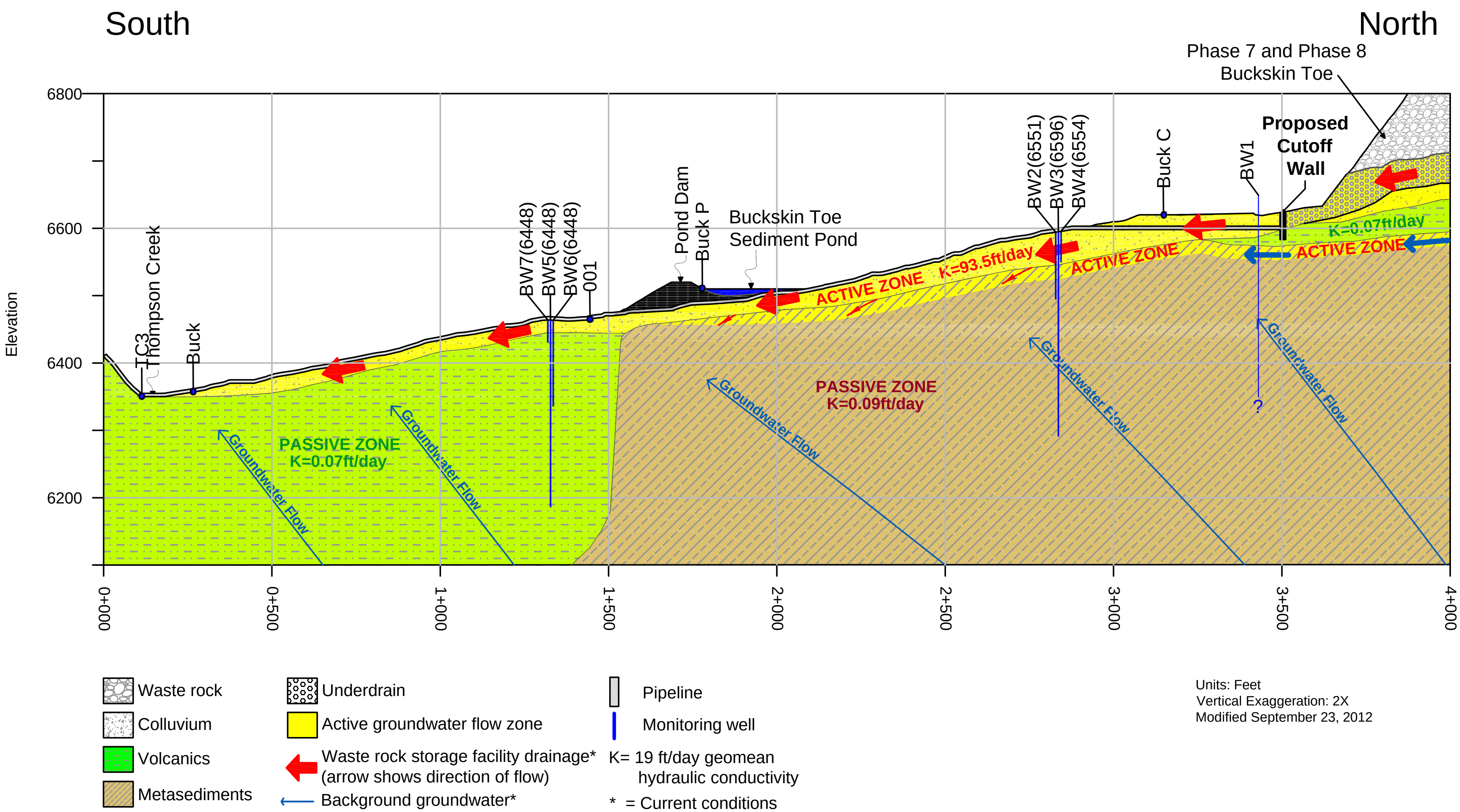
A surface water gaging station is downgradient of the point where groundwater and waste rock seepage exit the Buckskin WRSF underdrain. Flow at the gaging station was divided by source into total flow and water derived from infiltration (seepage) through the facility, which is considered mine water. Spring snowmelt produces the maximum flows at this station (Table 3.6-15).

Table 3.6-15. Flow and infiltration, toe of Buckskin WRSF.

Flow Event	Flow (acre-feet/year)	Infiltration (acre-feet/year)	Percent of Flow from Infiltration (%)
Maximum	1200	910	76
Mean	520	410	79
Minimum	140	105	74

Sulfate was used as a conservative[8] tracer to determine the influence of the Buckskin WRSF on water chemistry in the analysis area based on the assumption that the only sources of sulfate in the hydrologic system within the WRSF are oxidized sulfide minerals from the waste rock. The concentration of sulfate increased from approximately 600 mg/L in early 2000 to approximately 1,050 mg/L in late 2010 at the toe of the Buckskin WRSF. The increasing concentrations indicate that sulfide oxidation occurs in the facility, but due to the excess alkalinity, there has not been ARD, and the uniform concentrations of alkalinity indicate the system is well-buffered. The dominant volcanic and metasedimentary rocks in the facility are non-acid generating. However, the rocks contain enough sulfide minerals, notably pyrite and molybdenite, to be a source of sulfate under the oxidizing conditions of the facility. The concentrations of sulfate in groundwater in the colluvium and metasedimentary rock form a sulfate plume extending 100 feet below the ground surface, with the majority of the plume in the colluvium. The plume in the bedrock metasedimentary and volcanic rocks extends from the toe of the facility to Thompson Creek. The discharge of this groundwater contributes sulfate to Thompson Creek. In addition to sulfate, the concentration of calcium in groundwater has increased from approximately 190 mg/L in 2000 to 240 mg/L in 2010, primarily via the dissolution of pH buffering minerals, principally calcium carbonate ($CaCO_3$).

8 a conservative tracer does not react with other compounds along the flow path



Source: JBR (2012g)

Figure 3.6-4
Buckskin Creek drainage cross-section
Thompson Creek Mine EIS

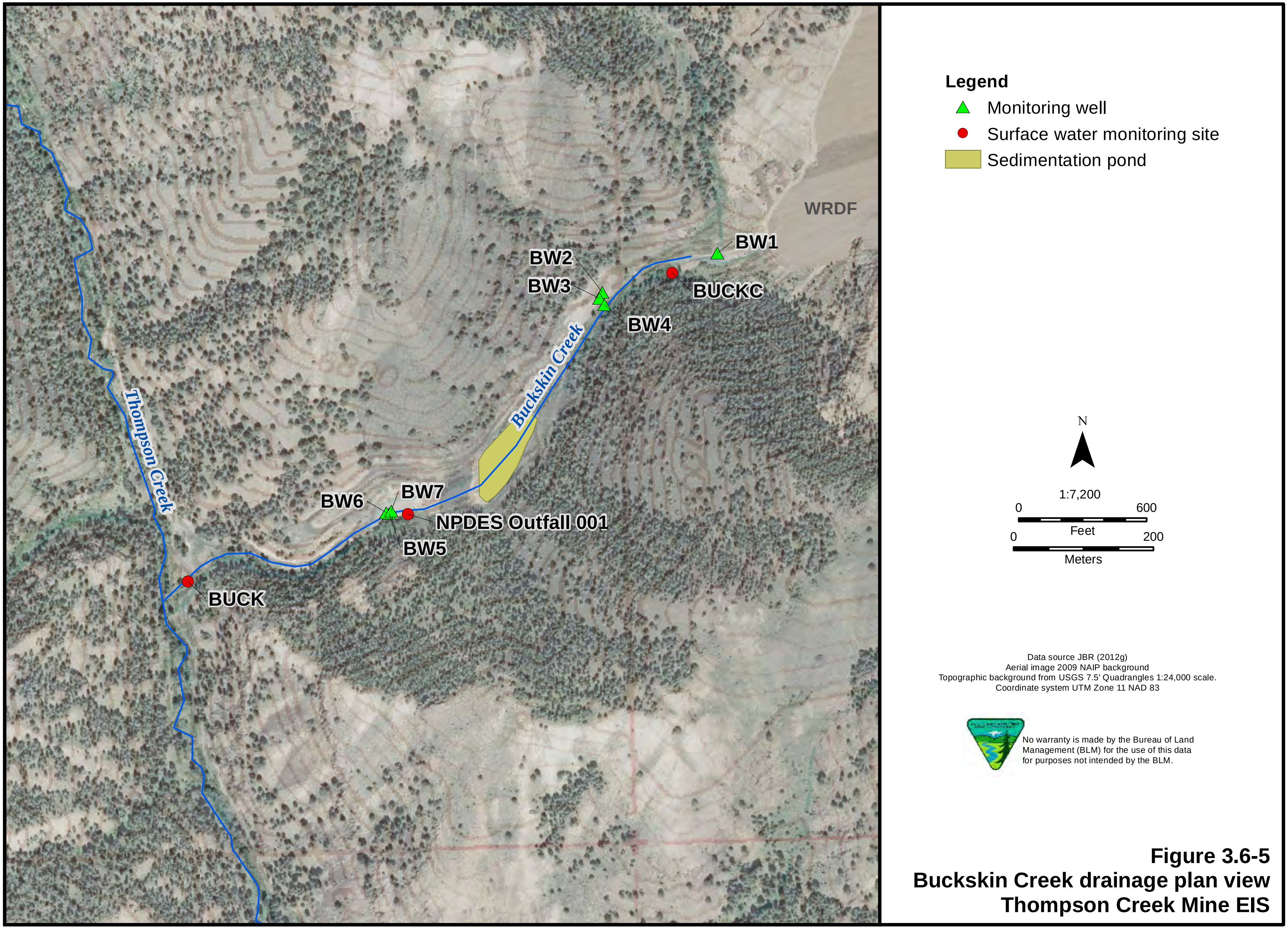


Figure 3.6-5
Buckskin Creek drainage plan view
Thompson Creek Mine EIS

The Idaho groundwater standard (IDAPA 58.01.11) for sulfate is 250 mg/L, which is a secondary standard (based on aesthetic qualities whereas primary standards are based on protection of human health).

Concentrations of measured parameters at the Buckskin WRSF (BuckC) are generally at their lowest in spring or early summer, following snowmelt when maximum flow through the waste rock increases dilution. BuckC is the surface water monitoring station that collects seepage and groundwater from the WRSF underdrain. The highest concentrations of most constituents occur in the fall and winter when the flow volumes are at their seasonal lows, except the concentration of selenium is highest during spring melt.

The two parameters of interest being leached are selenium and molybdenum, with peak total concentrations of 0.056 mg/L and 0.080 mg/L, respectively (Table 3.6-16).

Table 3.6-16. Groundwater quality, BW1, BW2, BW4, and BuckC (2009 to 2010).
all units are mg/L except s.u. for pH

	Measured					**Idaho Ground-water Standard**
	BW1 Deep Meta-sediments	**BW2 Shallow Meta-sediments**	**BW4 Colluvium**	**BuckC**		
Parameter	**(Mean)**	**(Mean)**	**(Mean)**	**(Mean)**	**(Max)**	
pH	8.1	7.6	7.3	8.1	8.2	6.5 – 8.5[1]
SO_4^{2-}	51.5	143	**942**	**976**	**1120**	250[1]
Al	0.002	0.003	0.002	0.0027	0.008	0.2[1]
As		.0082		0.00084	0.0016	0.05[2]
Cd	0.00002	0.00005	0.0004	0.00021	0.00041	0.005[2]
Co	0.00005	0.0001	0.0005	0.00053	0.001	
Cu	0.00005	0.0006	0.0003	0.0012	0.003	1.3[2]
Fe		< 0.03				0.3[1]
Mn	0.017	0.007	0.0002	0.0019	0.010	0.05[1]
Mo	0.020	0.047	0.048	0.063	0.078	
Ni	0.0002	0.0004	0.0019	0.0016	0.008	
Pb	0.00005	0.00005	0.00005	0.00015	0.00023	0.015[2]
Se	0.00005	0.003	0.033	0.037	0.056	0.05[2]
U	0.001	0.016	0.0098	0.010	0.012	
Zn	0.001	0.002	0.0083	0.0063	0.010	5[1]

[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

The loading of constituents into Thompson Creek from groundwater exiting the Buckskin Creek watershed was estimated by multiplying groundwater flow rates in the colluvium and metasedimentary rocks (Table 3.6-14.) by the mean concentrations of constituents measured in samples of groundwater from BW4 for the colluvium and BW2 for the metasedimentary rocks (Table 3.6-16.), and converting to pounds per day and pounds per year (Table 3.6-17).

Table 3.6-17. Groundwater loading to Thompson Creek from Buckskin Creek watershed.

Parameter	Thompson Creek Background Concentration (mg/L)[1]	Buckskin[2] Basin Load (metased. rock) (pounds/day)	Buckskin Basin Load (colluvium + metased. rock) (pounds/day)	Buckskin Basin Load (colluvium + metased. rock) (pounds/year)
pH	8.1 s.u.			
SO_4	14.1	2.72	146.49	53,444
Al	0.0088	0.00006	0.00036	0.132
As	0.00051	0.00015	0.00016	0.0576
Cd	0.00005	1.91×10^{-6}	0.00006	0.0226
Co	0.0001	1.91×10^{-6}	0.00008	0.0285
Cu	0.00081	0.00002	0.00006	0.0209
Fe	0.03	0.00057	0.00057	0.209
Mn	0.00048	0.00013	0.00017	0.0603
Mo	0.002	0.00090	0.01636	5.97
Ni	0.0005	7.62×10^{-6}	0.00030	0.109
Pb	0.000075	1.91×10^{-6}	9.53×10^{-6}	0.0031
Se-T	0.002	0.00006	0.00509	1.86
U	0.001	0.00030	0.00180	0.658
Zn	0.003	0.00038	0.00130	0.476

[1] except as noted for pH
[2] at BW2 in shallow metasedimentary rock

Pat Hughes Creek Watershed

Unlike the Buckskin WRSF, the Pat Hughes WRSF is used primarily for the storage of Type 2 rock, as well as a smaller percentage of Type 1 rock and low grade ore. The upper Pat Hughes Creek watershed is primarily underlain by volcanic rock, which extends down the valley and pinches out below the current toe of the Pat Hughes WRSF. The volcanic rocks are underlain by the Copper Basin Formation (metasedimentary rock, hardened mudstone). The valley floor is covered with alluvium and colluvium that increases in thickness downgradient. An underdrain was constructed to promote the collection of seepage after development of the facility, and is thus not underneath the uppermost portion of the facility. Site PH Toe is the surface water quality and flow monitoring point at the toe of the WRSF which captures: 1) groundwater recharged in the Pat Hughes watershed above the facility; 2) surface water that enters along the margins of the surface of the facility; and 3) precipitation that falls onto the surface of the facility and seeps into (infiltrates) the waste rock. The seepage at PH Toe is collected and conveyed directly to the Thompson Creek pipeline. Some seepage from the Pat Hughes WRSF passes under the collection system and eventually reaches Thompson Creek, but apparently with no discernible effect on the water quality of Thompson Creek (Section 3.6.1.1.). Surface water run-off from the upper Pat Hughes drainage basin is collected and routed around the WRSF. This includes run-off from the forested watershed upgradient of the WRSF, as well as run-off from the facilities area (e.g., mine shop and crusher). This water is routed around the WRSF by a pipeline and conveyed to Pat Hughes Creek at monitoring station PAT upstream of the sedimentation pond. Water from the sedimentation pond may then be discharged to Thompson Creek via Outfall 002 if the water meets NPDES permit limits, or it may be routed to the Thompson Creek pipeline for reuse in the mill.

There are 13 wells in the Pat Hughes watershed to monitor groundwater associated with the Pat Hughes WRSF (Figure 3.6-6., Figure 3.6-7). Nested wells were installed in 1999 to monitor groundwater at three depths just downgradient of the facility (PW1, PW2, and PW3). The base of PW1 is in the deep metasedimentary bedrock aquifer, the base of PW2 is in the shallow to intermediate depth volcanic bedrock aquifer, and the base of PW3 is in the colluvium aquifer (Figure 3.6-6). The wells were decommissioned in October 2009 prior to being buried by the planned expansion of the Pat Hughes WRSF; at the time of decommissioning, only the shallow, colluvium well (PW3) showed water quality effects from the WRSF. Well PW4 was installed with its base at the waste rock/colluvium interface in 2005 to monitor water within the WRSF. Water levels in PW4 vary with spring run-off, indicating unsaturated and free-draining flow within the facility.

Similar to the Buckskin watershed, most of the Pat Hughes watershed is covered by a thin layer of colluvium. The colluvium is underlain by a zone of fractured bedrock that transitions into more competent rock with depth. The groundwater flow in the upper areas of the watershed, where water flows through the colluvium and intermediate and shallow bedrock, is approximately horizontal and mimics the gradient (~ 10 %) of the topography. The Pat Hughes sedimentation pond (Figure 3.6-7.) may be a source of groundwater recharge. Near the toe of the Pat Hughes WRSF, seepage from the waste rock travels in the shallow colluvium aquifer, which is indicated by concentrations of sulfate of approximately 1,000 mg/L measured in samples from PW3 in the colluvium. The concentrations of sulfate samples from PW1 and PW2 indicate the colluvium groundwater is not hydraulically connected with the underlying intermediate and deep bedrock aquifers. Historic water levels indicate there is an upward hydraulic gradient (~ 5 %) between the deeper (PW1) and intermediate (PW2) bedrock aquifers (Figure 3.6-6).

Farther downgradient towards Thompson Creek, the volcanic bedrock pinches out leaving the metasedimentary bedrock closer to the surface (Figure 3.6-6). Groundwater in the intermediate bedrock is mixing with shallower groundwater in the colluvium, as inferred from the relatively high concentrations of sulfate in samples from PW7, PW8, and from surface water in Pat Hughes Creek (PAT). Mixing of the shallow and intermediate groundwater appears to be enabled by high permeability zones in the bedrock. The concentrations of sulfate become increasingly lower (diluted) downgradient of PH Toe, due in part to the collection of seepage from the toe for use in the mill, and also presumably due to dilution by lateral inflow of groundwater from the steep valley walls at the sides of the Pat Hughes watershed which has not contacted waste rock. There is also a distinct downward flow of groundwater (10 % gradient) between the colluvium and the intermediate bedrock aquifer (PW15 and PW14) and a distinct upward flow of groundwater (13 % gradient) between the deep and intermediate bedrock aquifers (PW13 and PW14). The shallow colluvium aquifer does not appear to be as hydraulically connected to the deep bedrock aquifer as is the intermediate aquifer.

The deep aquifer is less permeable and has lower concentrations of sulfate suggesting that it has not been influenced by seepage from the WRSF (PW13 and PW10). Groundwater flow rates have been estimated for the colluvium and metasedimentary rock (Table 3.6-18).

Table 3.6-18. Pat Hughes Creek watershed mean annual groundwater flow rates.

Geologic Unit	Hydraulic Conductivity (feet/second)	Flow Rate (gpm)
Colluvium	2.2×10^{-4}	20.6
Metasedimentary rock	3.9×10^{-6}	11.1

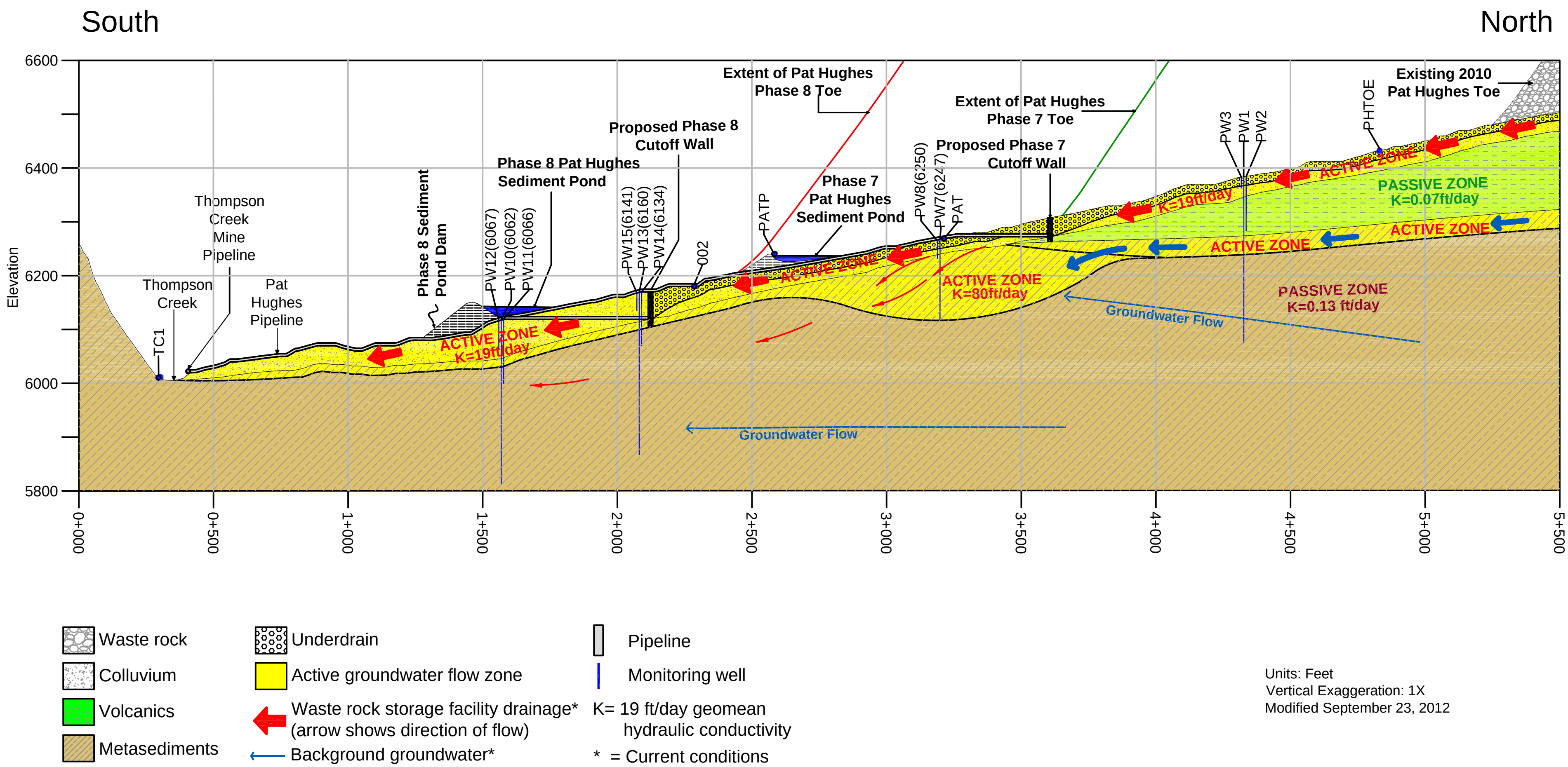
Measured through the cross-section at PW10, PW11, and PW12.

Annual and monthly flow volumes were monitored at the PH Toe monitoring station (Figure 3.6-7., Table 3.6-19). The percentage of flow from infiltration from the Pat Hughes WRSF is only about half that from infiltration in the Buckskin WRSF because the overall area of the Pat Hughes watershed is larger and the Pat Hughes facility occupies a much smaller percentage of its watershed than the Buckskin facility occupies of its watershed.

Table 3.6-19. Flow and infiltration, toe of Pat Hughes WRSF.

Flow Event	Flow (acre-feet/year)	Infiltration (acre-feet/year)	Percent of Flow from Infiltration
Maximum	1100	462	42
Mean	390	183	47
Minimum	130	56	43

Prior to spring snowmelt in 2003, the water quality of seepage from waste rock in the Pat Hughes facility was good, i.e., low concentrations of metals and near neutral pH. However, during spring snowmelt the chemistry of the water changed abruptly. The seasonal increase in flow from the facility had a distinct decrease in pH to approximately pH 4.5 with a corresponding increase in the concentrations of dissolved metals. For example, the concentration of zinc increased from approximately 200 µg/L to more than 5,000 µg/L. As peak flows subsided, the pH returned to near neutral (i.e., ~ pH 7), and the concentrations of metals decreased to the concentrations prior to spring melt.



Units: Feet
Vertical Exaggeration: 1X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-6
Pat Hughes Creek drainage cross-section
Thompson Creek Mine EIS

Source: JBR (2012g)

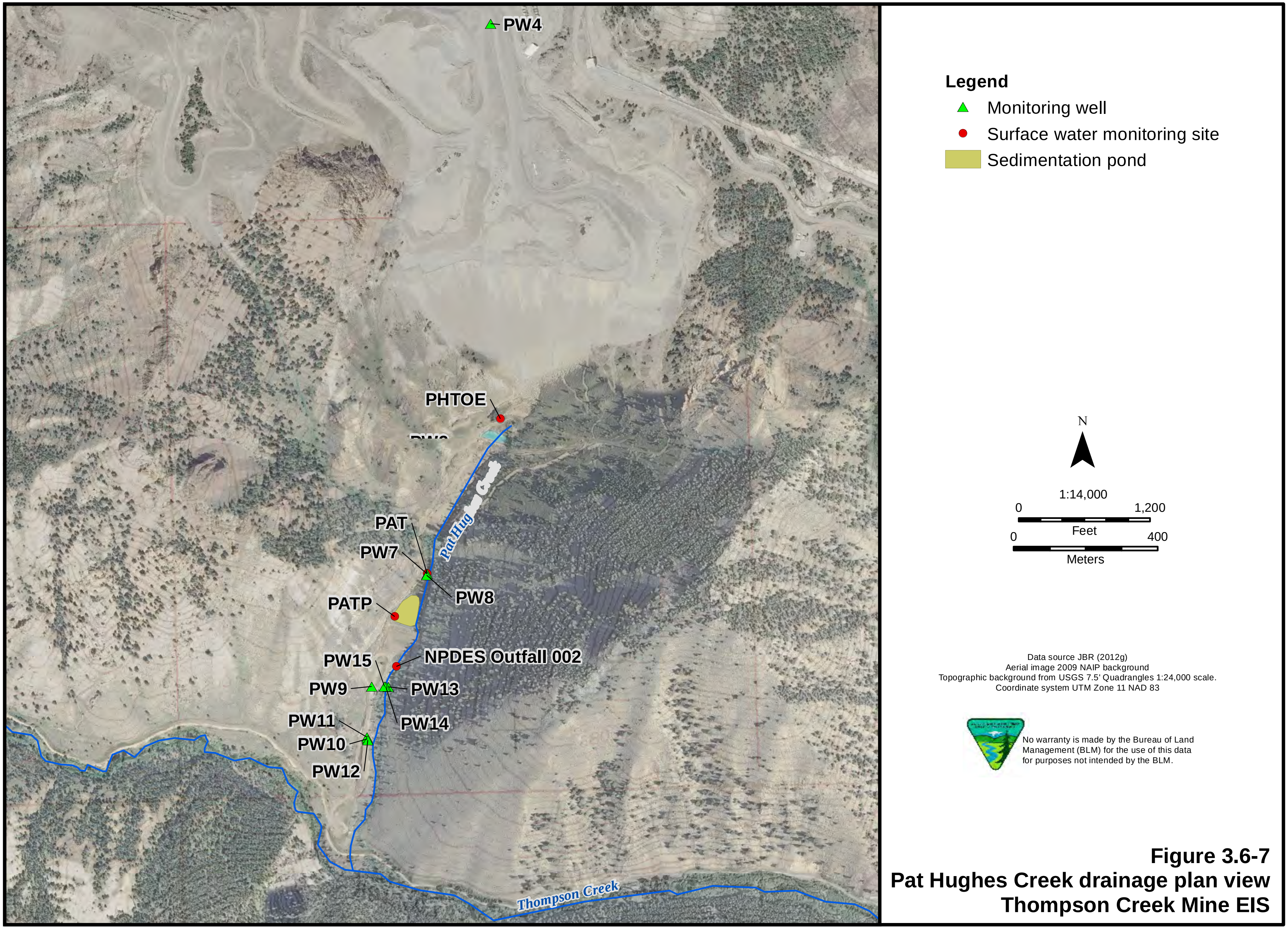
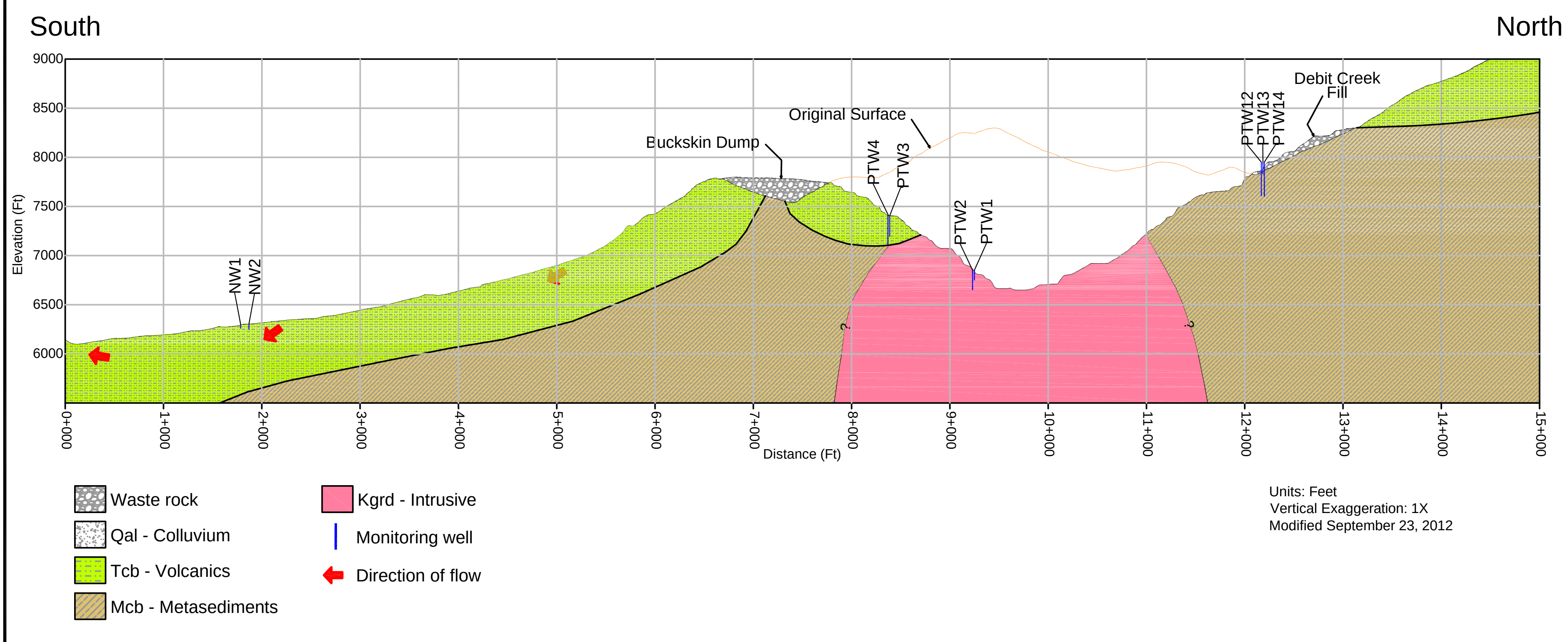


Figure 3.6-7
Pat Hughes Creek drainage plan view
Thompson Creek Mine EIS



No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-8
No Name Creek drainage cross-section
Thompson Creek Mine EIS

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-9
No Name Creek drainage plan view
Thompson Creek Mine EIS

Another change in geochemical pattern occurred in 2004. Following peak run-off, the pH of seepage water from the Pat Hughes WRSF did not immediately return to near neutral (remained < pH 6.0). The pH began to increase in 2005 following a relatively dry year reaching near neutral values (pH 6.5) immediately before spring snowmelt in 2006, which had the highest flow (1,300 gpm) measured during the study period (late 1999 to 2010). Since spring snowmelt in 2006, the pH has remained low and relatively stable (pH 4.2 to pH 4.9) with a median value of pH 4.6. The year 2003 is considered to be the onset of perennial ARD conditions from the Pat Hughes WRSF, i.e., the buffering capacity of waste rock in the Pat Hughes WRSF was exceeded by the acid-generating capacity of the Type 2 waste rock.

Metal loadings from the facility increased seasonally from 2002 to 2004 and increased perennially beginning in 2006, during which the highest monthly loads of sulfate were measured to date (2010). (A *load* is the concentration of a contaminant multiplied by the flow rate. A load is an amount of a contaminant that is a function of both concentration and flow rate. The load of a given contaminant therefore provides more comparative information for assessing or comparing effects than a concentration.) As flow conditions returned to normal later in 2006, the increased loads of metals persisted and the pH remained relatively low (< pH 5.0). The increased loads of metals in 2006 were probably due to compounding factors, including a lower-than-average spring run-off the year prior (less flushing within the Pat Hughes WRSF) and the build-up of oxidation products. During subsequent years there have been gradual increases in peak concentrations of metals during spring snowmelt with no obvious correlation to changes in peak flow volumes or pH (Table 3.6-20., Table 3.6-21., Table 3.6-23).

Mine affected water entering Thompson Creek from the Pat Hughes watershed predominantly occurs via groundwater, the exception being when controlled releases occur out NPDES outfall 001. These releases are infrequent and occur only when the NPDES permit water quality standards are met. The loading of metals and other constituents to Thompson Creek via the groundwater flowpath was estimated by multiplying groundwater flow rates by groundwater concentrations. Groundwater flow rates were estimated from measured gradients, hydraulic conductivity, and cross-sectional areas for flowpaths within the colluvium and metasedimentary bedrock (Table 3.6-18). Groundwater concentrations were based on mean values measured in wells screened within colluvium (PW11) and metasedimentary bedrock (PW12) downgradient of the sedimentation pond (Figure 3.6-22). Current (2010) loadings to Thompson Creek are summarized in pounds per day and pounds per year and are compared to background water quality in Thompson Creek in Table 3.6-23.

Table 3.6-20. Groundwater quality, Pat Hughes Crk. watershed, spring melt (March 2010).

	Elev./Depth	pH	NO_3^-/ NO_2^-	SO_4	Al	As	Cd	Cu	Fe	Pb	Mn	Mo	Ni	Se	Zn
Station	**Feet**	**s.u.**	**mg/L**	**mg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
NW2	Shallow	7.3	0.54	13	0.002	0.3	0.06	0.4	15	0.11	0.07	0.81	0.05	0.5	1
PH Toe	6430	4.88	9.8	956	14.5	1.1	18.7	104	15	0.79	9660	4.34	31.8	19	1370
PAT	6268	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PATP	6240	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW1	Deep	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW2	Medium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW3	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW4	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW7	Medium	7.4	1.04	**307**	0.003	0.5	0.01	2.7	15	0.025	7.01	5.15	3.1	4	28
PW8	Shallow	6.84	0.66	189	0.002	0.2	0.04	0.05	15	0.025	20.1	13.9	0.2	2	2
PW9	Shallow	7.07	0.89	**277**	0.002	0.7	0.03	0.05	15	0.025	1.33	17.8	1.1	4	3
PW10	Deep	7.27	0.02	138	0.002	1.2	0.05	0.25	142	0.025	162	5.05	4	2	179
PW11	Medium	7.37	0.005	248	0.0025	9.1	0.01	0.05	15	0.025	248	6.19	3.1	0.5	26
PW12	Shallow	7.4	0.7	248	0.002	0.4	0.04	0.05	15	0.025	1.7	14	0.05	3	1
PW13	Deep	7.45	0.005	182	0.003	0.4	0.01	0.2	137	0.025	278	1.88	1	0.5	160
PW14	Medium	7.57	0.005	**293**	0.002	2.3	0.01	2.3	62	0.025	312	8.51	3.9	2	8
PW15	Shallow	7.02	0.49	235	0.003	0.2	0.05	0.2	15	0.025	18.3	8.55	2.5	2	2
Idaho Standard =		6.5-8.5[1]	10[2]	250[1]	200[1]	50[2]	5[2]	1,300[2]	300[1]	15[2]	50[1]			50[2]	5,000[1]

ND = no data

[1] secondary standard, IDAPA 58.01.11

[2] primary standard, IDAPA 58.01.11

* bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-21. Groundwater quality, Pat Hughes Crk. watershed, base flow (August 2010).

	Elev./Depth	pH	NO_3^-/ NO_2^-	SO_4	Al	As	Cd	Cu	Fe	Pb	Mn	Mo	Ni	Se	Zn
Station	Feet	s.u.	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PH Toe	6430	**4.7**	5.14	**958**	11.6	0.7	13.7	76.4	15	1.65	7480	3.11	28.4	11	1150
PAT	6268	8.21	0.52	132	0.005	0.5	0.01	0.4	15	0.025	0.025	8.42	0.2	1	1
PATP	6240	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW1	Deep	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW2	Medium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW3	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW4	Shallow	**5.91**	1.97	159	0.013	0.05	0.78	0.2	15	0.025	110	43.6	0.8	0.5	51
PW7	Medium	7.07	0.8	**285**	0.001	0.5	0.01	0.05	15	0.025	2.33	5.05	0.05	3	8
PW8	Shallow	6.55	0.26	121	0.0005	0.4	0.01	0.05	15	0.025	0.97	10.5	0.05	1	1
PW9	Shallow	6.97	0.98	185	0.001	0.4	0.03	0.1	15	0.025	0.21	18.2	0.05	3	1
PW10	Deep	7.06	0.16	147	0.0005	2.7	0.02	0.25	1040	0.025	69.3	1.78	0.4	0.5	8
PW11	Medium	7.06	0.01	249	0.1	8.4	0.03	0.3	203	0.33	206	3.66	2.1	0.5	18
PW12	Shallow	6.84	0.78	214	0.0005	0.4	0.03	0.05	15	0.025	0.18	14.7	0.05	3	1
PW13	Deep	7.24	0.005	172	0.001	0.2	0.01	0.05	422	0.025	206	1.55	0.3	0.5	1
PW14	Medium	7.41	0.005	**301**	0.002	3.3	0.01	0.8	450	0.025	276	7.19	0.05	0.5	1
PW15	Shallow	6.85	0.65	204	0.001	0.4	0.03	0.2	15	0.025	0.42	17.6	0.5	3	1
Idaho standard		6.5-8.5[1]	10[2]	250[1]	0.2[1]	0.05[2]	5[2]	1,300[2]	300[1]	15[2]	50[1]			50[2]	5,000[1]

ND = no data
[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-22. Mean water quality, PW11 and PW12 (2010).
all units are mg/L except s.u. for pH

Parameter	PW11 (colluvium)	PW12 (metasedimentary rock)	Idaho Groundwater Standard
pH	7.63	7.32	6.5-8.5[1]
Al	0.027	0.001	0.2[1]
As	0.008	0.0004	0.05[2]
Cd	0.000035	0.00004	0.005[2]
Co	0.00115	0.0002	
Cu	0.00015	0.0001	1.3[2]
Fe	0.106	0.030	0.3[1]
Mn	**0.166**	0.002	0.05[1]
Mo	0.006	0.015	
Ni	0.002	0.0002	
Pb	0.00012	0.00005	0.015[2]
Se	0.001	0.003	0.05[2]
SO_4	245	221	250[1]
U	0.0085	0.003	
Zn	0.022	0.002	5[1]
Acidity	-	-	

1 secondary standard, IDAPA 58.01.11
2 primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-23. Groundwater loading to Thompson Creek from Pat Hughes Creek watershed (2010).

Parameter	Thompson Creek Background (mg/L)[1]	Pat Hughes (metasediment rock) (pounds/day)	Pat Hughes (colluvium + metasediment rock (pounds/day)	Pat Hughes (colluvium + metasediment rock (pounds/year)
pH	8.1 s.u.			
SO_4^{2-}	14.1	29.47	87.63	32,887
Al	0.0088	0.00013	< 0.00095	2.51
As	0.00051	0.00005	0.00133	0.74
Cd	0.00005	0.00001	< 0.00001	0.005
Co	0.0001	0.00003	0.00019	0.114
Cu	0.00081	0.00001	< 0.00019	0.018
Fe	0.03	0.00400	< 0.01143	11.1
Mn	0.00048	0.00027	0.03810	15.1
Mo	0.002	0.02000	0.00381	1.27
Ni	0.0005	0.00003	0.00038	0.19
Pb	0.000075	6.67×10^{-6}	< 0.00008	0.013
Se-Total	0.002	0.00040	< 0.00076	0.24
U	0.001	0.00040	0.00191	0.913
Zn	0.003	0.00027	0.00381	2.11

[1] except as noted for pH

No Name Creek Watershed

The No Name Creek watershed (intermittent flow) does not contain any mine facilities. The valley floor is composed of colluvium and alluvium up to 35 feet thick. Exposed bedrock consists of the volcanic rock throughout the watershed, which was measured as 600 feet thick adjacent to the pit and 900 feet thick near the confluence of No Name and Thompson creeks (Figure 3.6-8). There are two monitoring wells in the watershed: NW1 is in colluvium to a depth of 35 feet below the ground surface, and NW2 is in shallow volcanic bedrock to a depth of 60 feet below the ground surface (Figure 3.6-8., Figure 3.6-9). The wells indicate downward groundwater flow at the well sites. The lower reaches of the watershed are a groundwater discharge zone, indicated by natural springs that infiltrate back into the colluvium a short distance away. Two water samples from NW2 were analyzed in 2010. Both samples had neutral pH and low concentrations of most constituents, including sulfate and TDS (Table 3.6-24).

Table 3.6-24. Groundwater quality, No Name Creek watershed.

Parameter	Unit	NW2			Idaho Groundwater Standard
		3/28/2010	8/20/2010	Mean	
pH	s.u.	7.12	6.9	7.0	6.5-8.5[1]
Alkalinity	mg/L	106	108	107	
Hardness	mg/L	96	102	99	
TSS	mg/L	169	29	99	
TDS	mg/L	142	140	141	500[1]
NO_2^-/NO_3^-	mg/L	0.54	0.29	0.42	10[2]
SO_4^{2-}	mg/L	13	10	12	250[1]
Cl^-	mg/L	0.8	0.8	0.8	250[1]
DOC	mg/L	0.5	0.7	0.6	
S^{-2}	mg/L	< 0.04	< 0.04	< 0.04	
DISSOLVED METALS					
Ca	mg/L	32	35	33.5	
Mg	mg/L	4	4	4	
K	mg/L	< 1	< 1	< 1	
Na	mg/L	12	13	12.5	
Al	µg/L	2	< 1	1.5	200[1]
Sb	µg/L	< 0.05	< 0.05	< 0.05	6[2]
As	µg/L	0.3	0.4	0.4	50[2]
Be	µg/L	< 1	< 1	< 1	4[2]
Cd	µg/L	0.06	0.03	0.05	5[2]
Cu	µg/L	0.4	< 0.1	0.25	1,300[2]
Cr (Total)	µg/L	< 0.5	< 0.5	< 0.5	100[2]
Fe	µg/L	< 30	< 30	< 30	300[1]
Pb	µg/L	0.11	< 0.05	0.08	15[2]
Mn	µg/L	0.07	0.59	0.33	50[1]
Hg	µg/L	< 0.05	< 0.05	< 0.05	2[2]
Mo	µg/L	0.81	0.42	0.62	
Ni	µg/L	< 0.1	< 0.1	< 0.1	
Se	µg/L	< 1	< 1	< 1	50[2]
Ag	µg/L	< 0.03	< 0.03	< 0.03	
Ti	µg/L	< 0.5	< 0.5	< 0.5	
Zn	µg/L	< 2	< 2	< 2	5,000[1]

[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11

Open Pit

The Thompson Creek intrusive complex contains the ore body for the mine and forms the surface of the lower portion of the pit (491.2 acres, Figure 3.2-2., Figure 3.6-10., Section 3.2.1.1.). The middle portion of the pit is in the Copper Basin Formation, and the upper portion of the pit is in volcanic rock. The pit intercepts groundwater at depth, precipitation into the pit, and surface run-off from small areas around the pit where there are no diversion ditches. The water is removed from the pit using a combination of collection sumps and wells in the bottom of the pit, from which the water is recycled for use in the mill. Current (2009 and 2010) dewatering rates from the pit are approximately 300 gpm (approximately 165 gpm from groundwater).

The major source of groundwater to the pit is from the topographic high point to the north. From the topography, it is inferred that the regional groundwater gradient is from north to south. Based on measured gradients, groundwater preferentially flows within the fractured metasedimentary rock near the colluvium contact. Pit dewatering activities have lowered the water table around the pit and induced upward groundwater flow under the pit (i.e., there is a cone of depression around the pit).

Data from samples of water from the pit sumps and monitoring wells at the pit provides information about the quality of the groundwater near the pit (Figure 3.6-11). In general, the quality of the (mixed) water in the pit is neutral to alkaline with elevated concentrations of sulfate and molybdenum. The concentrations of trace metals are relatively low with variability noted in aluminum, antimony, arsenic, cadmium, copper, manganese, and zinc.

Bruno Creek Watershed

The Upper Bruno Creek watershed is composed of primarily volcanic rock, which extends down the valley and pinches out below the toe of the TSF embankment. In the lower portion of Bruno Creek, normal faults (north-to-south and east-west strike) transect the area near the confluence of Bruno and S. creeks. The valley floor of lower Bruno Creek is overlain by alluvium and colluvium that increase in depth downgradient.

The TSF fills the middle section of the Bruno Creek watershed. The base of BC3 is in deep metasedimentary rock. The base of MW1 is in the shallow metasedimentary aquifer as a back-up dewatering well in support of the TSF embankment seepage pumpback system. Two monitoring wells were installed in 1999 to further refine groundwater characteristics in the Bruno Creek watershed: the base of MW2 is in the colluvium aquifer and the base of BC3A is in the shallow metasedimentary aquifer (Figure 3.6-12., Figure 3.6-13).

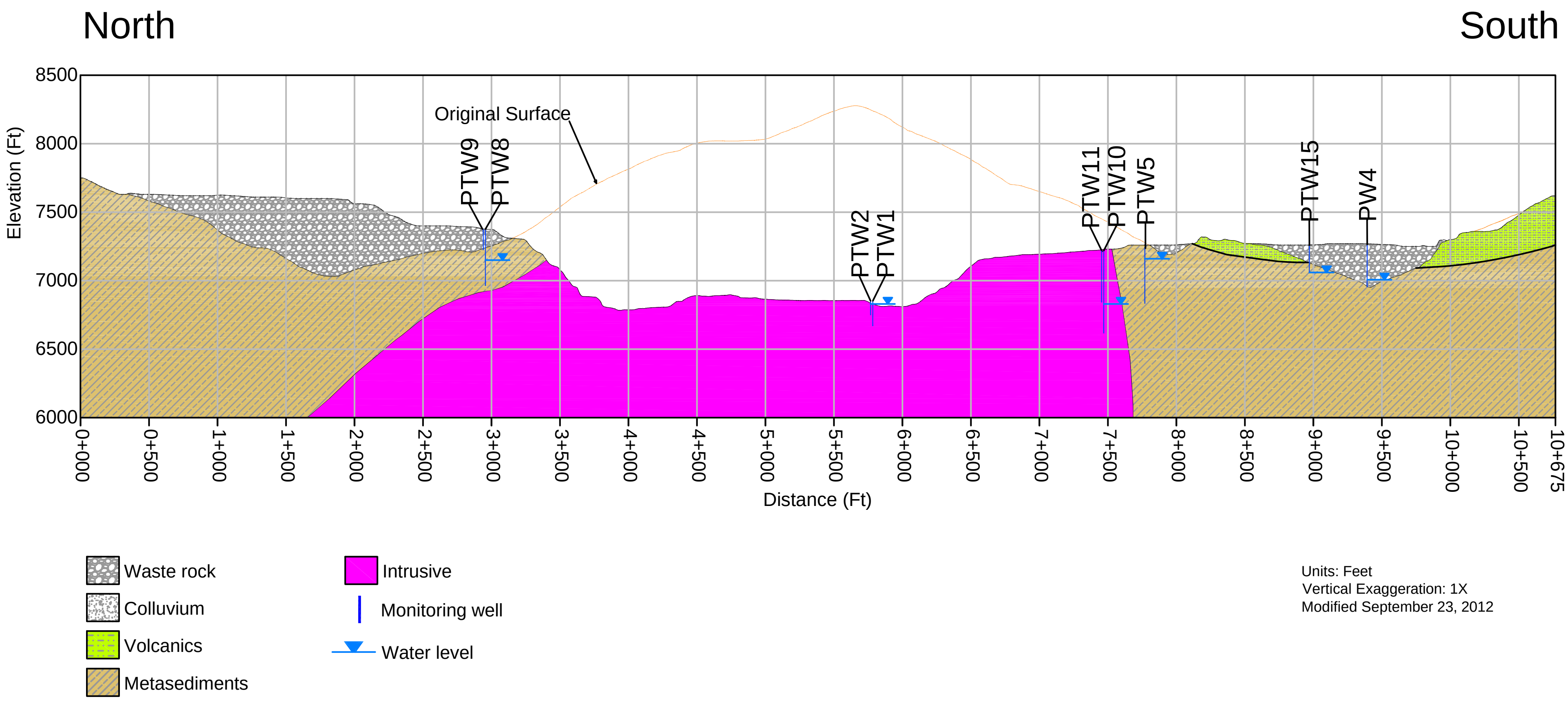
Downstream of the TSF embankment, the Bruno Creek watershed follows a steep, V-shaped valley that drains into S. Creek (Figure 3.6-10). Shallow wells installed downstream of the embankment (MW1 and MW2) have water levels within 12 feet of the ground surface. The groundwater flow between the wells is approximately horizontal (~ 7 % gradient), which mimics the topography. These wells show minor effects from seepage from the TSF, inferred from the concentrations of sulfate in samples from the wells (median concentration of 146 mg/L at MW1 and 89 mg/L at MW2) that are higher than those from samples of water from BC3 and BC3A (discussed below). Despite substantial scatter in the data, it appears the concentrations of sulfate have increased at MW1 since June 1993 and at MW2 since October 2007.

The deep bedrock well BC3 encountered extensive fractures from approximately 250 feet below the ground surface to the bottom of the well. Interpretation of the pump test results suggest that these fractures provide moderate to high secondary permeability. Artesian conditions have been observed at BC3 and BC3A since their installation. The concentrations of sulfate in samples of water from BC3 (median value of 61 mg/L) and BC3A (median value of 51 mg/L) are similar to such concentrations in samples of water from background sites, indicating that the TSF has not affected the quality of groundwater at this location. The lower Bruno Creek drainage is characterized as a groundwater discharge zone.

The TSF was designed to have no releases to surface waters. However, there are small amounts of seepage from TSF into the underlying groundwater, and the 1980 EIS indicated this would cause the water quality of Bruno Creek to exceed EPA criteria at times (USFS 1980, p. 5-10). The seepage reaches Redbird Creek via the paleo (ancient)-alluvial deposits underlying the volcanic rock that forms the divide between the Bruno Creek and Redbird Creek watersheds (Figure 3.6-14). The seepage rate (estimated to be approximately 35 gpm) is inferred from concentrations of chloride and sulfate in the TSF and at surface water site RB1. The concentrations of sulfate in Redbird Creek have increased by a factor of approximately three to near 200 mg/L over the previous 10 years or more. The data are sporadic prior to 2000, but elevated concentrations of chloride and sulfate appear to have begun in 1999 to 2000.

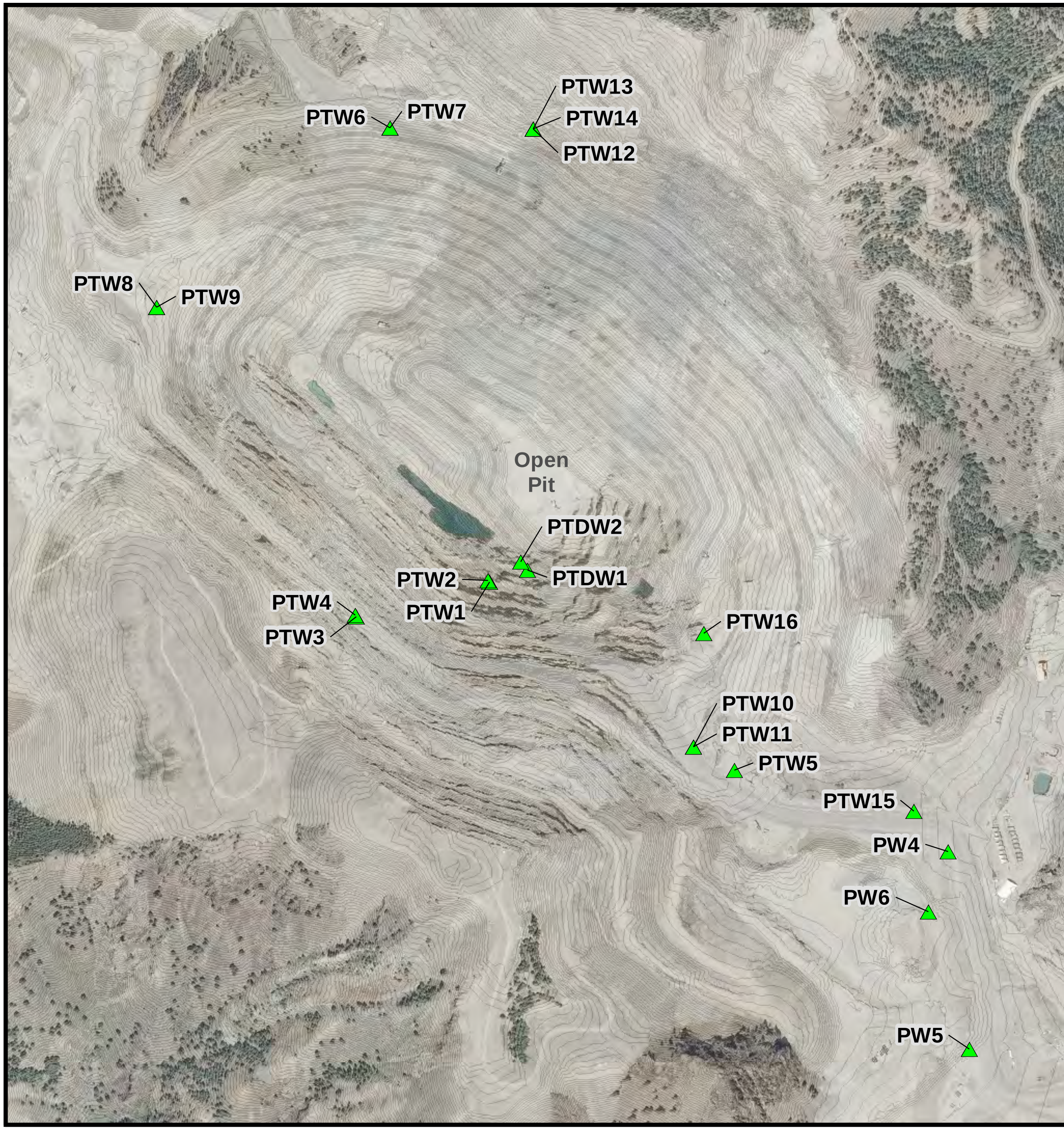
Water in the TSF is collected in the underdrain system and passes through the base of the embankment via the main drain, which captures flow from several components. Flow in the drain fluctuates seasonally in response to cyclone operations, snowmelt, and precipitation. Peak flows generally correspond to spring run-off and summer operation of the cyclones. Low flows generally occur during winter, and average annual flow into the main drain is of the order of 1,100 gpm. The water from the main drain is collected in the SRD and pumped back to the mill for reuse. Seepage from the SRD is collected in a constructed sump and is pumped back to the SRD pond. This pumpback system functions as secondary containment of discharge from the TSF.

The TSF leaks small amounts of water into the underlying shallow groundwater with minor effects on water quality. The 1980 EIS predicted that this seepage could result in increased concentrations of iron, manganese, and zinc in the groundwater (USFS 1980, p. 5-11). The quality of groundwater downstream of the TSF has remained similar over time. However, samples from the shallow wells (MW1, MW2) have higher concentrations of sulfate and lower concentrations of dissolved iron and manganese than samples from the deeper wells (BC3, BC3A). Despite substantial scatter in the data over time (beginning in 1993), concentrations of sulfate have been increasing at MW1 since 1993 and at MW2 since 2007, suggesting that some TSF water is getting past the SRD and pump-back sump.



Source: JBR (2012g)

Figure 3.6-10
Open Pit cross-section
Thompson Creek Mine EIS



Legend

▲ Monitoring well

N

1:12,000

0 — 1,000 Feet

0 — 300 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-11
Open pit plan view
Thompson Creek Mine EIS

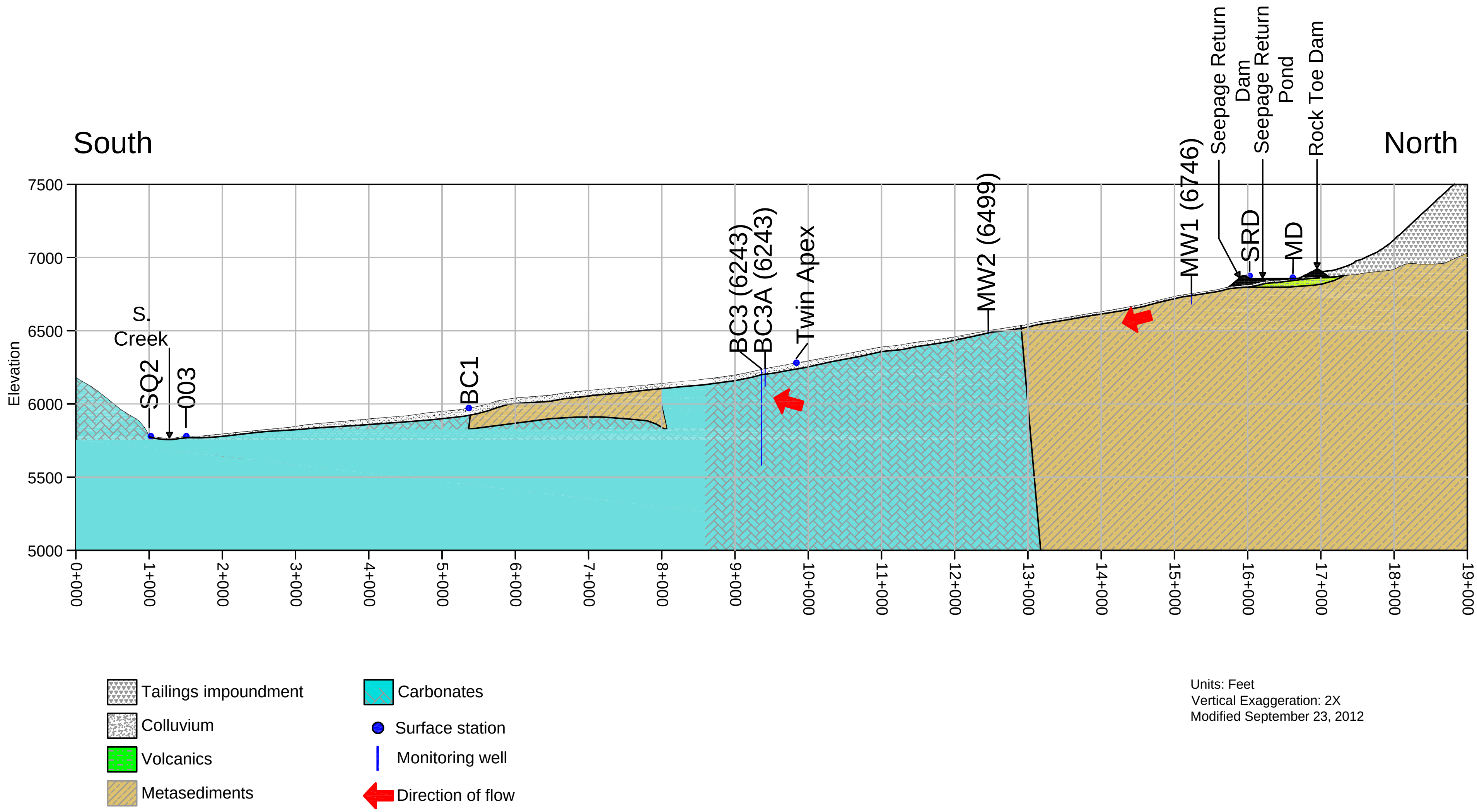


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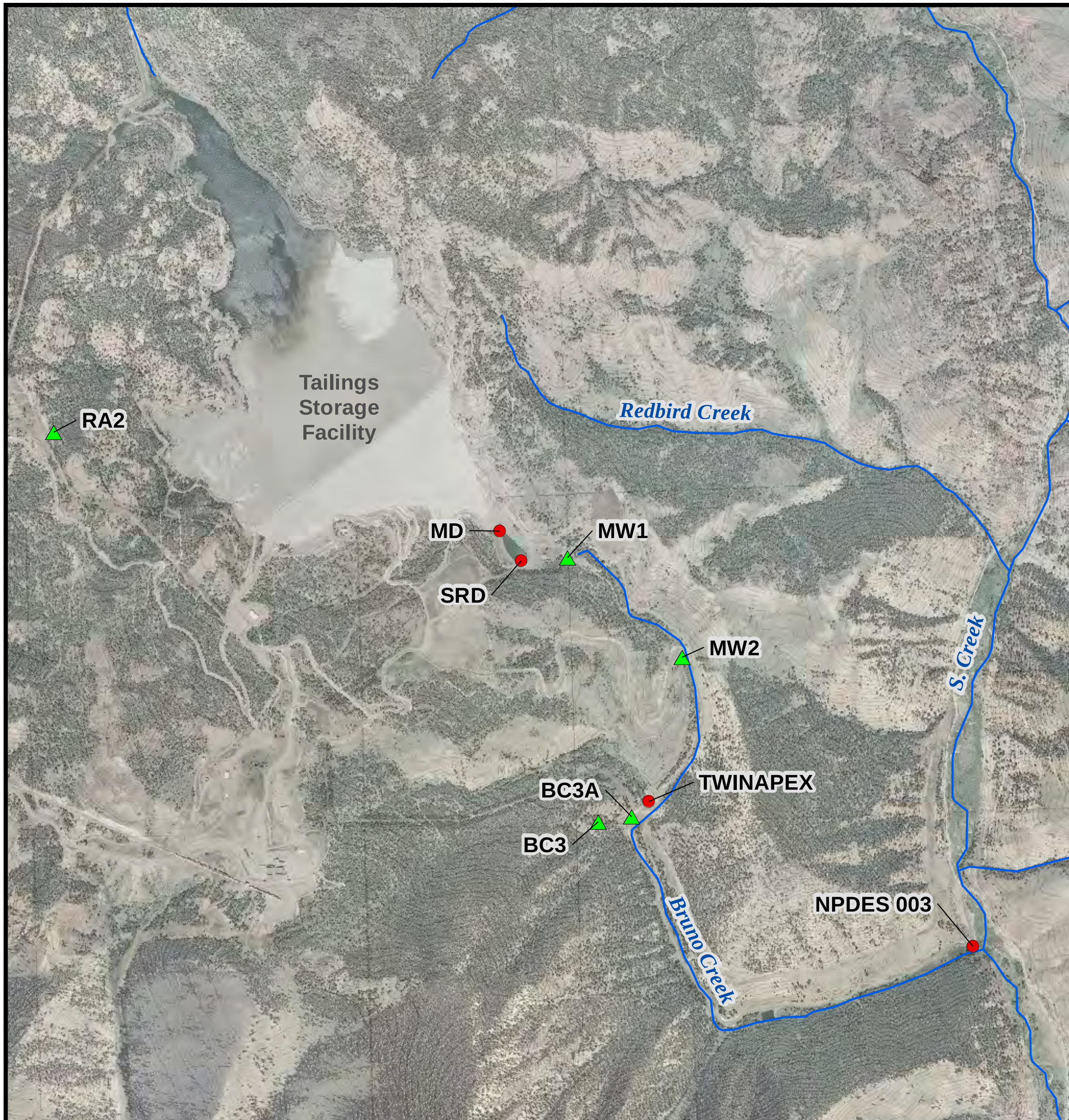
Figure 3.6-12
Lower Bruno Creek drainage cross-section
Thompson Creek Mine EIS

Source: JBR (2012g)



Legend

- ▲ Monitoring well
- ● Surface water monitoring site

N

1:30,000

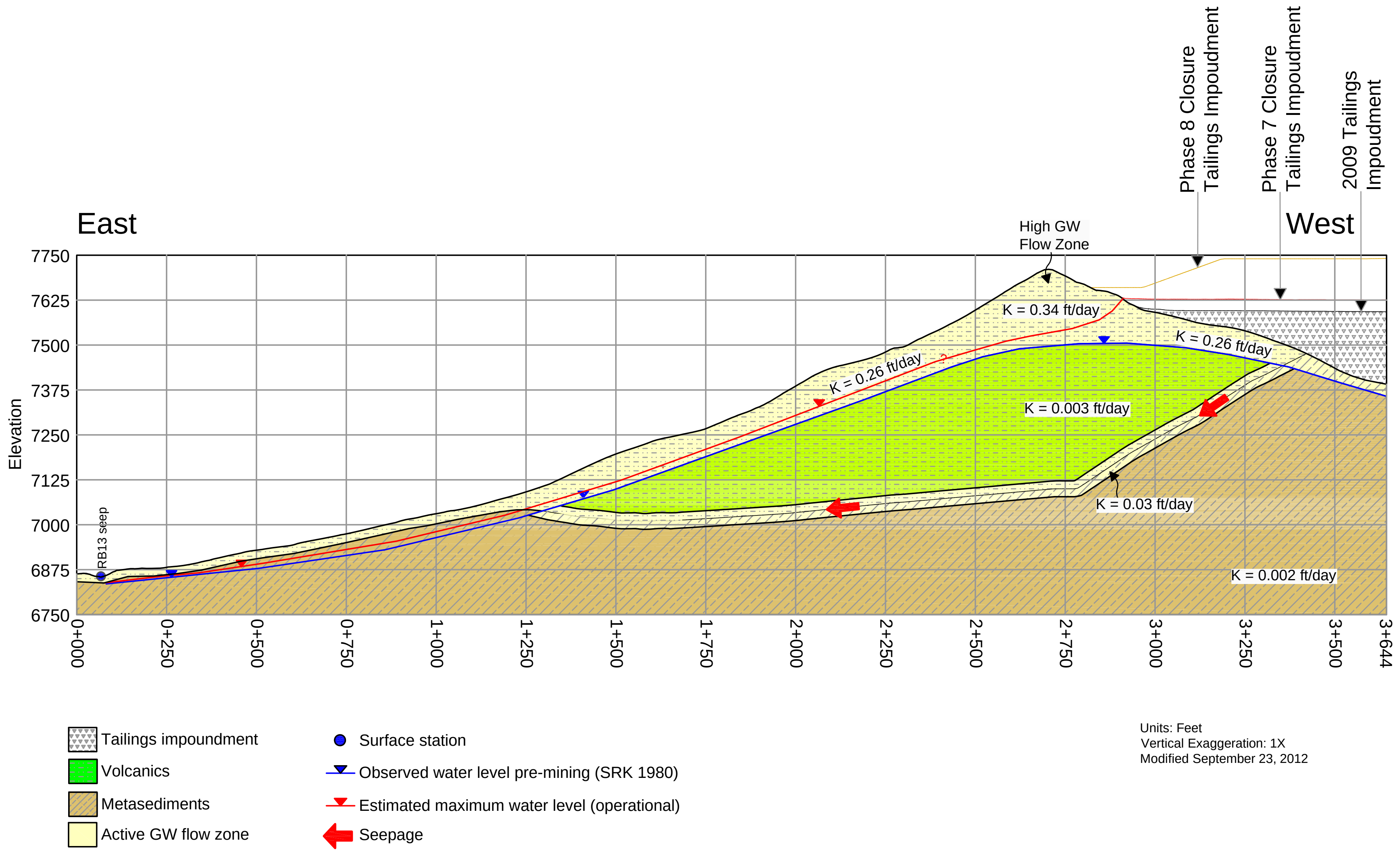
0 — 2,500 Feet

0 — 1,000 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-13
Bruno Creek drainage plan view
Thompson Creek Mine EIS



Source: JBR (2012g)

Figure 3.6-14
Flowpath from TSF to Redbird Creek drainage
Thompson Creek Mine EIS

There are no discernible trends in water quality parameters in the deeper wells (BC3 and BC3A) since the wells were installed (BC3 in 1980, BC3A in 1999).

Water discharged from the TSF has been represented and analyzed using samples from the main drain, tailings water, and a piezometer (MW10) at the interface of the tailings sands (embankment) and slimes (impoundment) (Figure 3.6-15., Table 3.6-25). Currently, the dominant source of water reaching the main drain is drainage from the impoundment, resulting from consolidation of tailings solids deposited in the impoundment (slimes) and process water (60 % from tailings slimes, 35 % from embankment sands, and 5 % from groundwater) (Andek 2011). Water from the main drain and the TSF pond water are both pH neutral environments in which there is abundant oxygen available, and dissolved iron was below the analytical detection limit (Table 3.6-25). The tailings slimes still have ample alkalinity to neutralize any acidity, particularly as long as the slimes remain in an anoxic, subaqueous environment as designed.

Table 3.6-25. TSF, water quality (2009 to 2010).
all units are mg/L except as noted

Parameter	Tailings Pond	MW10	Main Drain	Idaho Groundwater Standard
Year	**2009-2010**	**2010**	**2009-2010**	
Depth	**Surface**	**39 feet**	**Surface**	
pH, field (s.u.)	7.4	7.6	7	6.5-8.5[1]
Alkalinity-Total (mg/L $CaCO_3$)	34.5	45	122	
NO_2^-/NO_3^-	1.02	< 0.01	0.03	10[2]
SO_4^{2-}	**1073**	**913**	**1190**	250[1]
As-D	0.0014	0.0023	0.0019	0.05[2]
Cd-D	0.0004	0.0	0.0004	0.005[2]
Cu-D	0.0002	< 0.0001	0.0033	1.3[2]
Mo-D	1.321	0.144	0.657	
Ni-D	0.0055	0.0019	0.0124	
Zn-D	0.003	0.008	0.014	5[1]
H_2S-D	NA	0.0	NA	
Fe-D	< 0.03	0.166	< 0.03	
Fe-T	0.266	NA	**12.6**	0.3[1]
Mn-D	0.549	0.442	4.490	

Parameter	Tailings Pond	MW10	Main Drain	Idaho Groundwater Standard
Mn-T	**0.542**	NA	**4.880**	0.05[1]

The parameters for the TSF and main drain are median values for samples collected in 2009 and 2010.
Only one sample was collected from MW10 in 2010.
NA = Not Analyzed
1 secondary standard, IDAPA 58.01.11
2 primary standard, IDAPA 58.01.11
* bold typeface indicates exceeds Idaho groundwater standard

During mining and milling operations acidity released from the embankment sands is insufficient to overcome the alkalinity from impoundment slimes drainage. Furthermore, although the concentration of dissolved iron is relatively low (< 0.03 mg/L) in the oxidizing environments of tailings pond water and the main drain (Table 3.6-25.), the concentration of total iron is relatively high (~ 12.6 mg/L in the main drain) and the concentrations of dissolved arsenic and cadmium are relatively low (< 0.0019 mg/L and < 0.0004 mg/L, respectively, in the main drain), presumably due to sorption (where one substance becomes attached to another) of arsenic and cadmium onto precipitated iron oxides. The opposite conditions are generally found in anoxic, reducing environments (e.g., MW10), where the concentrations of total arsenic and cadmium increase with depth below sediment-water interface. The concentration of sulfate is higher in the oxidizing environments and lower at MW10.

There has been an increase in the concentrations of sulfate in the colluvial aquifer below the TSF, as indicated by samples from MW2, described above. Increased concentrations of sulfate (10 mg/L background to 182 mg/L) and chloride (5 mg/L background to 38 mg/L) to S. Creek are inferred to be from Redbird Creek, but no increased concentrations of other constituents of potential concern have been found to date in S. Creek. The source of these effects is seepage from the TSF as well as seepage from the abandoned Twin Apex mine in Bruno Creek, which is not affected by the Project. Seepage from the TSF affects S. Creek via two groundwater flowpaths that report to Redbird Creek and Bruno Creek. Seepage reporting to Redbird Creek is from the impoundment, while seepage reporting to Bruno Creek is due to small amounts of main drain seepage that bypasses the pumpback system.

Groundwater Rights

TCMC owns several water rights for groundwater with allowable beneficial uses of domestic (for employee uses) and industrial. Several of the water rights are for wells that were developed within the TCMC facility area. Two of the water rights (72-7414 and 72-7573) are for groundwater that seeps into the open pit. TCMC has also applied to the IDWR for a new water right (72-16728, pending) for the increased interception of groundwater during the pit expansion that would occur under the MMPO alternatives. The majority of the monitoring wells discussed above are not associated with a consumptive use, and consequently TCMC does not have or need water rights for these types of wells. TCMC has water rights (72-7219 and 72-7220) for two potable wells at the mine for employee use.

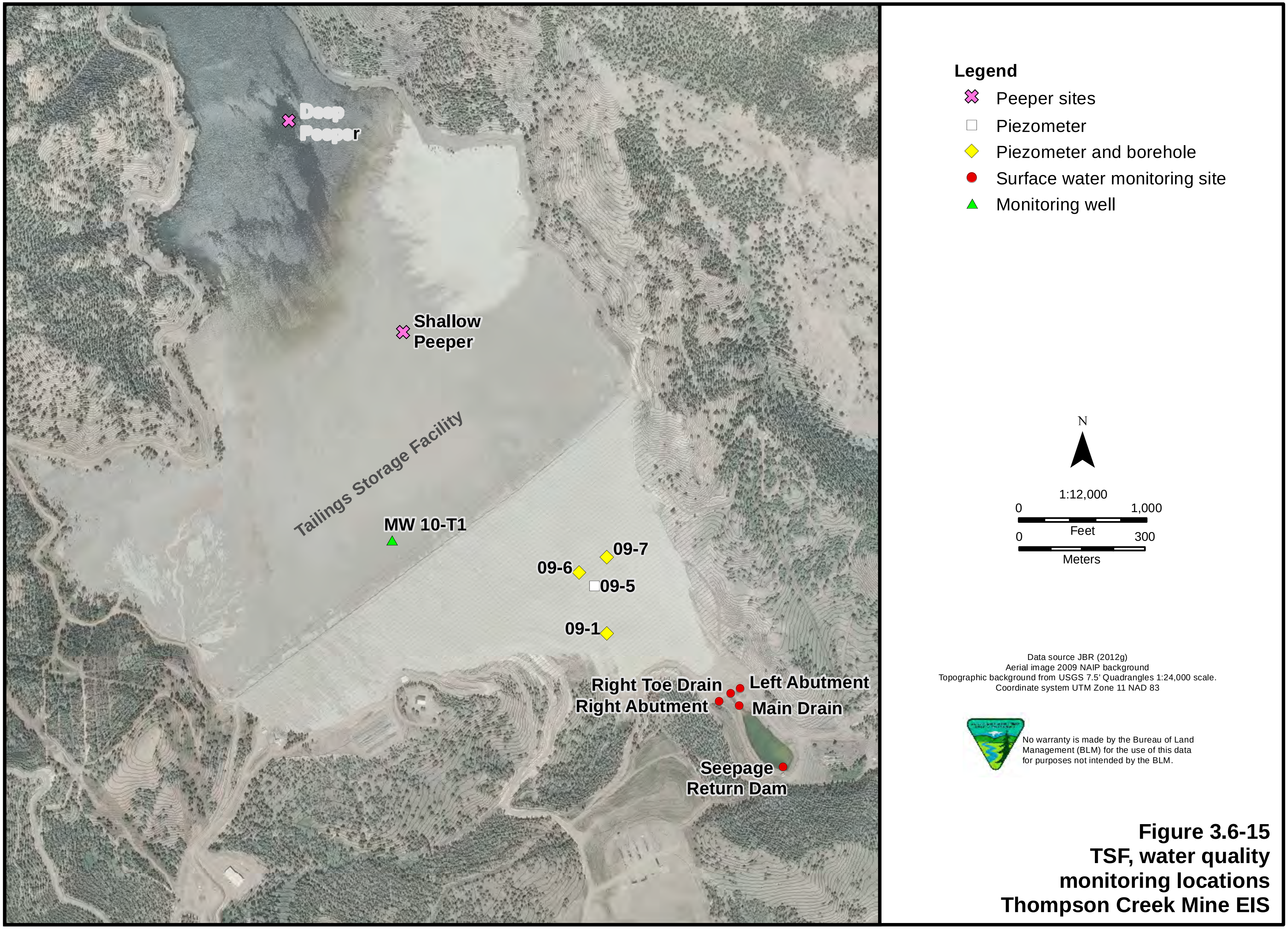


Figure 3.6-15
TSF, water quality monitoring locations
Thompson Creek Mine EIS

There are also water rights owned by others for groundwater from wells (domestic and irrigation beneficial uses) near the mouths of Thompson and S. creeks as well as along the Salmon River.

3.6.1.3. Springs

Naturally occurring springs (seeps)[9] are surface expressions of groundwater, i.e., points where the water table intercepts the ground surface. There are a number of springs in the analysis area. For example, according to water right records (IDWR 2012), the BLM has water rights for stockwatering for a number of springs along Thompson Creek. The source of some of these springs may be local alluvial deposits through which the base of Thompson Creek flows. Other potential sources might be re-emergence of water from Thompson Creek that has infiltrated into either alluvial deposits or fractured bedrock along the channel, or water from bedrock to the north. The springs along Thompson Creek are typically small (e.g., < 2 gpm, based upon discharge measurements made in 2008 by the BLM).

Several other springs discharge in the various watersheds that are tributaries to Thompson and Bruno creeks. The source of some of these springs might be small aquifers that are isolated from each other spatially due to hydraulic barriers. Two springs near the mouth of Buckskin Creek are used by TCMC under a water right that includes other nearby sources as well. An apparent natural spring (ID #BS Hillside Seep) from a hillside further upstream and to the west of the main channel supports several small wetlands (Figure 3.9-1).

No Name Creek gains in flow downgradient due to several springs along the creek (JBR 2012h). Springs occur particularly in the lower drainage where bedrock outcrops in the valley floor (SRK 1998). Water rights records include a BLM filing on a single spring near the mouth of the creek (IDWR 2012). These records also include BLM water rights for stockwatering from two springs in the Pat Hughes watershed, in or adjacent to the MMPO area. Two springs (PHSeep and PH2) in upper Pat Hughes Creek have a groundwater source (JBR 2012h). The BLM also owns water rights for stockwatering from two springs in the unnamed watersheds to the east, downgradient of the mill.

The Bruno Creek watershed contains several springs, both upstream and downstream of the TSF. There are two BLM water rights for two springs in the middle portion of the Bruno Creek watershed, near the Twin Apex property. Springs also discharge from limestone fractures in lower Bruno Creek. In addition to natural springs, there are a number of areas where seepage from the colluvium and/or bedrock into stream channels occurs as a result of the mine. These areas include Pat Hughes and Buckskin creeks, where infiltration of precipitation or run-off into or underneath the WRSFs essentially forms gaining channel reaches. Similarly, seepage from the TSF is inferred to have entered Bruno Creek below the TSF and to have also entered Redbird Creek.

[9] Springs typically emerge from a single point, whereas seeps emerge over a larger area with no well-defined origin, typically have lower flow than springs, and rarely have enough flow to form a stream. *Spring* herein refers to both springs and seeps.

3.6.2. Offered Lands - Broken Wing Ranch

3.6.2.1. Surface Water

The ranch is in the Salmon River-Bradshaw Creek 6th level watershed (26,315 acres) (HUC 170602011401). The ranch is primarily along the Salmon River bottom lands, which include the lower reaches/mouths of several small tributary streams (Sink Creek and Lyon Creek, as well as small unnamed tributaries). The ranch is approximately 12 miles downstream of the confluence of S. Creek with the Salmon River. Flows at the nearest active Salmon River gaging station to the ranch (No. 13296500) were previously discussed (Section 3.6.1.1.). There are no known flow records for small tributary streams that drain through the ranch, except in August 1996, as part of the BURP, a flow measurement of 0.7 cfs was made at the mouth of Sink Creek (IDEQ 2010a). The lower portion of Lyon Creek has perennial flow, and there is a diversion from the stream between BWR-1 and BWR-3 for irrigation on BWR-2 and BWR-3.

The Salmon River, where it flows through the ranch, has not been assessed in the most recent IR (IDEQ 2011a). Therefore, it is unknown if this portion of the river fully supports its beneficial uses of cold water aquatic life, primary contact recreation, and salmonid spawning. However, this portion is still afforded Tier II protection under Idaho's antidegradation policy. Similarly, Lyon Creek has not been assessed to determine whether its beneficial uses are supported or whether its water quality is impaired. Sink Creek is considered to be supporting its beneficial uses based upon an assessment in 1996 (IDEQ 2011a). In general, cattle are a major source of fecal coliform, e.g., Tiedemann et al. (1987) found the concentration of fecal coliform indicator bacteria in streamwater in pastures with managed grazing was approximately twice the concentration in streamwater in ungrazed pastures. However, nearly all of the riparian areas at the ranch are fenced to exclude livestock (Figure 3.5-2., Figure 3.5-3).

There are nine water rights for the ranch for surface water for irrigation totaling 15.89 cfs, 6.22 cfs from Lyon Creek, 6.56 cfs from the Salmon River, 2.21 cfs from Alkali Spring, and 0.9 cfs from Sink Creek. There is also a water right for the ranch for surface water for stockwater from the Salmon River (0.02 cfs). The BLM, Idaho, and other private entities also have water rights nearby for the Salmon River (IDWR 2012). There are five points of diversion along Lyon Creek, one of which is screened.

3.6.2.2. Groundwater

These are seven water rights on the ranch for groundwater for domestic and stockwater use totaling 0.34 cfs. The groundwater is from ten wells; three for irrigation, two for stock, four for domestic use, and one test well (IDWR 2012). The Federal government and several other private entities also have water rights for groundwater in the vicinity.

3.6.2.3. Springs

There is one spring used for portable water on the ranch approximately 600 feet west of the Lyon Creek ranch house (Doughty 2013). There is one spring in the Lyon Creek watershed, approximately ½ mile upstream of the western edge of BWR-1. In addition, Alkali Spring is on the east side of the Salmon River 1 mile east of the mouth of Sink Creek. There are water rights for the ranch for surface water for irrigation (2.21 cfs) and for stockwater (0.03 cfs) from Alkali Spring.

The water right for the letter is held in the name of the BLM because the stockwater use is on BLM land. The BLM also holds a water right for stockwater from Alkali Spring.

3.6.3. Offered Lands - Garden Creek Property

3.6.3.1. Surface Water

The property contains the upper portion (headwaters) of the Garden Creek 6^{th} level watershed (18,560 acres) (HUC 170402080402), which drains the central portion of the south slope of the Bannock Range. Garden Creek is a tributary to Marsh Creek, which drains to the Portneuf River subbasin (HUC 17040208), which ultimately drains to the Upper Snake River subregion (HUC 1704). The Garden Creek property is primarily in uplands at the head of Garden Creek, but also includes a reach of the stream that appears to be supported by a spring just outside of the property. Garden Creek is a perennial stream (~ 2 feet wide with a very narrow riparian corridor) with no known flow records, other than a single flow measurement (1.1 cfs) in July 2002 from a site approximately 5 miles downstream of the property (IDEQ 2010a).

Garden Creek, including the stream reach that flows through the Garden Creek property, is 303(d)-listed for pathogens (*Escherichia coli*) (IDEQ 2011a). Previous 303(d) listings for the concentrations of total nitrogen, total phosphorus, and sedimentation/siltation for Garden Creek were addressed in the Portneuf River TMDL. The current 303(d) listing indicates this portion of Garden Creek does not support cold water aquatic or secondary recreation beneficial uses, though it fully supports an assigned beneficial use for salmonid spawning. There is no known water quality data or water rights for surface water for the portion of Garden Creek on the property. However, the Forest Service and BLM have water rights for Garden Creek upstream of the property for wildlife and downstream of the property for stockwater, respectively.

3.6.3.2. Groundwater

There are no wells or water rights for groundwater on the property (IDWR 2012).

3.6.3.3. Springs

No springs were identified on the property, but a spring is mapped next to Garden Creek 350 feet north of the northeast corner of the property. The discharge from the spring probably flows downstream through the property via Garden Creek. There are no water rights for springs on the property (IDWR 2012).

3.7. Wildlife Resources

The analysis area for wildlife resources for the MMPO alternatives is the S. Creek and Thompson Creek 6^{th} level HUC watersheds (Figure 3.7-1). The analysis area for the land disposal alternatives is the selected and offered lands. Special status wildlife species are also summarized in this section. Special status wildlife species are those listed as proposed, candidate, threatened, or endangered under the ESA by the USFWS, or those listed as sensitive by either the

BLM or Forest Service. There are 26 special status wildlife species that fall within the jurisdictions[10] associated with the analysis areas (Table 3.7-1). For each of the wildlife resources analysis areas, there is a description of wildlife habitat, a table of special status wildlife species, a description of Forest Service MIS (if applicable), and a description of non-special status wildlife. Following these subsections is a description of all special status wildlife species and general wildlife in relation to all of the analysis areas.

3.7.1. MMPO Area and Selected Land

3.7.1.1. Wildlife Habitat

The wildlife habitat in the analysis area is fragmented by historic logging, mining, and roads, and is characterized by generally consistent background human disturbance and noise (Section 3.10.3.3.). Most areas are steeply sloped and comprised of either Douglas-fir forest or big sagebrush communities with native grasses and interspersed with rock outcrops or scree areas (Section 3.4.1.2.).

Riparian habitats are some of the most important habitat areas for non-game wildlife in the analysis area, as these habitats provide water and high structural diversity (BLM 1999, p. 323). Aspen occurs mainly near streams, and provides important wildlife habitat for beaver (*Castor canadensis*; BLM 1999, p. 284). Willows are an important component of bank stabilization and shading for streams in the analysis area, and provide thermal and hiding cover for wildlife, forage for ungulates and beaver, and non-game habitat (BLM 1999, p. 285). Conifer forests also provide high structural diversity and are important habitats for wildlife, particularly cavity-nesting birds (BLM 1999, p. 323). Forest habitat is very dense in some areas of the selected land, such as south of Bruno Creek. Sagebrush habitats in the analysis area provide suitable nesting habitat for migratory birds, including sensitive species such as Brewer's sparrow. Rocky outcrops in the analysis area provide nesting habitat for raptors and roosting habitat for bats. Winter range comprises important habitat for big game species. Winter range (typically lower elevations) provides critical foraging and shelter opportunities when food and shelter is scarce across other parts of a big game species range.

3.7.1.2. Special Status Wildlife Species

Surveys to document the presence or absence of special status wildlife species in the analysis area have been limited. Therefore, the potential presence and distributions of most special status wildlife species in the analysis area is inferred from their presence in nearby areas and the presence in the analysis area of habitats where special status wildlife species are normally found. Incidental observations have verified the presence of some species (Figure 3.7-1., Table 3.7-2.) (IDFG 2011a).

[10] Each land management agency (Forest Service and BLM) maintains its own sensitive species list. There is some overlap between Forest Service and BLM (some species are designated as sensitive by both). Threatened or endangered species (USFWS jurisdiction) would be evaluated in all areas.

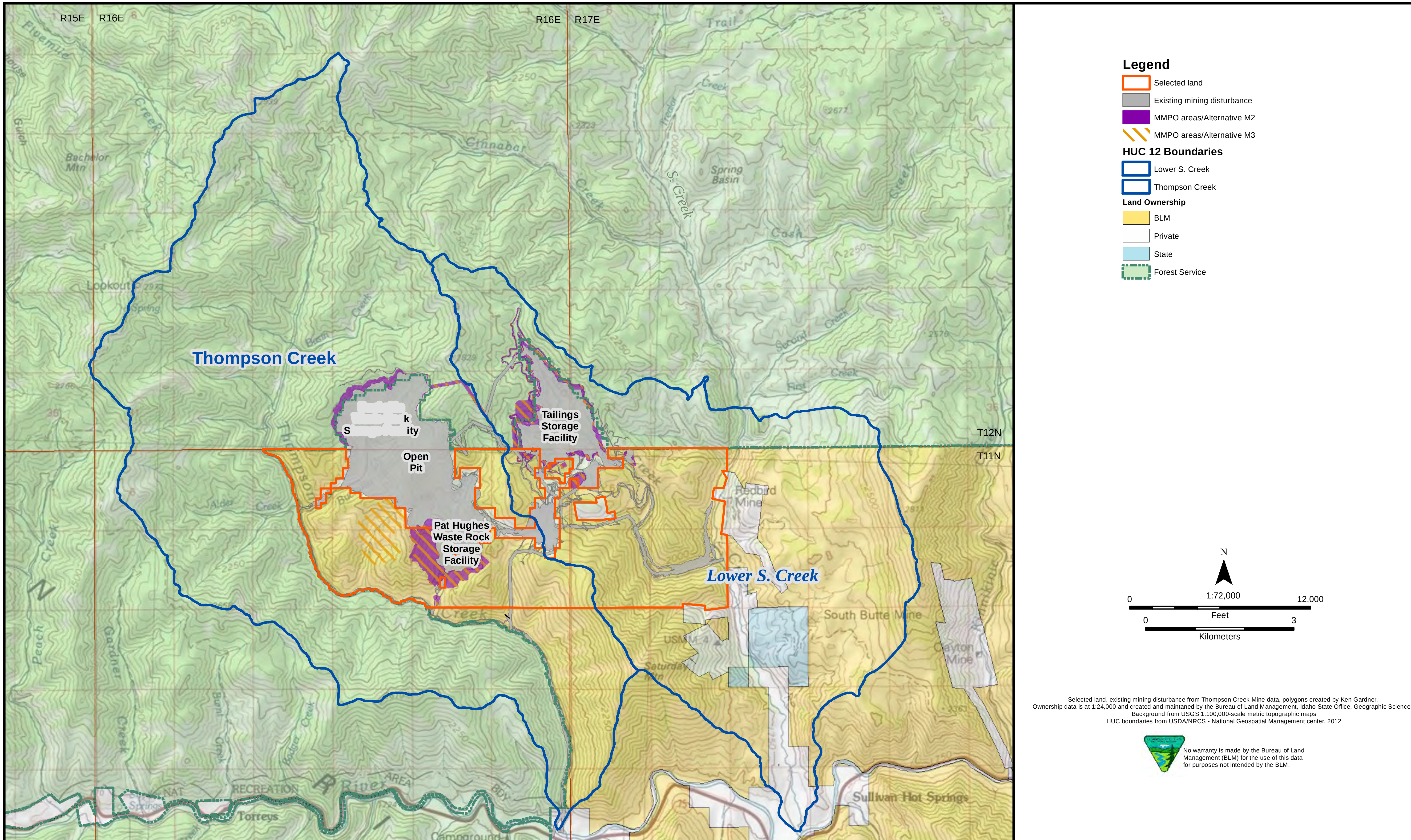


Figure 3.7-1
MMPO alternative analysis area, wildlife resources
Thompson Creek Mine EIS

Table 3.7-1. Special status wildlife jurisdiction, all analysis areas.

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
Agency Jurisdiction				
SPECIES **Common name** *Scientific name*	**BLM Challis and Forest Service Challis-Yankee Fork**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
MAMMALS				
Canada lynx *Lynx canadensis*	Yes (BLM)	Yes	Yes	No
Gray wolf *Canis lupus*	Yes (BLM)	Yes	Yes	Yes
American pika *Ochotona princeps*	Yes (Forest Service)	No	No	No
Bighorn sheep *Ovis Canadensis*	Yes (Forest Service)	No	Yes[1]	No
Fisher *Martes pennanti*	Yes (BLM and Forest Service)	Yes	Yes	No
Spotted bat *Euderma maculatum*	Yes (BLM and Forest Service)	Yes	Yes[1]	No
Townsend's big-eared bat *Corynorhinus townsendii*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Wolverine *Gulo gulo*	Yes (BLM and Forest Service)	Yes	Yes	No
BIRDS				
Bald eagle *Haliaeetus leucocephalus*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Boreal owl *Aegolius funereus*	Yes (Forest Service)	No	No	No
Brewer's sparrow *Spizella breweri*	Yes (BLM)	Yes	Yes	Yes
Calliope hummingbird *Stellula calliope*	Yes (BLM)	Yes	Yes	Yes
Flammulated owl *Otus flammeolus*	Yes (BLM and Forest Service)	Yes	Yes	Yes

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
Agency Jurisdiction				
SPECIES **Common name** *Scientific name*	**BLM Challis and Forest Service Challis-Yankee Fork**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
Great gray owl *Strix nebulosa*	Yes (Forest Service)	No	No	No
Hammond's flycatcher *Empidonax hammondii*	Yes (BLM)	Yes	Yes	Yes
Northern goshawk *Accipiter gentilis*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Olive-sided flycatcher *Contopus borealis*	Yes (BLM)	Yes	Yes	Yes
Peregrine falcon *Falco peregrinus anatum*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Pileated woodpecker *Dryocopus pileatus*	Yes (Forest Service)	No	No	No
Three-toed woodpecker *Picoides tridactylus*	Yes (Forest Service)	No	No	Yes[1]
Willow flycatcher *Empidonax traillii*	Yes (BLM)	Yes	Yes	Yes
Williamson's sapsucker *Sphyrapicus thyroideus*	Yes (BLM)	Yes	Yes	Yes
REPTILES AMPHIBIANS				
Columbia spotted frog *Rana luteiventris*	Yes (Forest Service)	No	No	No
Common garter snake *Thamnophis sirtalis*	Yes (BLM)	Yes	Yes	Yes
Northern leopard frog *Rana pipiens*	No	No	No	Yes

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
Agency Jurisdiction				
SPECIES **Common name** *Scientific name*	BLM Challis and Forest Service Challis-Yankee Fork	BLM Challis	BLM Challis	BLM Pocatello
Western toad (N Rocky Mountain) *Bufo boreas*	No	No	No	Yes

[1] Evaluated due to habitat suitability.

Table 3.7-2. Special status wildlife species, MMPO analysis area.

Species (Status)	Occurrence
MAMMALS	
Canada lynx (threatened)	**Possible** Sightings of lynx have been confirmed in Custer County (IDFG 2011a) north and just south of the analysis area. Lynx may pass through the analysis area.
Gray wolf (sensitive)	**Likely** The analysis area contains part of the Yankee Fork wolf activity center (Nadeau et al. 2009) as well as several single wolf observations. Other wolf activity centers are in the vicinity (see wolf activity center map; Nadeau et al. 2009), thus individuals from several packs are likely to pass through the analysis area.
American pika (sensitive)	**Present** Pikas were observed in rock piles and the WRSFs. Pikas may also occur in other rocky habitats in the analysis area.
Bighorn sheep (sensitive)	**Possible** No winter range or crucial habitat for bighorn sheep is available in the analysis area. However, some individuals may move through the area while migrating between seasonal ranges.
Fisher (sensitive)	**Possible** Suitable forest habitat is present. The closest fisher observation was at Rough Creek, ~ 15 miles west of the analysis area (Purvine 2009).
Spotted bat (sensitive)	**Possible** Spotted bats are known to occur in Salmon River canyon in the analysis area. Spotted bats may temporarily roost in rock outcrops in the analysis area.

Species (Status)	Occurrence
Townsend's big-eared bat (sensitive)	**Possible** The analysis area may contain limited amounts of suitable maternity or hibernacula habitat or caves. It is more likely that Townsend's big-eared bats would forage and roost temporarily in rock outcrops in the analysis area.
Wolverine (proposed threatened)	**Possible** Wolverines have been observed along the Salmon River in the southernmost portion of the analysis area. They have also been observed northeast and southeast of the analysis area (IDFG 2011a) and may use the habitats in the analysis area for temporary refuge, hunting, or denning.
BIRDS	
Bald eagle (sensitive)	**Present** An active nest is on S. Creek on private land in the analysis area, 2.5 miles south of the selected land (IDFG 2009a). The nest is adjacent to S. Creek Road, which is used by TCMC employees and haul vehicles. Nesting or migrating bald eagles may forage in the analysis area.
Boreal owl (sensitive)	**Possible** Surveys by IDFG (2007) documented boreal owls in the Boundary Creek watershed ~ 60 miles to the west of the analysis area. Some suitable forest habitat for nesting is in the analysis area.
Brewer's sparrow (sensitive)	**Possible** Suitable habitat for Brewer's sparrow (sagebrush or other shrub steppe) is present.
Calliope hummingbird (sensitive)	**Possible** Suitable forest edge and riparian habitat is present.
Flammulated owl (sensitive)	**Present** Surveys by IDFG (2007) documented two flammulated owls in the S. Creek watershed in the analysis area (both detections within the selected land), and there were 56 detections in the "south zone" of the SCNF, which includes the northern portion of the analysis area.
Great gray owl (sensitive)	**Possible** Forest Service (2003) records indicate observations from Marsh Creek and Yankee Fork 5^{th} level HUC watersheds, northeast of the analysis area. Some suitable forest habitat for nesting is in the analysis area.
Hammond's flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat is present.
Northern goshawk (sensitive)	**Possible** Some suitable forest habitat is present.
Olive-sided flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat is present.

Species (Status)	Occurrence
Peregrine falcon (sensitive)	**Possible** A peregrine aerie is present near the mouth of S. Creek. This aerie was occupied in 2008 and 2009 but unoccupied in 2012 (IDFG 2009b, IDFG 2012a). Peregrine falcons may forage in the analysis area.
Pileated woodpecker (sensitive)	**Possible** Suitable forest habitat is present.
Three-toed woodpecker (sensitive)	**Possible** Suitable spruce forest habitat is present.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat is present.
Williamson’s sapsucker (sensitive)	**Possible** Suitable forest habitat is present.
REPTILES AMPHIBIANS	
Columbia spotted frog (sensitive)	**Possible** Suitable (riparian) habitat is present.
Common garter snake (sensitive)	**Possible** Suitable (riparian) habitat is present.

3.7.1.3. Management Indicator Species

MIS are identified for Forest Service land in the analysis area, such as that associated with the MMPO alternatives (Table 3.7-3.) (USFS 2006). MIS are key species representative of life forms in general, and are species for which populations and habitat objectives can be established and tracked as indicators of habitat capability (USFS 1987).

Table 3.7-3. MIS, NFS land in the analysis area.

MIS	Habitat	Occurrence
Columbia spotted frog	riparian habitat/community	suitable wet (riparian) habitats
Sage-grouse *Centrocercus urophasianus*	sagebrush habitat/community	not expected to occur
Pileated woodpecker	coniferous habitat/community	observed in analysis area (USFS 2006)
Bull trout *Salvelinus confluentus*	aquatic habitat/community	may occur in Thompson or S. creeks (Section 3.8.1.1.)

3.7.1.4. General Wildlife

Elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), blue grouse (*Dendragapus obscures*), golden eagle (*Aquila chrysaetos*), and coyote (*Canis latrans*) are common in the analysis area. A cluster of little brown bats (*Myotis lucifugus*) was detected in June 2010 at the Lower Bruno Pond near the mouth of Bruno Creek (JBR 2012e). Game animals and migratory birds are discussed in more detail below.

Big Game

Big game in Idaho is managed by the IDFG. The analysis area is in IDFG Game Management Unit 36B. Mule deer and elk are the most visible species in the analysis area. Pronghorn antelope (*Antilocapra americana*) are occasionally observed, but numbers are low (BLM 2003). Bighorn sheep and mountain goats (*Oreamnos americanus*) have been observed in Unit 36B but are not common in the analysis area. Incidental counts of bighorn sheep during elk surveys identified 117 bighorn sheep across Unit 36B in 2010.

Mule Deer

A relatively high number of mule deer (8,720) were observed in Unit 36B in 2011 (Gaughan 2012). Unit 36B and several of the adjacent units to the north contain the majority of the most productive mule deer units in the region. The relatively high mule deer productivity is probably due to low competition from other ungulate species because white-tailed deer (*Odocoileus virginianus*) are mostly restricted to private land along major riparian areas, and the ranges of antelope, bighorn sheep, and mountain goats generally do not overlap with those of mule deer (Rachael et al. 2010a).

Mule deer are common throughout the analysis area, including areas close to human activity (e.g., roads) (BLM 1999). Preferred mule deer habitat is in timbered or brushy areas (hiding cover) mixed with sagebrush-grass and mountain mahogany (*Cercocarpus ledifolius*) foraging sites (BLM 1999). Approximately 94 percent of the analysis area is mule deer winter range. No mule deer migration corridors are known in the analysis area (BLM 1999, Map 22). Approximately 150 mule deer spend the winter between Thompson Creek and S. Creek (Wolf 2010).

Elk

A 2010 survey found 1,097 elk in Unit 36B (Wolf 2010). In 2008 there were 866 elk, a decrease of 55 percent compared to the 2005 estimate of 1,914 (Rachael et al. 2010b). Elk generally prefer areas away from roads with abundant timbered or brushy areas (hiding cover) and open sagebrush-grassland foraging sites. Important hiding cover includes timber stands, patches of mountain mahogany, riparian zones, and rugged terrain (BLM 1999). However, elk have become habituated to human activity at the mine site and commonly forage next to the Bruno Creek Road. Approximately 98 percent of the analysis area is elk winter range. No elk migration corridors are known in the analysis area (BLM 1999, Map 21). Approximately 90 to 130 elk spend the winter between Thompson Creek and S. Creek (Wolf 2010).

Black Bear and Mountain Lion

Black bears (*Ursus americanus*) typically occupy both forested and riparian habitats. The IDFG black bear data analysis unit (DAU) 1J, which includes Unit 36B, contains some of the best black bear habitat in the Salmon Region, and black bear are harvested annually (White et al. 2009). Therefore, black bear probably occur in the analysis area. The IDFG Salmon Region/Salmon DAU, which includes Unit 36B, supports abundant mountain lion (*Puma concolor*) prey species such as deer, elk, bighorn sheep, and mountain goat, and mountain lion are common (White et al. 2010). Therefore, mountain lion probably occur in the analysis area.

Migratory Birds

There are three types of suitable habitat for migratory birds in the analysis area (Table 3.7-4.) and migratory birds likely utilize these habitats during certain portions of the year.

Table 3.7-4. Migratory bird habitats, analysis area.

Migratory Bird Habitats	Portion of Analysis Area	Occurrence
Riparian	selected land	49 acres willow/alder shrub
	MMPO area	none
Douglas-fir	selected land	901 acres Douglas-fir 418 acres mixed Douglas-fir/lodgepole pine
	MMPO area	108 acres Douglas-fir 31 acres mixed Douglas-fir/lodgepole pine
Sagebrush scrub	selected land	1,225 acres big sagebrush + low sagebrush
	MMPO area	60 acres big sagebrush

3.7.2. Broken Wing Ranch

3.7.2.1. Wildlife Habitat

Most of the valley areas at the ranch are cultivated or otherwise disturbed for agricultural use. There are scattered cottonwoods along the Salmon River corridor. Lyon Creek has a more developed riparian corridor with large black cottonwoods, willows, and other riparian shrubs. Foothills contain varying amounts of bare ground (gravel/cobble substrate) and vegetation, including scattered sagebrush, shadscale, and native grasses (Section 3.4.2.2.).

The ranch provides good foraging habitat for raptors nesting in the vicinity. Large cottonwood trees along the Salmon River and Lyon Creek provide roosting perches, particularly for bald eagles during winter. Migratory birds would be expected to use the riparian vegetation for nesting or as temporary roosting and foraging. In general, the riparian and adjacent habitat along Lyon Creek is high-quality bird habitat (BLM 2009b).

3.7.2.2. Special Status Wildlife Species

A variety of special status wildlife species occur or may occur at the ranch (Table 3.7-5).

Table 3.7-5. Special status wildlife species, Broken Wing Ranch.

Species (Status)	Occurrence
MAMMALS	
Canada lynx (threatened)	**Possible** Within secondary habitat for Canada lynx as mapped by the Forest Service (USFS 2007); although unlikely, lynx may pass through or forage at the ranch.
Gray wolf (sensitive)	**Possible** No members of any wolf pack or individual wolf are known to use the ranch, but the Buffalo Ridge wolf pack activity center is near the west part of the ranch (Nadeau et al. 2009). Therefore, individuals or packs may pass through the ranch.
Bighorn sheep (sensitive[1])	**Possible** 15 % of the ranch is in bighorn sheep winter range (the upper elevations around Lyon Creek).
Fisher (sensitive)	**No** No suitable habitat.
Spotted bat (sensitive)	**Possible** Roost habitat is present around the ranch and river and meadow/fields associated with the ranch. It is possible that spotted bats would use the ranch for foraging.
Townsend's big-eared bat (sensitive)	**Possible** Suitable habitat in the form of rocky outcrops and caves for maternity roosts and hibernacula are not present on the ranch, but Townsend's big-eared bats may roost in the vicinity and forage in riparian areas on the ranch.
Wolverine (proposed threatened)	**No** No suitable habitat.
BIRDS	
Bald eagle (sensitive)	**Present** Bald eagles have been observed along the Salmon River and at the ranch (IDFG 2011a).
Brewer's sparrow (sensitive)	**Possible** Suitable sagebrush habitat (BLM 2009b, Area A) is present.
Calliope hummingbird (sensitive)	**Possible** Suitable riparian habitat (BLM 2009b, Area A) is present.
Flammulated owl (sensitive)	**No** No suitable habitat.
Hammond's flycatcher (sensitive)	**No** No suitable habitat.
Northern goshawk (sensitive)	**No** No suitable habitat.
Olive-sided flycatcher (sensitive)	**No** No suitable habitat.

Species (Status)	Occurrence
Peregrine falcon (sensitive)	**Possible** Peregrine falcons may use the ranch for foraging.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat (BLM 2009b, Area A) is present.
Williamson's sapsucker (sensitive)	**No** No suitable habitat.
REPTILES AMPHIBIANS	
Common garter snake (sensitive)	**Possible** Suitable riparian habitat (BLM 2009b, Area A) is present.

[1] Forest Service sensitive, but because of the presence of winter range it is included in the analysis for the ranch.

3.7.2.3. General Wildlife

Wildlife common on the ranch include big game (elk, mule deer), game birds (chukar and blue grouse), and migratory birds using riparian and sagebrush habitats. Raptors are expected to roost and forage in the area because rock and forest habitat suitable for nesting is in the vicinity.

Big Game

The majority (west of the Salmon River) of the ranch is in IDFG Unit 36B. The big game species of this unit were previously described (Section 3.7.1.4.).

Elk, Deer, and Big Horn Sheep

The portions of the ranch east of the Salmon River are in Unit 36A. The most recent elk count for this unit was 2,095 in 2008 (Rachael et al. 2010b), which is at or above objectives (Section 3.7.1.4.) despite a decrease in the count of 33 percent compared to the count in 2004 (3,124). There were 4,711 mule deer counted in the unit in 2011 (Gaughan 2012). The entire ranch is crucial winter range for mule deer. In addition, 10 percent of the ranch is winter range for elk, and 15 percent of the ranch is winter range for bighorn sheep. There are no big game migration corridors through the ranch. Approximately 60 to 70 elk and 200 mule deer spend the winter in the Lyon Creek drainage (Wolf 2010, 2011).

Black Bear and Mountain Lion

Black bear and mountain lion probably occur on the ranch for foraging and hunting, but due to the level of agricultural development and human disturbance it is improbable that these animals would utilize the ranch for denning.

Migratory Birds

The ranch contains three habitats suitable for migratory birds: agricultural land (the majority of the ranch), riparian (7 acres of willow, i.e., shrub-dominated riparian and 26 acres of willow/cottonwood along the Salmon River), and sagebrush scrub (260 acres, big sagebrush only). Migratory birds probably utilize these habitats during certain portions of the year.

3.7.3. Garden Creek Property

3.7.3.1. Wildlife Habitat

The property is densely forested in most areas, with mixed aspen and conifer trees in various stages of growth (< 100 years). Some dead trees and other woody debris are present, with a thick understory of shrubs and very young trees (saplings) in some places. The property has a few open, less steep areas with grasses and forbs. However, the majority of the property is fairly steep. Garden Creek crosses the upper northwest corner of the property and is approximately 2 feet wide with a very narrow riparian corridor. Forested areas provide raptor nesting habitat for goshawk and sensitive owls. The property likely has a fairly diverse bird population due to its location at the headwaters of Garden Creek, and the presence of forest habitat with a developed shrub layer. Amphibians may utilize the stream margins. The riparian area and forest openings provide foraging habitat for bats.

3.7.3.2. Special Status Wildlife Species

A variety of special status wildlife species occur or may occur at the property (Table 3.7-6).

Table 3.7-6. Special status wildlife species, Garden Creek property.

Species (Status)	Occurrence
MAMMALS	
Gray wolf (sensitive)	**No** No known wolf packs in the vicinity of the property.
Townsend’s big-eared bat (sensitive)	**Present** No suitable maternity or hibernacula habitat, or caves, cliffs suitable for roosting, but Townsend’s big-eared bats forage on the property in riparian areas and forest openings and were detected on the property on 22-23 June 2010 (JBR 2012e).
BIRDS	
Bald eagle (sensitive)	**No** No suitable habitat.
Brewer’s sparrow (sensitive)	**No** No suitable habitat.
Calliope hummingbird (sensitive)	**Possible** Suitable forest edge and wooded hillside habitat.
Flammulated owl (sensitive)	**Possible** Suitable forest habitat and the closest observations of the species are 3 miles north and 7 miles northwest of the property (IDFG 2011a).
Hammond’s flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat.
Northern goshawk (sensitive)	**Possible** Suitable forest habitat and the closest observations of the species are 5 miles north and 3 miles east of the property (IDFG 2011a).

Species (Status)	Occurrence
Olive-sided flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat.
Peregrine falcon (sensitive)	**No** No suitable nesting habitat.
Three-toed woodpecker (sensitive)	**Possible** Suitable forest habitat is present.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat is present.
Williamson's sapsucker (sensitive)	**Possible** Suitable forest habitat is present.
REPTILES AMPHIBIANS	
Common garter snake (sensitive)	**Possible** Suitable (riparian) habitat is present.
Northern leopard frog (sensitive)	**Possible** Suitable (riparian) habitat is present.
Western toad (sensitive)	**Possible** Suitable riparian and terrestrial habitat is present.

3.7.3.3. General Wildlife

Big Game

The Garden Creek property is in IDFG Game Management Unit 70, and does not contain winter range for any big game species.

Elk and Deer

IDFG Unit 70 and the surrounding region comprise the least productive area in southeast Idaho for mule deer, mainly due to the conversion of perennial grasslands to shrublands and forest, and due to the encroachment of human activity into winter ranges. There is no winter range on the Garden Creek property. The mule deer population in Unit 70 was 3,278 (± 153) in 2008 (Class 2010, 2011). The elk population in the unit was 100 cows and 65 bulls in 2010, which was above objectives. However, incidental observations during mule deer counts in 2008 suggest there may be as many as 400 elk in the unit during some years (Class 2010, 2011).

Black Bear and Mountain Lion

It is unlikely that black bear den on the property because of lack of suitable terrain, but black bear are known to occur on the property, e.g., a black bear was observed on the property during a field inspection in August 2009 (JBR 2012e). The property is not in an IDFG black bear DAU (White et al. 2009). Mountain lions are also unlikely to den on the property due to lack of suitable terrain, but probably hunt on the property. The property is in the Southeast

Region/Pocatello mountain lion DAU (west district). Concern over mountain lion depredation on the mule deer population in the west district has prompted relatively higher harvest quotas for mountain lions in that district (White et al. 2010).

Migratory Birds

The property contains two habitats suitable for migratory birds: riparian (<1 acre of forested riparian corridor) and Douglas-fir (64 acres). Migratory birds likely utilize these habitats during certain portions of the year.

Bats

Eight species of bats were detected in one location on the property in 2010: Townsend's big-eared bat, hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), little brown myotis, long-legged myotis (*Myotis volans*), and Yuma myotis (*Myotis yumanensis*) (JBR 2012e).

3.7.4. Special Status Wildlife Species, All Analysis Areas

Some basic information on special status wildlife species was provided in each of the three main subsections (MMPO area/selected land, Broken Wing Ranch, Garden Creek property) above. More detailed information is provided below.

Canada Lynx (Threatened)

Analysis Areas: All

The Canada lynx was listed as threatened in the contiguous US under the ESA in 2000. Lynx analysis units (LAUs) have been identified by the Forest Service and are used to analyze a project's effects to lynx productivity, mortality risk factors, movement, and dispersal. The area of an LAU is the approximate area used by individual lynx, not an actual home range, and includes all seasonal habitats. A small portion of the selected land (38 acres) is in the Thompson-Lower S. LAU.

In the western US, lynx occur primarily in Douglas-fir, spruce-fir, and fir-hemlock forests between approximately 5,000 feet to 6,500 feet elevation. The distribution of lynx is very similar to that of snowshoe hares, and lynx tend to occur where snowshoe hare density is highest (Aubry et al. 2000). Snowshoe hares occur in early successional stands with high stem densities. In southern boreal forests, alternative prey for lynx (especially red squirrels) is also important. However, in southern boreal forests, such habitats appear to be used by lynx primarily for hunting; all known den sites in southern regions were in mature forest stands with large woody debris. Denning habitat may be root wads, wind-thrown piles, or large down trees. Relatively large home ranges appear to be characteristic of lynx in southern boreal forests (Aubry et al. 2000).

The SCNF is part of "secondary" lynx habitat as defined in the Northern Rockies Lynx Amendment (USFS 2007). Secondary habitat has relatively few and more sporadic current and historical records of lynx compared to primary or "core" habitat, and reproduction in secondary habitat has not been documented (USFS 2007). The nearest lynx core habitat is more than 150 miles east and north of the portions of the SCNF in the analysis areas (USFS 2007). A male lynx was incidentally trapped and released in the Williams Creek drainage, approximately 11 miles southwest of Salmon, on January 26, 2012 (Waterbury 2012). This occurrence, approximately 50 miles northeast of the MMPO area, is the first verified occurrence of lynx in the Upper Salmon River drainage since 1991. Lynx may pass through the MMPO area, selected land, or the Broken Wing Ranch (secondary lynx habitat). However, lynx would not occur at the Garden Creek property because this area is not core, secondary, peripheral or linkage habitat for lynx (USFS 2007). The CTNF contains the closest linkage habitat (and mapped LAUs), 45 miles east/southeast of the property.

Gray Wolf (Sensitive)

Analysis Areas: All

The Northern Rocky Mountain population of gray wolves was delisted as an endangered species under the ESA on May 5, 2011 (76 FR 25590-25592). Gray wolves are now managed in Idaho by the IDFG as a game animal under the 2002 Wolf Conservation and Management Plan (Idaho Legislature 2002).

Wolves are social animals, frequently traveling and hunting in family packs of 2 to 12 wolves. Packs typically occupy and defend territories of 20 to 214 square miles. Wolves prey on a wide variety of medium-sized and large mammals, including white-tailed and mule deer, elk, caribou (*Rangifer* sp.), bighorn sheep, mountain goats, and beaver (68 FR 15804-15875). Wolves require habitat suitable for denning (i.e., areas with sufficient vegetative cover and isolation from human activity), and rendezvous sites for resting and gathering (i.e., meadows adjacent to forested areas), and accessibility to prey species. Idaho wolf numbers have grown steadily since the mid-1990s (76 FR 25590-25592). By the end of 2010 at least 705 wolves and 87 resident wolf packs were documented in Idaho (Holyan et al. 2011).

The MMPO area and selected land are in the territory of the Yankee Fork and Buffalo Ridge wolf packs. The Broken Wing Ranch is not in the known territory of a wolf pack, but the ranch is very near the known territory of the Buffalo Ridge pack. Therefore, it is possible wolves may occasionally pass through the ranch. Wolves are not expected on the Garden Creek property because there are no known wolf packs in the area (IDFG-NPT 2012).

American Pika (Sensitive)

Analysis Areas: MMPO Area

The American pika was petitioned for listing under the ESA in October 2007, and in January 2010 the USFWS found that listing the American pika was not warranted (75 FR 6438-6471). However, the pika remains a Forest Service sensitive species.

Pikas are small, vocal members of the rabbit family that live in talus (rocky) fields, or similar human-made habitat such as mine waste rock piles, lumber piles, stone walls, rockwork dams, and structure foundations. Pikas are patchily distributed in cool, rocky habitats (usually alpine) in western Canada and the western US. Pika distribution ranges from sea level to 9,850 feet in the northern part of pika distribution (southwestern Canada), but in the southern extent (New Mexico, Nevada, and Southern California) populations rarely exist below 8,200 feet. In Idaho the Northern Rocky Mountain subspecies (*Ochotona princeps princeps*) is broadly distributed and occupies many sites throughout much of the state. Pikas rely on gathered hay piles of summer vegetation to persist through the winter and do not hibernate. Thermoregulation is an important aspect of pika physiology and thus habitat selection, as hyperthermia (elevated body temperature) or death can occur after brief exposures to temperatures more than 78 ºF (75 FR 6440-6441). Pikas occupy the current WRSFs at the mine; several pikas were observed in the WRSFs during wildlife species surveys in 2010 (JBR 2012e). Therefore, it is likely pikas would occur in the current and expanded Buckskin and Pat Hughes WRSFs and the No Name WRSF (Alternative M3 only) in the MMPO area.

Bighorn Sheep (Sensitive)

Analysis Areas: MMPO Area, Broken Wing Ranch

Bighorn sheep are a Forest Service sensitive species, and managed by the IDFG as big game in the Idaho game management units. This species is also given special consideration in land use planning and other BLM actions.

The habitats for bighorn sheep are diverse but generally mountainous. Bighorn sheep prefer open habitat with good visibility and high-nutrient forage with adjacent, rugged, escape terrain (IDFG 2010). However, the Middle Main Salmon River population management unit contains some of the least rugged terrain in eastern Idaho (IDFG 2010a). Summer ranges are primarily higher elevations in sub-alpine regions. Winter ranges are dominated by sagebrush and grassland habitats with low precipitation (Toweill et al. 2008). Bighorn sheep winter along the Salmon River corridor in the Middle Main Salmon River population management unit. Some individuals remain in the corridor during summer, whereas others migrate to higher elevation sub-alpine and alpine habitats.

From 1989 to1991 bighorn sheep populations in the Salmon River region rapidly declined by 30 to 50 percent, followed by several years of very low lamb births. Recent aerial surveys suggest lamb numbers are still low (25 lambs/100 ewes). In general, bighorn sheep populations may be stabilizing with some populations increasing (Toweill et al. 2008).

The Salmon River region has had a very active bighorn sheep capture and translocation program since 1974. For example, the IDFG released eight bighorn sheep from Panther Creek to an area near Birch Creek southwest of Challis in 1982. This translocation was an attempt to stimulate growth of a small, stable population in Unit 36B. Aerial surveys of bighorn sheep were conducted in Unit 36A and Unit 36B during July 2007 to June 2008. There were 108 bighorn sheep in the Morgan Creek area of Unit 36B and 22 bighorn sheep in the Birch Creek area of the unit in 2008 (Toweill et al. 2008). Bighorn sheep may move through the MMPO area or the upper elevations of the Lyon Creek area of the Broken Wing Ranch.

Fisher (Sensitive)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

Fishers are agile, carnivorous, aggressive hunters that are members of the weasel family. Suitable fisher habitat includes continuous-canopied, mature to old-growth spruce-fir forest for denning, and areas with dense understories of young conifers, shrubs and herbaceous cover for hunting and foraging (Ruggerio et al. 1994). In Idaho fishers occur in a mosaic of mesic conifer, dry conifer, and sub-alpine forests in the northern and central parts of the state (IDFG 2005b). Fishers use mature and old-growth forests during summer, and young and old-growth forests during winter (Groves et al. 1997). Forested riparian habitat is also important (IDFG 2005b). Fishers may occur in the MMPO area or at the selected land, but are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Spotted Bat (Sensitive)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

Spotted bats are rare and have a highly fragmented distribution, occupying a variety of habitats, from desert to montane forest (including pinyon-juniper woodlands), ponderosa pine (*Pinus ponderosa*), open pasture, and coniferous forest up to 8,000 feet elevation (Groves et al. 1997). Spotted bats roost in deep rock crevices in canyon walls and cliffs. The bats are thought to migrate south during the winter but seasonal movements and winter activity are not well known. The bats forage primarily over dry, open coniferous forest associated with riparian or wet meadows. Individual bats are solitary during the active period and appear to maintain exclusive foraging areas, although they tolerate overlap from other spotted bats. In Idaho spotted bats occur mainly in the southwest corner of the state (Perkins and Peterson 1997) in deep, narrow canyons. However, spotted bats have been reported in the Salmon River Canyon (IDFG 2005b). Therefore, spotted bats may occur at the MMPO area, selected land, and Broken Wing Ranch due to habitat suitability and observations of spotted bats in the region of these areas (Salmon River Canyon).

Townsend's Big-Eared bat (Sensitive)

Analysis Areas: All

Townsend's big-eared bats occur in much of western North America in a variety of habitats and over a wide range of elevations. During the summer these bats roost in abandoned mines, caves, and occasionally in empty or occupied buildings or bridges. Hibernacula (winter shelter) occur exclusively in caves and mine tunnels (Groves et al. 1997) and most roost sites in Idaho are caves (Groves 1992). Populations in Idaho occur predominantly on the Snake River Plain, but scattered populations have been reported throughout the state (IDFG 2005b). Only two maternity colonies have been confirmed in Idaho; both are in Craters of the Moon National Monument. Numerous hibernacula in lava tube caves have been identified in south central and southeast Idaho (IDFG 2005b). Townsend's big-eared bats may occur in all of the analysis areas and were observed at the Garden Creek property (Table 3.7-6). Because there is no roosting habitat on the property, bats are probably foraging in the riparian corridor.

Wolverine (Proposed threatened)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

In North America, wolverines occur in a wide variety of arctic and alpine habitats, but primarily in boreal forests, tundra, and mountains. A general trait of areas occupied by wolverines is their remoteness from humans and human developments (Banci 1994). The southern portion of their range extends into Idaho (73 FR 12929-12941), where the wolverine is a wide-ranging species throughout mountainous areas. Potential wolverine habitat includes tundra and coniferous forest zones at higher altitudes in summer, and at mid- to lower elevations in winter. Den sites for wolverine in Idaho have most often been linked to talus and boulder fields in remote areas at higher elevation (Ruggiero et al. 1994). During a winter survey on the SCNF, wolverines were found principally in mixed conifer habitat dominated by lodgepole pine, and used spruce-fir stands along stream bottoms and adjacent meadows (Bachman et al. 1990). Wolverines may occur in the MMPO area and at the selected land. Wolverines are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Bald Eagle (Sensitive)

Analysis Areas: All

The USFWS estimates that the bald eagle population in the lower 48 states increased from 487 breeding pairs in 1963 to 9,789 breeding pairs in 2007. The bald eagle is protected under the Bald and Golden Eagle Protection Act (16 USC 668-668c) and the MBTA. In addition, the USFWS issued National Bald Eagle Management Guidelines (72 FR 31156) with recommended conservation measures to minimize adverse effects to the bald eagle.

Bald eagle nests as well as communal night roosts are usually located in uneven-aged (multi-storied) stands with old-growth components and near water bodies which support an adequate food supply. In Idaho large cottonwoods, ponderosa pine, and Douglas-fir are the preferred nesting trees (IDFG 2008b). Wintering eagles perch on a variety of substrates, but typically in trees that provide high vantage points near feeding areas. Isolation is also an important feature of bald eagle wintering habitat, although bald eagles can become accustomed to nearby vehicle traffic. Adequate food sources are the most critical components of bald eagle breeding and wintering habitat. Fish, waterfowl, rabbits, and carrion (including big game carrion in Idaho) comprises the majority of the bald eagle diet (IDFG 2008b, USFWS 1986).

The bald eagle population in Idaho is stable to increasing, thus currently unoccupied suitable habitat is expected to be colonized by an ever-expanding number of bald eagles (Sallabanks 2006). Mid-winter bald eagle counts in the Salmon/Challis area increased each year between 1980 and 2005, from a low of 7 in 1980 to a high of 137 in 2005 (USFS 2006). Bald eagles winter in cottonwood-riparian habitats along the Salmon River, and the eagles are expected to occur at the Broken Wing Ranch. A bald eagle nest also occurs along S. Creek on private land 2.5 miles south of the selected land. The nest was first detected in 2009 and was active (IDFG 2009a); therefore, bald eagles are expected to forage at the selected land. Bald eagles are not expected to nest in the MMPO area or at the Garden Creek property due to a lack of suitable habitat, but bald eagles might forage in these areas.

Boreal Owl (Sensitive)

Analysis Areas: MMPO Area

Boreal owls are typically found in mature to old-growth spruce-fir forests in the Rocky Mountains. The owls often nest in abandoned northern flicker (*Colaptes auratus*) and pileated woodpecker cavities in large dead or dying conifers, ponderosa pine, large Douglas-fir, or aspen in mixed conifer, spruce, and Douglas-fir forests (Hayward 1994). Boreal owl roosting and foraging habitat occurs in relatively closed canopy subalpine fir and Engelmann spruce forests (Hayward 1994). Boreal owls may occur in the MMPO area.

Brewer's Sparrow (Sensitive)

Analysis Areas: All

Brewer's sparrows require sagebrush habitat. The sparrows are closely associated with sagebrush shrublands with abundant, scattered shrubs and short grass. The sparrows breed in high densities and tend to be the most abundant bird species where they occur. They build open cup-shaped nests in large sagebrush plants. One study in Idaho found that Brewer's sparrows select taller shrubs ranging from 16 to 41 inches high (Ritter 2000). Brewer's sparrows may occur at the MMPO area, selected land, or Broken Wing Ranch. Brewer's sparrows are not expected to occur at the Garden Creek property due to a lack of suitable habitat.

Calliope Hummingbird (Sensitive)

Analysis Areas: All

Calliope hummingbirds are associated with open coniferous forests, montane meadow-shrublands, riparian thickets of willow and alder, burned areas, and wooded hillsides. The hummingbirds nest in riparian areas and open forests at the edge of meadows. The hummingbirds build nests in trees, usually on a horizontal branch with another branch overhanging, presumably for shelter (Ritter 2000). Calliope hummingbirds may occur in all of the analysis areas.

Flammulated Owl (Sensitive)

Analysis Areas: All

Flammulated owls occur year-round in cool, temperate semi-arid climates, and migrate when necessary to maintain access to their insect prey. The habitat of flammulated owls consists primarily of open ponderosa pine or similar dry montane forests (McCallum 1994). Forests used by flammulated owls include an interspersion of dense thickets for roosting in open, mature to old-growth stands of ponderosa pine, Douglas-fir, or aspen. Flammulated owls are obligate cavity nesters, using natural cavities or (more commonly) old woodpecker holes in large trees and snags (IDFG 2005b). Flammulated owls are likely to occur in the MMPO area and selected land, and may occur at the Garden Creek property. Flammulated owls are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Great Gray Owl (Sensitive)

Analysis Areas: MMPO Area

The primary habitat of the great gray owl in southeastern Idaho is mid- to late-succession Douglas-fir forest (the most abundant habitat available) associated with clear-cut and natural meadows. Great gray owls forage in relatively open, grassy habitat that may include bogs, selective and clear-cut logged areas, natural meadows, or open forests (Duncan and Hayward 1994). Great gray owls may occur in the MMPO area.

Hammond's Flycatcher (Sensitive)

Analysis Areas: All

Hammond's flycatchers are found in coniferous forests (e.g., old-growth Douglas-fir/ponderosa pine in Idaho) and woodlands. During migration the flycatchers can be found in a wider variety of habitats, including deserts and scrubland, and pine and pine/oak associations. Females build cup-shaped nests in trees (coniferous or deciduous) and hunt from a perch (Groves et al. 1997). Hammond's flycatchers may occur at the MMPO area, selected land, or Garden Creek property. Hammond's flycatchers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Northern Goshawk (Sensitive)

Analysis Areas: All

Northern goshawks are forest generalists, but tend to avoid young, dense forests due to their large size and wingspan. Optimal habitat for northern goshawks includes forest stands with canopy cover greater than 60 percent, overstory trees with diameters greater than 15 inches, and the presence of dead or defective trees greater than 10 inches in diameter. The home range and foraging area varies from 1,235 to 9,884 acres and may be composed of a variety of forest types and openings. Quality foraging habitat is single- or two-storied, non-alpine stands with open or relatively open understories (Samson 2006). Goshawks are not dependent on large, unbroken tracts of old-growth or mature forest (Brewer et al. 2007). Goshawks may occur at the MMPO area, selected land or the Garden Creek property. Goshawks are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Olive-sided Flycatcher (Sensitive)

Analysis Areas: All

Olive-sided flycatchers are found in forests and woodlands, especially in burned areas with standing dead trees, such as taiga, subalpine coniferous forests, mixed forests, boreal bogs, muskeg, and the borders of lakes and streams. Females build cup-shaped nests in trees (coniferous or deciduous) and hunt from a perch (Groves et al. 1997). Olive-sided flycatchers may occur at the MMPO area, selected land, or Garden Creek property. Olive-sided flycatchers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Peregrine Falcon (Sensitive)

Analysis Areas: All

Peregrine falcons are adaptable raptors that inhabit mountains, river corridors, marshes, lakes, coastlines, and cites. Peregrine falcons breed on cliffs, cut banks, and in trees. Peregrine falcons do not build stick nests but will use the abandoned nests of hawks, eagles, and ravens. In Idaho peregrine falcons are associated with mountains, major river corridors, reservoirs, and lake basins (IDFG 2005b). A peregrine aerie is present near the mouth of S. Creek. This aerie was occupied in 2008 and 2009 but unoccupied in 2012 (IDFG 2009b, IDFG 2012a). Peregrine falcons may occur or forage at the MMPO area, selected land, or Broken Wing Ranch. Peregrine falcons would not occur at the Garden Creek property due to a lack of suitable nesting habitat, but may use the property for foraging.

Pileated Woodpecker (Sensitive and MIS)

Analysis Areas: MMPO Area

The pileated woodpecker is an uncommon resident species linked to mature Douglas-fir and mixed conifer forest, primarily at mid-elevations. Pileated woodpeckers require large-diameter trees for nesting and roosting. Pileated woodpeckers are not known in the MMPO area, but the woodpeckers were detected in 2005 in the Yankee Fork District (which contains the Forest Service land in the MMPO area) (Table 3.7-3.) (USFS 2006). Therefore, pileated woodpeckers may occur in the MMPO area.

Three-toed Woodpecker (Sensitive)

Analysis Areas: MMPO Area, Garden Creek Property

Three-toed woodpeckers occur in the northern and central parts of Idaho (IDFG 2005b). The woodpeckers usually occupy mature to old forest stands with a high degree of insect and disease activity and numerous snags. The woodpeckers are strongly attracted to infested forests or burned areas (USFS 2009) because the woodpeckers flake off bark to forage on bark beetles (Koplin 1969), and are thus typically found in forests with high densities of bark beetle larvae (IDFG 2005b). Three-toed woodpeckers may occur in the MMPO area or at the Garden Creek property.

Willow Flycatcher (Sensitive)

Analysis Areas: All

Willow flycatchers breed in riparian habitat with a midstory of willows or alders and an intact lower layer. Shrub thickets interspersed with openings are used more than continuous stands. A dense overstory may discourage use by willow flycatchers. The flycatchers build cup-shaped nests in forks of shrubs or deciduous trees, and are most common at elevations below 5,500 feet (Ritter 2000). Willow flycatchers may occur in all of the analysis areas.

Williamson's Sapsucker (Sensitive)

Analysis Areas: All

Williamson's sapsuckers are found in montane coniferous forests, especially fir and lodgepole pine. The sapsuckers can also be found in lowland forests during migration and winter. The sapsuckers nest in cavities in snags (Groves et al. 1997). Williamson's sapsuckers may occur at the MMPO area, selected land, or Garden Creek property. Williamson's sapsuckers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Columbia Spotted Frog (Sensitive and MIS)

Analysis Areas: MMPO Area

Columbia spotted frogs in central Idaho are not part of the Great Basin Distinct Population Segment (candidate for listing under the ESA) that occurs in southwest Idaho. Columbia spotted frogs in central and northern Idaho, including those in the SCNF, are part of a relatively abundant northern population from Alaska to Wyoming (USFWS 2006). The frogs require aquatic habitat components for hibernation (water-flooded burrows), breeding (pooled water), foraging (e.g., shallow pond margins), and migrating between breeding and hibernation sites (corridors containing water and vegetative cover, e.g., wet meadows) (USFWS 2006). The frogs may be found in any suitable riparian or wetland habitat, but are typically found in association with vernal pools. Surveys in 2005 found spotted frog egg masses at six sites in the SCNF Challis-Yankee Fork District (USFS 2006). Columbia spotted frogs may occur in the MMPO area.

Common Garter Snake (Sensitive)

Analysis Areas: All

Garter snakes are found in habitats such as grasslands, shrublands, woodlands and open areas in forests, but are generally associated with marshes and water areas in Idaho (Groves et al. 1997). Garter snakes may occur in all of the analysis areas.

Northern Leopard Frog (Sensitive)

Analysis Areas: Garden Creek Property

Northern leopard frogs are associated with marshes, pond margins, and slow-moving sections of streams and rivers. In southern Idaho northern leopard frog populations have been reported in the Snake River and tributaries, including Portneuf River, Bear River, and Marsh Valley. Shive and Peterson (2002) reported the northern leopard frog was the second most abundant species found in their study area in south central Idaho. Northern leopard frogs may occur at the Garden Creek property.

Western Toad (Sensitive)

Analysis Areas: Garden Creek Property

Western toads are found in desert springs and streams, meadows and woodlands, and in and around ponds, lakes, reservoirs and slow-moving rivers and streams. Breeding areas are typically shallow water at the edges of ponds; the edges of lakes, streams, or rivers with slow-moving water; or other flooded or ponded areas (Keinath and McGee 2005). After breeding, western toads move to more terrestrial habitats and eventually to hibernacula that may be a substantial distance from the breeding site (up to 1.5 miles, but usually much less; Keinath and McGee 2005). Western toads dig a burrow in loose soil or use burrows of small mammals (Groves et al. 1997) and remain in hibernation until the following spring. Western toads may occur at the Garden Creek property.

3.8. Fish and Aquatic Resources

The analysis area for fish and aquatic resources for the MMPO alternatives is the S. Creek and Thompson Creek 6^{th} level HUC watersheds (which include a number of smaller subwatersheds such as Buckskin Creek, Pat Hughes Creek, Cherry Creek, Bruno Creek, etc.), as well as the Salmon River between the mouths of Thompson Creek and S. Creek. The analysis area does not include a specified reach of the Salmon River downstream of S. Creek (e.g., 10 miles downstream). However, the analysis of Salmon River water quality includes inputs from S. Creek and, as a result, effects to fish and aquatic resources in the Salmon River described in Chapter 4 include effects both up and downstream of the mouth of S. Creek. The analysis area for fish and aquatic resources for the land disposal alternatives is the Broken Wing Ranch, the Lyon Creek drainage, and the Garden Creek property. With the exception of the Garden Creek property, all of the aforementioned streams and watersheds are in the Upper Salmon River 5^{th} level watershed (HUC 17060201). The Garden Creek property is in the Portneuf River 5^{th} level watershed (HUC 17040208) (Section 3.6.1.1.).

3.8.1. MMPO Area and Selected Land

Thompson Creek, S. Creek, Bruno Creek, and the Salmon River are the primary fish-bearing streams in the analysis area. Fish may also use accessible habitat in some tributaries to Thompson Creek and S. Creek; most of the accessible tributaries are upstream of the mine. Buckskin and Pat Hughes creeks do not provide fish habitat, but would be affected under all of the MMPO alternatives. The hydrologic characteristics of all of these streams were described previously (Section 3.6.1.1.).

Near the confluence of S. Creek with the Salmon River, the IDFG in cooperation with TCMC has constructed a steelhead (*Oncorhynchus mykiss*) smolt acclimation and adult trapping facility/pond on S. Creek, referred to as South Butte Pond. The pond receives water via a screened water diversion from S. Creek (IDFG 2004). Release of B-run steelhead smolts into the pond began in 1998. The first return of B-run steelhead adults was in 2002 when 119 adults were collected in the upper Salmon River from fish released at South Butte Pond. Adults have continued to return, e.g., 129 in 2003 and 157 in 2004. Moreover, the total estimated returns of adults (i.e., including the number of adults harvested by sport fisherman) to the upper Salmon River was 1,469 in 2002, 1,813 in 2003, and 1,279 in 2004 (IDFG 2011b). As of 2005, the IDFG estimated that nearly 1,100,000 B-run steelhead smolts had been released from South Butte Pond into lower S. Creek. However, adult fish are collected at South Butte Pond using a temporary weir, which has been problematic due to failure during high water events. As a result, B-run broodstock from S. Creek were transferred to the Pahsimeroi Fish Hatchery in 2009 (IDFG 2012b). The goal is to release up to 280,000 smolts annually to S. Creek. The smolts are currently released directly to S. Creek, and the pond is not being used (IDFG 2011b).

The fish habitat of Bruno Creek is fragmented by the mine, e.g., the TSF fills 2 miles of the stream and there are two sedimentation ponds in lower Bruno Creek. The TSF and associated flow diversions have also impacted lower Bruno Creek through the loss of streamflow. Regardless, until recently there are isolated fish populations upstream of the TSF, and it appears that fish habitat also remains below the TSF. However, recent surveys above the TSF found no fish present (USFS 2013b). The long-term population viability above the TSF is limited by the lack of gene flow and the inability for fish to re-colonize the reach following events such as floods and drought.

3.8.1.1. Fish Species Present

The analysis area for the MMPO and the selected land provides habitat for six salmonid species, and many native, non-salmonid species that may also be present (Table 3.8-1). The salmonid species exhibit both resident and anadromous life histories and five of the six species are special status species: mountain whitefish [*Prosopium williamsoni*] is the only salmonid not a special status species. Special status fish species are discussed in further detail below, and include those listed as threatened, endangered, proposed, candidate, or sensitive, as well as MIS. Of the native, non-salmonid species that may be present in the analysis area at some point in their life history, sculpin (*Cottus* spp.) are the most common.

Table 3.8-1. Fish species occurrence, MMPO and selected land.

Species	Status	Occurrence
SPECIAL STATUS SPECIES		
Bull trout *Salvelinus Confluentus*	Threatened/MIS	**Present** Bull trout are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). These streams are designated critical habitat for bull trout.
Chinook salmon *Oncorhynchus tshawytscha*	Threatened/MIS	**Present** Chinook salmon are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). Only juvenile Chinook salmon have been found in Thompson and S. Creek (no documented adults or redds). All waters presently or historically accessible to Chinook salmon in the Upper Salmon River watershed are designated critical habitat for Chinook salmon. In the analysis area, this includes the Salmon River, Thompson Creek, and S. Creek. Because of the manner in which critical habitat was designated for Chinook salmon (see below), it also would likely include Buckskin Creek, Pat Hughes Creek, and Bruno Creek. However, these streams are unoccupied and would not be occupied for the foreseeable future.
Steelhead/Rainbow trout *Oncorhynchus mykiss*	Threatened (steelhead) MIS/BLM sensitive (rainbow)	**Present** Juvenile steelhead and/or rainbow trout are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). Only juvenile steelhead/rainbow trout have been found in Thompson Creek (no documented adults or redds). Juvenile steelhead and rainbow trout are indistinguishable based on physical appearance; however, they can be differentiated based on genetics. The Salmon River, Thompson Creek, and S. Creek are designated critical habitat for steelhead.
Sockeye salmon *Oncorhynchus nerka*	Endangered	**Present** Sockeye salmon use the Salmon River for migration to/from central Idaho lakes. The Salmon River is designated critical habitat for Sockeye salmon (BLM 1998).
Westslope cutthroat trout *Oncorhynchus clarkii lewisi*	Forest Service/BLM sensitive/MIS	**Present** Westslope cutthroat trout are present in the Salmon River, Thompson Creek, S. Creek, and Bruno Creek (GEI 2011, IDFG 2004, IDFG 2005b).

Species	Status	Occurrence
NON- SPECIAL STATUS SPECIES		
Bridgelip sucker *Catostomus columbianus*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Largescale sucker *Catostomus macrocheilus*		**Possible** May be present in the Salmon River (BLM 1998).
Longnose dace *Rhinichthys cataractae*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Mottled sculpin *Cottus bairdii*		**Possible** Sculpin are present in Thompson and S. creeks, and although most of these are identified as shorthead sculpin (GEI 2011), many sculpin are not identified to species (IDFG 2005a, IDFG 2004) and mottled sculpin may also be present. Likely present in the Salmon River (BLM 1998).
Mountain whitefish *Prosopium williamsoni*		**Present** Was historically present in Thompson Creek and is present in S. Creek and the Salmon River (GEI 2011).
Northern pikeminnow *Ptychocheilus oregonensis*		**Possible** May be present in the Salmon River (BLM 1998).
Pacific lamprey *Lampetra tridentata*		**Possible** Precise distribution data for Pacific lamprey is unavailable for much of the upper Salmon River; however, lamprey once migrated into all Idaho waters that salmon and steelhead migrated into (Simpson 1982). Lamprey have been found ~ 90 miles downstream of the analysis area (Curet 2013).
Redside shiner *Richardsonius balteatus*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Shorthead sculpin *Cottus confusus*		**Present** Present in the Salmon River, Thompson Creek, and S. Creek (BLM 1998, GEI 2011).

Species	Status	Occurrence
Speckled dace *Rhinichthys osculus*		**Possible** Likely present in the main Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
White sturgeon *Acipenser transmontanus*		**Not Present** The Snake River population of white sturgeon occurs in the Snake River and the mainstem Salmon River. They are rarely seen above the North Fork Salmon River (~ 100 miles downstream of the analysis area) (IDFG 2005a).

Special Status Species

There are four fish species listed as threatened or endangered that use components of the analysis area for a portion of their life history: bull trout, Chinook salmon, sockeye salmon, and steelhead (Table 3.8-1). In addition, westslope cutthroat trout and resident rainbow trout are also present in the analysis area. Westslope cutthroat trout are a MIS and a Forest Service and BLM sensitive species.

The analysis area also contains designated critical habitat for bull trout, sockeye salmon, Chinook salmon, and steelhead. The USFWS oversees recovery efforts and critical habitat for resident fish species (e.g., bull trout) and the NMFS oversees recovery efforts and critical habitat for anadromous fish species (e.g., salmon, steelhead). The ESA defines species to include distinct population segments (DPS). Three elements are considered in the designation of a DPS (61 FR 4722): 1) discreteness of the population segment in relation to the remainder of the species to which it belongs; 2) the significance of the population segment to the species to which the segment belongs; and 3) the population segment's conservation status in relation to the ESA standards for listing.

For Pacific salmon, the NMFS has established evolutionary significant units (ESUs) as the listing unit for salmon. Under this policy, a population is considered a DPS if it represents an ESU (61 FR 4722). An ESU is a population or group of populations that is substantially reproductively isolated from other populations of the same species and represents an important component in the evolutionary legacy of the species (61 FR 4722, NMFS 1999). As steelhead may come under the jurisdiction of both the USFWS (for resident rainbow trout) and NMFS (anadromous steelhead), steelhead are listed as DPSs (71 FR 834).

In addition to being designated critical habitat, streams in the analysis area are essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (16 USC 1801 *et seq.*): "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 USC 1802). The habitat is designated on a watershed scale and includes all currently viable waters and most of the habitat historically accessible to salmon in a specified USGS hydrologic unit (PFMC 1999). All waters designated critical habitat for Chinook salmon in the Upper Salmon River subbasin (HUC 17060201) are also EFH.

Bull Trout and Designated Critical Habitat

Bull trout exhibit a variety of life history traits, including migratory and resident forms. Migratory forms can be anadromous near coastal areas, or more commonly, fluvial, and adfluvial migrant forms. Fluvial and adfluvial adults reside in large rivers and lakes, returning to headwater tributaries to spawn. The offspring rear in the headwater streams for 1 to 4 years before migrating to larger rivers or lakes. Resident bull trout have adapted to reside their entire life in the headwater streams. Habitat requirements for bull trout appear to be very specific, including cold, clean water for spawning and complex habitat, with a large amount of large woody debris (LWD) being especially important. As a result of the reliance on cold, clean water bull trout primarily spawn in upper elevation streams.

In the Upper Salmon River drainage, bull trout move into natal tributaries beginning in August and spawn in mid- to late September and October (BLM 2011). Eggs may hatch in winter or early spring, with alevin (sac fry) remaining in the gravel until spring (April). Once the juveniles fully emerge, they inhabit side channels and other low velocity habitat.
The USFWS draft bull trout recovery plan (USFWS 2002) initially subdivided bull trout distribution in Idaho into seven recovery units including the Salmon River Recovery Unit, of which the Upper Salmon River Core Area was a subset. The USFWS subsequently issued a final rule designating critical habitat for bull trout in 2010 (75 FR 75 63898). In the Final Rule, the USFWS identified six draft recovery units that replaced earlier recovery units. The analysis area is in the Upper Snake Recovery Unit. In the recovery units, there are 32 designated critical habitat sub-units, with the analysis area in the Upper Salmon River critical habitat subunit (CHSU). In the analysis area, the Salmon River, Thompson Creek, and S. Creek are all designated critical habitat for bull trout. Critical habitat provides features considered essential to the conservation of the species. The Upper Salmon River CHSU has been determined to be critical habitat essential to bull trout conservation because the river provides a rare fluvial life history expression in the Upper Snake Recovery Unit. The river contains many individuals, a large amount of habitat, and few threats. The CHSU contains populations with fluvial life history expressions that are important in the long-term recovery of the species (USFWS 2009).

Chinook Salmon, Designated Critical Habitat, and EFH

Spring/summer Chinook salmon in the Snake River drainage form a distinct ESU, which includes all naturally spawning populations in the Salmon River subbasin (57 FR 23458). Snake River spring/summer Chinook salmon enter the Columbia River from February through March, arriving at natal tributaries from June through August, then hold in deep mainstem and tributary pools until late summer when the fish spawn (Good et al. 2005, NMFS 2011). Spring-run Chinook salmon spawn in mid- to late August, with summer-run Chinook salmon spawning approximately 1 month later (Good et al. 2005). Chinook salmon present in the analysis area are primarily summer-run fish and are part of the Upper Salmon major population group (MPG) (NMFS 2011).

Spring/summer Chinook salmon in the Snake River drainage have a stream-type life history. After spawning in late summer or early fall, eggs incubate overwinter and hatch in later winter/early spring of the following year. As described for bull trout, alevins remain in the gravel for approximately 4 to 6 weeks after the embryos hatch, with juveniles emerging during the spring. Juveniles then rear throughout the summer, overwinter, and migrate to the ocean in the spring of their second year (Good et al. 2005). Spring/summer Chinook salmon use the Salmon River as a migration corridor to access tributary spawning habitats. Chinook salmon also spawn as adults and are present as rearing individuals in the Salmon River. It is uncertain if Chinook salmon spawning occurs in the primary tributary streams in the analysis area, including Thompson Creek, S. Creek, and Lyon Creek (offered land). However, juvenile individuals have been documented to occur in the aforementioned streams.

The NMFS designated all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon as critical habitat in 1993 (58 FR 68543), with a revision in 1999 (64 FR 57399). In the Upper Salmon River watershed, this includes the Salmon River, Thompson Creek, S. Creek, and Lyon Creek (offered land). Although fish habitat in Buckskin Creek, Pat Hughes Creek, and Bruno Creek was largely eliminated prior to designation of critical habitat, the critical habitat designation only explicitly excludes those areas blocked by impassable natural falls and Hells Canyon Dam. In addition, although Buckskin Creek and Pat Hughes Creek may have been intermittent historically (which would have resulted in dry, impassable reaches during portions of the year), the critical habitat designation rule implies that intermittent streams are included (58 FR 68547, EPA 2006). As a result, Buckskin, Pat Hughes, and Bruno creeks are considered designated critical habitat although they are currently not occupied by Chinook salmon and could not be occupied in the future due to barriers (sediment ponds) in the lower reaches and the WRSFs and TSF in the upper reaches. Streams in the analysis area that are freshwater EFH (Salmon River, Thompson Creek, S. Creek, and Lyon Creek) are defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity (50 CFR 600 Subpart K).

Sockeye Salmon and Designated Critical Habitat

Sockeye salmon differ from other Pacific salmon species in that sockeye salmon generally spawn in freshwater lakes and inlet or outlet streams to these same lakes. The Snake River sockeye salmon ESU that spawns in mountain lakes of central Idaho were listed as endangered in 2001 (57 FR 212). Adult Snake River sockeye salmon use the Snake and Salmon rivers as migration corridors to spawn in Redfish Lake and other central Idaho lakes. Smolts from Redfish Lake (and from the Sawtooth Fish Hatchery captive broodstock program) also use the Salmon River as a migration corridor for their outmigration. Snake River sockeye salmon do not use habitat in the analysis area for any other life stages. Critical habitat for Snake River sockeye salmon was designated in 1993 (58 FR 68543). The designation includes the Salmon River from Alturas Lake Creek to the confluence of the Salmon River with the Snake River. The analysis area includes 4.4 miles of designated critical habitat for Snake River sockeye salmon along the Salmon River.

Steelhead/Rainbow Trout and Designated Critical Habitat

Steelhead are anadromous rainbow trout. Rainbow trout life history can be complex as they can be anadromous (steelhead) or freshwater resident (rainbow or redband trout) and can yield offspring of the opposite form (Good et al. 2005). Juvenile steelhead are indistinguishable from resident rainbow trout based on physical appearance (some may be differentiated based on genetics). The Snake River steelhead DPS includes all naturally spawned populations of steelhead in the Snake River and its tributaries (including the Salmon River and its tributaries). Steelhead were originally listed as threatened in 1997 (62 FR 43937). However, the original listing for the Snake River steelhead ESU included anadromous steelhead and resident, non-anadromous rainbow trout. The revised listing for the Snake River steelhead DPS as threatened does not include rainbow trout, which are under the jurisdiction of the USFWS (71 FR 834). Steelhead in the analysis area are in the Salmon River MPG (NMFS 2011).

As with salmon, multiple life histories exist for steelhead. Steelhead in the analysis area are primarily summer run steelhead. Summer run steelhead adults enter freshwater in a sexually immature condition between May and October and require several months to mature and spawn. After holding over the winter, adult summer-run steelhead spawn the following spring (March to May) over clean gravel. Juveniles typically emerge by early June or mid-July (NMFS 2011) and rear for 1 to 3 years in freshwater before beginning the smoltification process. Steelhead smolts will typically migrate to the ocean in April through July.

Snake River summer steelhead are divided into two groups: A-run and B-run. Steelhead returning to the Salmon River are considered to be primarily A-run steelhead, which are predominantly age-1 ocean fish. Steelhead use the Salmon River as a migration corridor to access tributary spawning and rearing habitat. However, steelhead also spawn as adults and are present as rearing individuals in the Salmon River. In addition, the IDFG hatchery program (under the Lower Snake River Compensation Program) has worked to establish a B-run steelhead fishery in the upper Salmon River, which has included releases in S. Creek and South Butte Pond (IDFG 2012b) (Section 3.8.1.). Critical habitat for steelhead was initially designated in 1999 (FR 59:54840), with a final designation in 2005 (70 FR 52630). Designated critical habitat in the analysis area includes all waters of the Upper Salmon River watershed, including the Salmon River, Thompson Creek, and S. Creek.

Westslope Cutthroat Trout

Westslope cutthroat trout feed primarily on aquatic macroinvertebrate organisms and are not highly piscivorous (i.e., do not have a diet of primarily fish) like other cutthroat trout subspecies (Behnke 1992). Westslope cutthroat trout reach maturity at 4 to 5 years of age and spawn primarily in small tributary streams between March and July. Early life history (i.e., embryo, alevin, swim-up) is similar to what is described for steelhead/rainbow trout. Fry may grow to maturity in the spawning streams or may move downstream into larger rivers. Similar to bull trout, adults may be resident or fluvial migrant fish (Behnke 1992).

3.8.1.2. Acid Rock Drainage Effects to Fish

Metals released from ARD become readily available to biological organisms. For example, in water when fish are exposed directly to metals and acid through the gills, impaired respiration may result from chronic and acute toxicity. Fish are also exposed indirectly to metals through ingestion of contaminated sediment and food items. Water with pH 2.0 to 4.5 is acutely toxic to most aquatic life. Most fish species are not affected by water with pH 5.5 to 10.0 (RRG 2008). Background information more relevant to metal toxicity to fish for the MMPO alternatives is presented in Section 4.8.1.

3.8.1.3. Aquatic Habitat

Various BLM, Forest Service, IDFG, and TCMC surveys, water quality monitoring sites, and biological monitoring sites have been established in the analysis area (Section 3.6.1.1.,

Figure 3.8-1). The baseline conditions for aquatic habitat in the analysis area are described using data from these surveys and monitoring.

JBR (2012f) describes the baseline conditions of aquatic habitat in the MMPO area and the selected land relative to the NMFS indicators of properly functioning condition (PFC) and standards for future desired conditions matrix (NMFS 1996) and the associated USFWS matrix for bull trout (USFWS 1998). Both the NMFS matrix and the USFWS matrix are used since anadromous fish such as steelhead and Chinook salmon are under NMFS jurisdiction, whereas non anadromous bull trout are under the jurisdiction of the USFWS. JBR (2012f) also analyzes effects that might occur relative to the NMFS and USFWS indicators under the MMPO alternatives. The analysis in JBR (2012f) described effects that would be confined to habitat removal (Buckskin and Pat Hughes creeks), small changes in water quantity, and changes in water quality. Therefore, the discussion of baseline aquatic habitat conditions in this section focuses on stream disturbance, flow, and water quality. This discussion corresponds to the NMFS and USFWS indicators for disturbance history, riparian reserves, sediment/turbidity, chemical contaminants and nutrients, and peak/base flows. Discussion of other indicators can be found in JBR (2012f) and in the Biological Assessment (BA) prepared for this project. Additional detail regarding chemical contaminants and nutrients, and peak/base flows is provided in Section 3.6.1.1. (NMFS 1996, USFWS 1998).

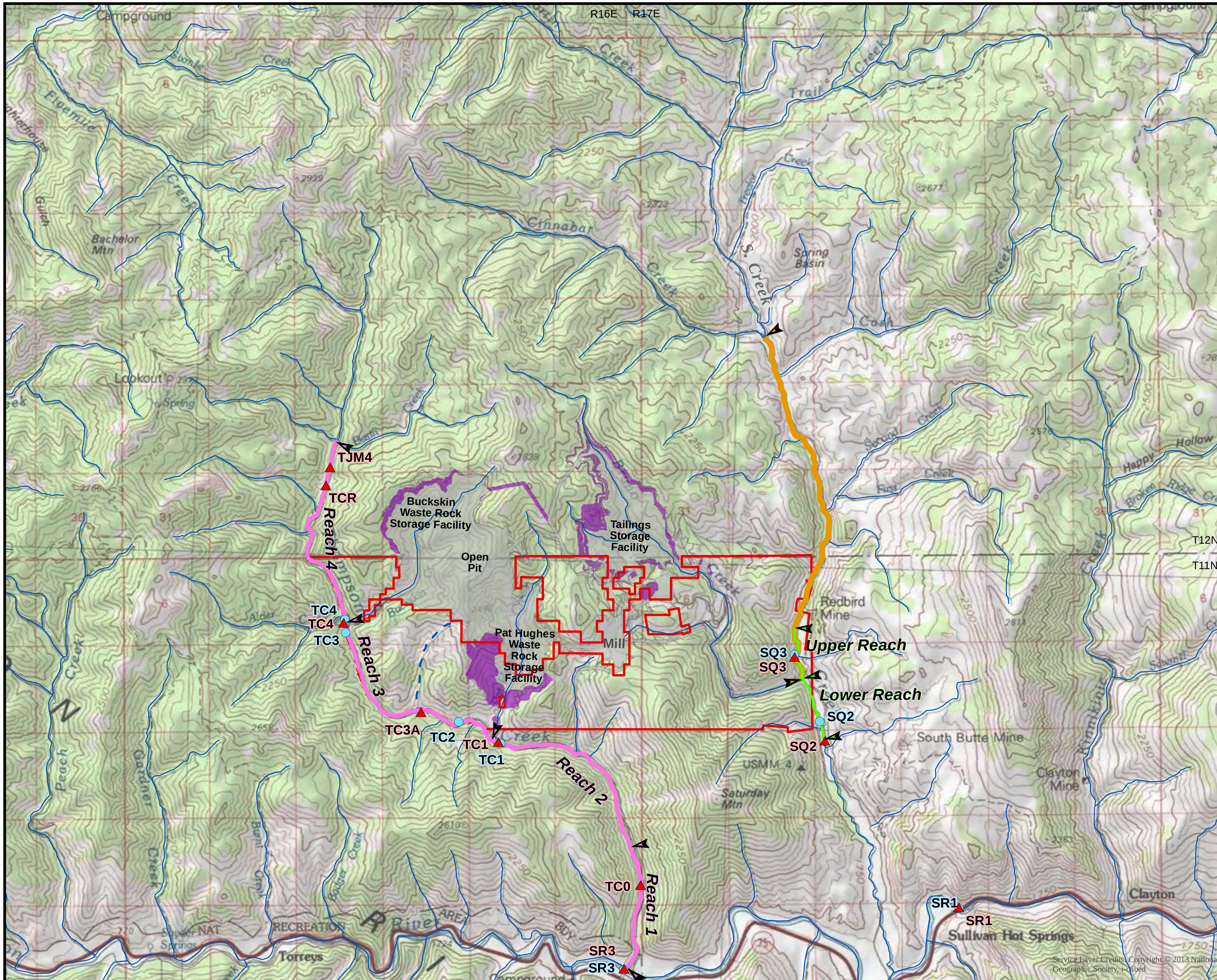
As the discussion of baseline condition includes assigning a condition level to each indicator discussed using NMFS (1996) and USFWS (1998) guidelines, the terms used are described below. For each indicator (e.g., disturbance history, riparian reserves, sediment/turbidity, chemical contaminants and nutrients, and peak/base flows) a condition is assigned one of three NMFS or USFWS condition levels. The NMFS condition levels are *properly functioning*, *functioning at risk*, and *not properly functioning*. The USFWS condition levels are *functioning appropriately*, *functioning at risk*, and *functioning at unacceptable risk*. These are terms specified in NMFS (1996) and USFWS (1998) and are not an analysis of effects, but only terms used to rate the baseline condition.

Thompson Creek

Water Quality

<u>Sediment and Turbidity</u>

The NMFS guidelines for sediment/turbidity suggest a guideline for the percentage of fine sediment in gravel (< 12 %) for properly functioning condition; USFWS suggest a guideline for fine sediment in gravel (< 12 %) as well as for surface fines (< 20 %). As a result, data from core sampling (percentage fine sediment in gravel) and visual estimates (surface fines) are used to analyze baseline condition. Percentage fine sediment in gravel at TC4 and TC1 has been greater than 12 % in approximately half the core samples taken during 1996 to 2010. The results of core sampling indicate that the mean percentage of fine sediment at the sites during 1996 to 2010 was 11.0 percent at TC4 (upstream of Buckskin Creek and all surface water discharge from the mine) and 12.5 percent at TC1 (EnviroNet 2011). In the last year of the period of record analyzed (2010), the percentage of fine sediment was greater than 12 percent at both sites (12.4 % at TC4, 12.5 % at TC1).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Selected land
- Biological monitoring sites
- Water quality monitoring sites
- IDFG Transect start locations
- 1992 Forest Service R1/R4 survey
- 2002 Forest Service R1/R4 surveys reaches
- 2009 TCMC R1/R4 surveys reaches

N

1:72,000

0 — 6,000 Feet

0 — 2 Kilometers

Data source Lorax 2011e
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Water quality and biological monitoring sites from TCM
Reach surveys from TCM and Forest Service
IDFG Transects from unpublish reports from Idaho Department of Fish and Game
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.8-1
Survey and monitoring locations, MMPO area and selected land
Thompson Creek Mine EIS

However, the percentage of fine sediment has been less than 12 percent in many years and the mean percentage is below 12 percent at TC4 during 1996 to 2010. There is no statistically significant difference in the percentage of find sediment between background and sites downstream of mine facilities.

In addition, the percentage of surface fine sediment in Thompson Creek has typically been low. The mean percentages of fine sediment (particles < 6 mm in diameter; 1 mm ≈ 0.04 inch) in the R1/R4 survey reaches in 2002 were 16.6, 15.4, 11.5, and 11.8 percent for reaches one, two, three, and four, respectively. At TC4 and TC1, the mean percentage of surface fine sediment has typically been less than 7 percent in both reaches, with a mean percentage of 5.6 and 7.5 percent during 1996 to 2009 for TC4 and TC1, respectively. However, surface fine sediment at the TCMC monitoring sites has been defined as particles less than 4.8 mm in diameter, rather than 6 mm in diameter. Regardless, the monitoring (and the assessments conducted during the R1/R4 survey in 2002) are conducted visually, and distinguishing between such small size differences (~ 1 mm) visually through moving water is relatively difficult. As a result, the two sets of data (and the TCMC data to the NMFS and USFS guideline of 6 mm) should be comparable (Markham 2007). With low percentages of surface fine sediment (< 20 % from all data considered, and typically much lower) and the percentages of fine sediment in gravel fluctuating around 12 percent, the baseline condition for sediment and turbidity is *properly functioning/functioning appropriately*. In addition, turbidity is generally low based on TCMC monthly turbidity records from January 1999 to December 2010 (Section 3.6.1.1.).

Chemical Contamination and Nutrients

Water at TC4 (upstream for Buckskin Creek and all surface water discharge from the mine site) has good quality. Molybdenum is present at concentrations above the laboratory detection limit, whereas the concentrations of other trace metals are typically below the laboratory detection limit. The concentration of molybdenum varies seasonally but is naturally occurring in detectable concentrations in Thompson Creek because it naturally contains relatively high concentrations of molybdenum in the stream sediment (e.g., the first indications of the ore deposit during mineral exploration in the region were elevated concentrations of molybdenum in Pat Hughes Creek, Schmidt 1991). The water quality of Thompson Creek decreases downstream of the mouth of Buckskin Creek, particularly at TC3, between the mouths of Buckskin and Pat Hughes creeks. For example, at TC3 the TDS, conductivity, hardness, and the concentrations of sulfate, nitrate, barium, molybdenum, and selenium are all greater than that of background concentrations (TC4) (but the pH is the same). The concentrations of other elements, such as copper, which is discussed further in Section 4.6.1.2., are not greater than that of background concentrations (Section 3.6.).

Of these constituents, only the concentration of selenium has exceeded WQSs. Due to past difficulty in meeting WQSs and the potential for bioaccumulation of selenium in the food chain, selenium is one of the primary chemicals of potential concern for fisheries resources. Selenium in samples from TC3 equaled or exceeded the CCC standard for aquatic life of 5 μg/L during low flow during 2000 to 2004. Water from Buckskin Creek has not been discharged since 2005 to Thompson Creek when its streamflow is less than 7 cfs as measured at the USGS gage, and since 2005 the concentration of selenium at TC3 has never exceeded the CCC of 5 μg/L. From 2005 to 2010, concentrations of selenium of 5 μg/L were present in water sampled in August 2006, October 2006, and October 2009; the selenium concentration in all other samples were between 2 μg/L and 4 μg/L at TC3. The monitoring sites in Thompson Creek are sampled year-round (not just during base flow). However, during periods of higher flow there is greater dilution and the concentrations of selenium are lower than described above, and no CCC exceedances have occurred. However, even when WQSs are met, there is the potential for bioaccumulation of chemicals in fish, particularly selenium.

Studies show that selenium bioaccumulates in fish primarily via ingestion (Hamilton 2004, Hamilton et al. 2004). Invertebrates and plants concentrate dissolved selenium from the water, and this selenium can then be part of the food base for fish feeding in contaminated reaches of streams (Chapman 2007, Hamilton et al. 2004). The eventual location of such selenium may be in the stream sediment where the selenium may be perennially available for bioaccumulation in plants, benthic invertebrates, and fish, even though the concentrations of selenium in the water may seasonally be less than aquatic life toxicity thresholds for the concentration of selenium in water (Hamilton 2004). Excessive bioaccumulation of selenium in fish can result in larval developmental abnormalities and mortality (Holm et al. 2005).

The bioaccumulation of selenium in Thompson Creek was assessed during 2000 to 2004 to satisfy requirements in the NPDES permit for the mine. The concentrations of selenium in sediment, fine particulate organic matter (FPOM), macroinvertebrate organisms, and fish tissues were assessed from four sites on Thompson Creek, two upstream (TCR and TC4) of mine disturbance and two downstream (TC3A and TC1) (Chadwick 2005). Sites TC2 and TJM4 were not sampled as part of the bioaccumulation assessment. The concentrations of selenium in sediment were below detection limits in 2004 at all of the sampled sites, but were higher in previous years. Selenium was present in macroinvertebrate organisms and fish at all four sites in 2004, including the upstream sites, demonstrating bioaccumulation of selenium in the food chain (Chadwick 2005). This was true for previous years as well. The concentration of selenium in macroinvertebrate organisms and sculpin was statistically higher in 2004 at TC1 and TC3A (downstream of mine discharge) and TC4 (just upstream of mine discharge) than at the furthest upstream site (unaffected by mine discharge) (Table 3.8-2).

Table 3.8-2. Mean concentrations of selenium.

Site	Year	Mean Concentration (mg/kg dry weight)				
		Sediment	FPOM	Macroinvertebrate Organisms	Sculpin	Rainbow/Cutthroat Trout
TCR	2000	NS	NS	NS	NS	NS
	2001	NS	NS	NS	NS	NS
	2002	0.20	4.53	2.01	3.22	2.39
	2003	0.26	2.60	1.66	6.21	3.97
	2004	< 0.84	< 0.6	2.69	6.01	6.37
TC4	2000	[1]0.70	NS	10.13	8.98	7.12
	2001	[2]0.70	NS	8.62	10.00	6.46
	2002	0.70	4.48	4.74	6.81	3.61
	2003	0.48	2.90	5.13	10.34	6.44
	2004	< 0.91	< 0.6	7.45	10.74	7.65

Site	Year	Mean Concentration (mg/kg dry weight)				
		Sediment	FPOM	Macroinvertebrate Organisms	Sculpin	Rainbow/Cutthroat Trout
TC3A	2000	NS	NS	NS	NS	NS
	2001	NS	NS	NS	NS	NS
	2002	1.00	5.68	7.14	8.39	4.10
	2003	1.06	5.20	6.69	9.29	6.57
	2004	< 0.89	1.9	6.72	8.70	7.80
TC1	2000	0.70[1]	NS	8.83	7.85	7.87
	2001	2.30[2]	NS	5.19	9.98	8.03
	2002	1.80	8.44	3.57	7.55	4.49
	2003	0.55	5.90	7.72	9.93	6.50
	2004	< 0.95	6.7	7.25	10.18	7.71

NS – Samples were not collected at TCR or TC3A in 2000 or 2001. Sites TC2 and TJM4 were not sampled as part of the bioaccumulation assessment.

[1] Value is from a single sample and is not a mean of multiple samples

[2] Estimated value due to matrix interferences during laboratory analysis

Chadwick (2002, 2003a, 2004, and 2005)

The concentrations of selenium in macroinvertebrate organisms in all years were below the dietary selenium threshold of 11 mg/kg (dry weight) for coldwater fish recommended by DeForest et al. (1999) and used by Chadwick (2003b, 2005). Furthermore, Chadwick (2003b, 2005) determined that the concentration of selenium in all years for sculpin and trout was below an effects level of 11.6 mg/kg derived from the literature (e.g., EPA 2002). However, the EPA has subsequently released draft aquatic life water quality criteria for selenium (EPA 2004) that discusses similar effects levels for salmonids as those used by Chadwick (2005), but proposes a national standard of 7.91 mg/kg (dry weight). The mean concentrations of selenium in 2004 from sculpin from TC4, TC3A, and TC1 would exceed the new proposed criterion, as would the mean concentrations of selenium in 2000, 2001, and 2003. The concentrations of selenium in trout were less than the proposed criterion at each site and in each year, except in 2001 at the most downstream site (TC1). Ongoing biological monitoring on Thompson Creek shows macroinvertebrate, sculpin, and trout populations have not declined due to the mine (GEI 2011) (Section 3.8.1.4.). Based on the biological monitoring, Chadwick (2005) concluded that the existing concentrations of selenium in Thompson Creek do not pose a threat to the aquatic community.

The most recent IR considers Thompson Creek as fully supporting its designated cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses (IDEQ 2011a). In addition, changes in water management at the mine since 2005 have improved the water quality of Thompson Creek, particularly regarding selenium. The changes have also probably led to decreased selenium bioaccumulation, but data on bioaccumulation since the changes are not publicly available. Furthermore, in the approved mixing zones downstream of Buckskin and Pat Hughes creeks, the concentrations of certain constituents are allowed to be greater than the WQSs. Mixing zones as they relate to the NPDES permit and the effects to special status species are described in detail in EPA (2000). Even though there are no 303d listings, there is the possibility for effects from the mixing zones and selenium concentrations in biota (such as sculpin) that may exceed the proposed national standard of 7.91 mg/kg (Table 3.7-3., based on the 2004 data, the last year of data available). As a result, the more conservative baseline condition for chemical contaminants and nutrients is *functioning at risk*.

Peak/Base Flows

Due to diversions of Buckskin and Pat Hughes creeks, the base flow in Thompson Creek is approximately 10 percent lower than prior to mine activity (Section 3.6.1.1.). In addition, peak flows following precipitation events are less pronounced due to permeability of the WRSFs. The IDFG considers the low summer base flows to be a limiting factor for fish populations in Thompson Creek (IDFG 2005a). Therefore, the baseline condition for peak/base flows is *functioning at risk*.

Disturbance History

The primary disturbance in the Thompson Creek watershed is the TCM on 1,824 acres of the watershed. The mine covers 9.5 percent of the watershed, which is below the 15 percent equivalent clear-cut area (ECA) specified in NMFS (1996) and USFWS (1998) for *properly functioning/functioning appropriately*. Although the mine disturbance is stable, a portion of the disturbance includes portions of streams and riparian areas in the Buckskin and Pat Hughes subwatersheds. Much of the streams and associated riparian vegetation in these two subwatersheds are buried by waste rock and no longer function as natural streams, with flow captured and diverted to the mine during parts of the year. Although sediment control ponds collect sediment from disturbance, disturbance has heavily altered the function of these tributaries, and the baseline condition for disturbance history is *functioning at risk*.

Riparian Reserves

The riparian condition along Thompson Creek is generally good, with intact vegetation along approximately 90 percent of the streambank (no vegetation was present along 11.5, 8.4, 3.5, and 12.4 % of the streambank in reaches 1 through 4 in 2002). The dominant vegetation is willow, alder, and wetland forbs and grasses (USFS 2002). However, riparian vegetation is less intact in the small tributary drainages affected by the mine (i.e., Buckskin, Pat Hughes) and the baseline condition for riparian reserves is *functioning at risk*.

S. Creek

Water Quality

Sediment and Turbidity

As described for Thompson Creek, guidelines for both the percentage of fine sediment in gravel and for surface fines are considered. The results of core sampling indicate that the mean percentage of fine sediment in gravel substrate at SQ2 and SQ3 during 1996 to 2010 were 14.7 and 15.0 percent, respectively. The percentages were greater than the guideline in 11 (SQ2) and 10 (SQ3) of the 16 sample events. The percentages of fine sediment in gravel in the last year of the data analyzed (2010) were 12.7 and 17.5 percent at SQ2 and SQ3, respectively. Statistical analysis, comparing the data from each year between 1996 and 2010, shows that the amount of fine sediment was higher at the upstream site in 2010 than in 2009. However, there was no statistically significant difference between years at the downstream site or among all previous years combined and 2010 (EnviroNet 2011).

Similar to Thompson Creek, the percentages of surface fine sediment have generally been below 12 percent, with mean percentages of 5.2 percent (SQ2) and 6.1 percent (SQ3) during 1996 to 2010. The percentages of surface fine sediment from the R1/R4 reaches in 2009 were 10.0 and 9.7 percent for the upstream and downstream reaches, respectively. Although the percentages of surface fine sediment are generally low, the percentages are higher than ideal in substrate core samples in many years. However, the percentages of surface fine sediment have also been below the NMFS and USFWS guideline in some years, and sediment in S. Creek may be close to a properly functioning/functioning appropriately condition. The BLM (2011) also noted that the percentages of surface fine sediment were low on BLM portions of S. Creek and that substrate may be functioning appropriately. However, the average percentage of fine sediment in gravel substrate from Forest Service core sampling just above the BLM/Forest Service boundary (just upstream of where Redbird Creek enters S. Creek) during 1995 to 2004 and 2007 to 2008 was 27.8 percent (BLM 2011). Given that the Forest Service and TCMC core sampling data shows a tendency for higher than ideal concentrations of fine sediment in S. Creek, the more conservative baseline condition for sediment and turbidity is *functioning at risk*, which was the same conclusion reached by the BLM (2011). However, the relatively high percentages of fine sediment are probably due in large part to natural conditions, e.g., numerous active and remnant beaver dams on S. Creek (BLM 2011). Because of this beaver activity, the TCMC monitoring sites have needed to be relocated several times over the years.

Chemical Contamination and Nutrients

The concentrations of the constituents measured at SQ2 and SQ3 (Figure 3.8-1.) were within all the WQSs. However, between 2008 and 2010, the mean concentrations of sulfate were statistically greater (43.5 mg/L to 59.8 mg/L) at the upstream site (SQ3) than they were during 2000 to 2007 (Table 3.6-9. and Table 3.6-10). Furthermore, the median concentrations of sulfate, chloride, and molybdenum during 2000 to 2010 were approximately 5 mg/L, 1.1 mg/L, and 0.00039 mg/L higher, respectively, downstream of the mouth of Bruno Creek (SQ2) than upstream (SQ3), indicating an input of mine-affected water between the two sites (Table 3.6-9. and Table 3.6-10.; JBR 2013g). Additionally, the median concentration of dissolved barium was 0.001 mg/L higher at SQ2 than at SQ3 (Table 3.6-9. and Table 3.6-10). The TSS is generally less than 10 mg/L, with a high of 43 mg/L at SQ3 and 53 mg/L at SQ2.

Water from the abandoned Twin Apex mine (which flows into lower Bruno Creek) may contribute to the concentrations of metals at SQ2. However, overall Bruno Creek contributes a relatively small load of metals to S. Creek (Section 3.6.1.1.). The effect of Redbird Creek on S. Creek as a result of mine-related loading of chemical contaminants to Redbird Creek has not been determined because the historic upstream monitoring site on S. Creek used for this analysis is downstream of Redbird Creek. An additional monitoring site (SQ5) upstream of Redbird Creek was established in August 2011 to provide better background information in the future. However, the concentrations of chemicals of potential concern measured in samples from the monitoring site in lower Redbird Creek are all well below the WQSs. Therefore, there may not be any meaningful effects to aquatic life in S. Creek from water from Redbird Creek.

The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation designated beneficial uses for S. Creek. The portion of S. Creek from Redbird Creek to the confluence of S. Creek with the Salmon River fully supports the designated beneficial use for S. Creek of cold water aquatic life. Salmonid spawning and secondary contact recreation were not assessed (IDEQ 2011a). Therefore, because the WQSs are met, the beneficial use is fully supported, and there are no chemicals of concern for bioaccumulation, the baseline condition for chemical contaminants and nutrients in S. Creek is *properly functioning*/ *functioning appropriately*.

<u>Peak/Base Flows</u>

Streamflow in lower S. Creek is reduced by the affects of the mine to Bruno Creek (Section 3.6.1.) and by substantial water diversions from S. Creek for agriculture. The baseline condition for peak/base flows is *functioning at risk*.

<u>Disturbance History</u>

The primary disturbance in the Lower S. Creek watershed is the TSF covering 992 acres (8.2 %) of the watershed, which is below the 15 percent ECA specified for *properly functioning*/*functioning appropriately*. However, a large portion of the disturbance includes filling riparian areas along Bruno Creek. As a result, the baseline condition for disturbance history is *functioning at risk*.

<u>Riparian Reserves</u>

The riparian condition along S. Creek is generally good with intact vegetation along approximately all of the streambank. The most dominant vegetation is willow, alder, and wetland forbs and grasses (GEI 2009). However, the TSF permanently covered riparian vegetation along Bruno Creek, and hence the baseline condition for riparian reserves, is *functioning at risk*.

Salmon River

Water Quality

The mine is 3 miles north of the Salmon River, so effects from the MMPO and land disposal alternatives would be limited to changes in water quality and quantity. Water quality may be affected from 1) flows from Thompson Creek and S. Creek (as currently occurs), and 2) discharge of mine water from Outfall 005 on the Salmon River (after reclamation). Outfall 005, the end of a pipeline between the Salmon River and the mine, does not currently discharge mine water to the Salmon River (rather, it is currently the intake for water pumped to the mine for use in the mill), but will discharge water following reclamation.

<u>Temperature/Sediment and Turbidity</u>

Data on temperature, sediment, and turbidity for the Salmon River is not as extensive as for Thompson Creek and S. Creek. However, between the mouths of Thompson and S. creeks the Salmon River is 303(d)-listed for not supporting the cold water aquatic life beneficial use due to sedimentation/siltation and water temperature. The IDEQ has proposed delisting this portion of the river for sediment and temperature, pending the assessment of additional sediment and temperature data. Due to the 303(d) listing of the Salmon River between the mouths of Thompson and S. creeks, the baseline condition for the Salmon River for water temperature and sediment and turbidity is *functioning at risk*. However, the condition would likely change to *properly functioning*/*functioning appropriately* if the listing were revised as explained above.

<u>Chemical Contamination and Nutrients</u>

Of the measured constituents, only the concentrations of sulfate and barium have slightly higher median concentrations during 2007 to 2010 at the downstream Salmon River site (SR1) (2 mg/L) than at the upstream reference site (SR3) (0.0012 mg/L). Water at both of the sites meets all WQSs. Designated beneficial uses for the Salmon River downstream of the mouth of Thompson Creek include cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply. The Salmon River downstream of the mouth of S. Creek fully supports the designed beneficial uses of cold water aquatic life and primary contact recreation; support for salmonid spawning uses was not assessed (IDEQ 2011a). As noted above, between the mouths of Thompson and S. creeks the Salmon River is 303(d)-listed for not supporting the cold water aquatic life beneficial use due to sedimentation/siltation and water temperature. The ability of this portion of the Salmon River to support domestic water supply, primary contact recreation, and salmonid spawning was not assessed (IDEQ 2011a). Upstream of the mouth of Thompson Creek, the Salmon River fully supports all of its beneficial uses (cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply) (IDEQ 2011a). As the 303(d) listing of the Salmon River between the mouths of Thompson and S. creeks is not for any constituents other than temperature and sedimentation/siltation, the baseline condition for the Salmon River for chemical contaminants and nutrients is *properly functioning*/*functioning appropriately*.

<u>Peak/Base Flows</u>

Streamflow in the upper Salmon River is similar to other snowmelt-driven systems, with the highest flows occurring in later spring to early summer, and lowest flows during late fall/winter. The Salmon River has historically meandered across the valley bottom, with complexes of beaver dams, willows, and thick stands of cottonwoods. However, land use has altered the river, primarily through riparian/streambank alterations and water diversions for agriculture (BLM 2011). Consequently, streamflow has been reduced, particularly during summer months, and the baseline condition is *functioning at risk*.

3.8.1.4. Fish Populations

Thompson Creek

The Thompson Creek watershed provides habitat for multiple fish species, including both resident and anadromous salmonids. The majority of fish monitoring for the mine is concentrated on four sites: TC0, TC1, TC4, and TCR (Figure 3.8-1). Long-term data exists for only the original two sites (TC1 and TC4). Fish presence/absence is described using results from all four sites; however, only data from TC1 and TC4 is used to compare fish populations over the life of the mine, as well as between the upstream and downstream sites. The IDFG sampled 15 sites in the Thompson Creek watershed in summer 2004 (IDFG 2005a): twelve sites on Thompson Creek, one site on Alder Creek (which joins Thompson Creek opposite Buckskin Creek), and two sites on unnamed tributaries to Thompson Creek upstream of the mouth of

Buckskin Creek. In addition, the Forest Service has one long-term monitoring site on upper Thompson Creek (approximately 3.6 miles upstream of Buckskin Creek) that was sampled in August 2007 (USFS 2008b).

Salmonid species currently documented to occur in Thompson Creek include bull trout, Chinook salmon, steelhead/rainbow trout, and westslope cutthroat trout (GEI 2011, IDFG 2005a, USFS 2008b). In addition, two species of sculpin may be present, and whitefish were present historically (GEI 2011). Spawning and rearing habitat for several key species, including Chinook salmon and steelhead, also probably was present in Thompson Creek historically. Despite documentation of the continued use of Thompson Creek for rearing, the current usage for spawning is unknown.

Multiple-pass electrofishing was used to sample fish populations at the monitoring sites for the mine in late summer or fall of most years during 1980 to 2010 (GEI 2011). However, fish were counted by snorkeling during the summer in 2000, 2002, and 2003 (GEI 2011). Accordingly, to minimize variability in fish density estimates associated with sample methodology, data from 2000, 2003, and 2003 was omitted (Table 3.8-3). In addition, Chadwick (2003a) collected cutthroat trout and rainbow trout in 1998 from Thompson and S. creeks to evaluate the degree of hybridization between the species. Based on morphological features, cutthroat trout in Thompson Creek were greater than 50 percent cutthroat trout, but had substantial hybridization with rainbow trout. As a result, Chadwick (and later GEI) classified all cutthroat or rainbow trout in Thompson and S. creeks as cutthroat/rainbow trout hybrids (Chadwick 2003a, GEI 2011). Although cutthroat trout and rainbow trout are discussed separately in the following sections, density estimates (1 km ≈ 0.6 mile) are for cutthroat/rainbow trout hybrids (Table 3.8-3).

Table 3.8-3. Thompson Creek fish density estimates (number/km).

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin
TC4				
1980	41	72	0	667
1981	10	236	0	564
1982	11	317	0	1,127
1983	0	260	0	1,389
1984	31	244	0	687
1985	0	697	0	321
1986	0	305	0	183
1989	13	575	0	1,264
1990	0	131	0	492
1991	11	165	0	593
1994	0	44	0	560
1996	0	146	0	439
1997	0	159	0	331
1998	0	216	0	997

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin
2001	0	516	0	1,143
2004	0	109	0	1,130
2005	0	70	0	996
2006	0	254	0	714
2007	11	226	0	548
2008	0	375	0	979
2009	0	333	0	1,075
2010	11	202	0	865
TC1				
1980	29	231	39	1,033
1981	11	285	164	1,324
1982	9	234	63	1,258
1983	0	211	85	1,169
1984	14	324	0	1,155
1985	0	1,240	0	690
1986	0	699	0	293
1989	12	434	0	3,546
1990	0	295	0	1,368
1991	0	179	0	477
1994	0	154	0	549
1996	0	124	0	295
1997	0	89	0	480
1998	0	66	0	875
2001	0	1,022	0	1,413
2004	0	53	0	1,085
2005	0	35	0	1,232
2006	0	185	0	435
2007	0	265	0	500
2008	10	495	0	610
2009	0	189	0	541
2010	0	355	0	953

Modified from GEI (2011). To ensure comparability, fish density estimates were produced from the results of the first electrofishing pass at each site.

Special Status Species

Bull Trout

The IDFG identified (from electrofishing) five juvenile bull trout in Thompson Creek approximately 10 miles upstream from its mouth (IDFG 2005a). In addition, the Forest Service identified five juvenile bull trout 9.1 miles upstream of the mouth of Thompson Creek (USFS 2008b). Both of these locations are upstream of all mine monitoring sites. In 6 of the

10 years between 1980 and 1991, bull trout were present in low numbers at TC4. Bull trout were also present at TC1 in 5 of the 10 years during the same time period, but in slightly lower numbers than at TC4 (Table 3.8-3). Bull trout were not identified again at these two sites until 2007. However, bull trout may have been present in Thompson Creek but not identified, i.e., electrofishing typically does not capture all fish in the sample zone, and species with low numbers of individuals are prone to being missed during surveys. Bull trout may also have been present during the years sampling was not conducted. Since 2007, they have again been identified in several years at these sites. It is unclear whether bull trout were not identified at these sites between 1991 and 2007 due to the potential limitations discussed above, or if they were not present due to mine activity, natural variability, or other unknown factors. With only 3 years of pre-TCM data (1980 to1983), it is difficult to determine if the numbers of bull trout were as variable prior to the mine as they have been since. The mine operations have been fairly consistent during the period of record (1980 to 2010) and do not appear to be connected to the low and variable numbers of bull trout sampled during monitoring efforts. The WQS for selenium was exceeded during low flow during 2000 to 2004 due to seepage from the Buckskin WRSF. However, such exceedance would not explain the low numbers (or absence) of bull trout in samples prior to 2000 or since 2004.

It is unknown whether bull trout in Thompson Creek exhibit a resident or fluvial life history, but at least historically both life histories were probably present (IDFG 2005a). The IDFG (2005b) reported that all bull trout captured in 2004 were juvenile fish with lengths from 80 to 100 mm. All fish captured at the Forest Service monitoring site were also juvenile fish, with lengths from 47 to 56 mm (USFS 2008b). This absence of adults in the IDFG and Forest Service surveys suggests at least a portion of the bull trout population may be composed of fluvial fish (i.e., the adults had migrated downstream to the Salmon River). However, bull trout captured at the monitoring sites for the mine in 2010 were larger (245 mm at TC4, 232 mm at TC0) (GEI 2011). These results are similar to other results from the sites in other years. The larger fish could be resident adults or fluvial subadults, and the life history of bull trout in Thompson Creek remains uncertain based on the existing data.

Chinook Salmon

Juvenile Chinook salmon use the lower reaches of Thompson Creek as rearing habitat and as thermal refuge from the higher temperatures found in the Salmon River (IDFG 2005a). Juvenile and young of the year (YOY) Chinook have been collected in Thompson Creek downstream of the USGS gage by both the IDFG and TCMC. In the IDFG samples, 18 juvenile Chinook salmon were collected from the lowest site (STCO1 to STCO2, Figure 3.8-1.) near the mouth of Thompson Creek (IDFG 2005a). Chinook have been collected at site TC0 every year since 2005 (the first year that site was established), although generally in low numbers (e.g., 1 to 17 individuals each year during 2005 to 2010). There were six YOY Chinook salmon collected at the site in 2010. However, Chinook salmon have not been collected upstream of TC0 during sampling at the other TCMC sites (Figure 3.8-1). The initial fish surveys on Thompson Creek prior to mine development in 1981 documented juvenile Chinook salmon as far as 2 miles above the mouth of Thompson Creek (VTN 1980c), which is approximately halfway between TC0 and TC1. Juvenile Chinook may still be present within this same distance from the Salmon River, but without sampling between TC0 and TC1, the current usage upstream of TC0 is unknown. It is also unknown if Chinook salmon spawn in Thompson Creek.

Steelhead/Rainbow Trout

Juvenile wild steelhead and/or resident rainbow trout have been present in Thompson Creek since sampling began. However, as previously discussed, all Thompson Creek and S. Creek steelhead/rainbow trout and westslope cutthroat trout have been classified as rainbow/cutthroat trout hybrids (Chadwick 2003a, GEI 2011). Hybrid trout have been reported at all sites in all years (Table 3.8-3). The IDFG differentiated between steelhead/rainbow trout and cutthroat trout during their sampling based on external characteristics (i.e., fish with a red slash under the jaw were classified as cutthroat trout). The IDFG collected steelhead/rainbow trout from the seven lowermost sites on Thompson Creek, with fish found in upstream reaches appearing to be cutthroat trout (IDFG 2005a) (Figure 3.8-1). Although the densities of rainbow/cutthroat trout hybrids (as classified by GEI) at TC1 and TC4 have varied throughout the years, the amount of variation is not atypical of western streams for which annual variations of 50 percent or more are common (GEI 2011, Platts and Nelson 1988).

Populations of rainbow/cutthroat hybrid trout include multiple age classes and the presence of adult fish indicates that at least a portion of the population consists of resident rainbow and/or cutthroat trout (GEI 2011, IDFG 2005a). However, the densities of adult trout at the monitoring sites for the mine are typically low, with the populations typically dominated by juvenile and YOY fish (GEI 2011). As a result, it appears that some of the fish are of steelhead origin, or in the case of cutthroat trout, fluvial migrant fish as discussed below for westslope cutthroat trout.

Westslope Cutthroat Trout

Westslope cutthroat trout are widely distributed in Thompson Creek, with westslope cutthroat trout or rainbow/cutthroat trout hybrids (as classified by GEI 2011) collected from all sites along the stream (GEI 2011, IDFG 2005a) (Figure 3.8-1). The IDFG (2005b) reports fish in the uppermost reaches of Thompson Creek may be less hybridized based on external characteristics. Both the IDFG data and the long-term data from the monitoring sites for the mine show low densities of adults (GEI 2011, IDFG 2005a), indicating a population that may include fluvial fish. The IDFG (2005b) cites unpublished IDFG data from a radio-telemetry tracking study of westslope cutthroat in 2004 that indicates some fish may use Thompson Creek briefly for spawning before returning to the Salmon River.

S. Creek

The Lower S. Creek watershed also provides habitat for multiple fish species, including both resident and anadromous salmonids. Salmonid species currently documented in S. Creek include bull trout, Chinook salmon, steelhead/rainbow trout, westslope cutthroat trout, and mountain whitefish. In addition, two species of sculpin may be present (GEI 2011, IDFG 2004). As for Thompson Creek, the fish density data from snorkeling in 2000, 2002 and 2003 was excluded from this analysis, and the density estimates are for cutthroat/rainbow hybrid trout even though cutthroat trout and steelhead/rainbow trout are discussed separately (Table 3.8-4).

Table 3.8-4. S. Creek fish density estimates (number/km).

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin	Chinook Salmon
SQ3					
1980	0	184	31	810	0
1981	0	777	109	2,101	0
1982	0	308	199	1,143	0
1983	0	241	273	1,761	0
1984	0	383	55	1,048	0
1985	0	556	36	693	0
1986	0	442	36	823	0
1989	0	1,828	79	2,115	0
1990	0	1,934	197	1,115	0
1991	0	385	55	582	0
1994	0	77	0	253	0
1996	0	55	8	518	0
1997	0	51	13	1,079	0
1998	12	1,069	0	1,713	12
2001	8	661	24	1,866	0
2004	0	164	0	846	8
2005	0	99	0	643	0
2006	0	62	7	298	0
2007	9	880	9	1,538	17
2008	0	393	7	1,511	0
2009	0	363	29	1,275	0
2010	0	757	9	1,243	0
SQ2					
1980	10	434	212	1,463	0
1981	0	602	194	1,849	0
1982	32	516	204	1,527	0
1983	23	292	23	1,076	0
1984	28	706	125	1,939	0
1985	0	2,853	171	3,039	0
1986	0	563	55	1,635	0
1989	0	1,902	110	1,585	0
1990	0	747	76	444	0
1991	11	242	55	934	0
1994	0	72	0	646	0
1996	0	75	7	1,380	0
1997	0	49	16	1,775	0
1998	0	155	7	1,465	0
2001	0	583	19	1,963	0
2004	0	265	8	547	0
2005	0	155	0	538	0

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin	Chinook Salmon
2006	0	59	0	400	0
2007	0	290	11	1,108	0
2008	0	586	14	545	0
2009	0	257	15	1,147	0
2010	0	245	7	1,281	0

Modified from GEI (2011). To ensure comparability, fish density estimates were produced from the results of the first electrofishing pass at each site.

Special Status Species

Bull Trout

Bull trout have only been captured sporadically at the TCM monitoring sites since 1980 (Table 3.8-4). During the IDFG fish surveys in 2003, bull trout were present only at SQ3 on S. Creek in the upper watershed (IDFG 2004). Therefore, it appears bull trout use of S. Creek is low, and it is unclear if the fish present are resident, fluvial, or both.

Chinook Salmon

Juvenile Chinook salmon were present at the upstream site (SQ3) in 1998, 2004, and 2007. Chinook have not been present at the lower site (SQ2) since sampling began in 1980. However, Chinook salmon juveniles use the lower reaches of S. Creek for rearing and thermal refuge (IDFG 2004). The IDFG (2004) found Chinook salmon juveniles in four transects between the mouth of S. Creek and the mouth of Redbird Creek (just upstream of Bruno Creek). Fish densities were highest near the mouth of S. Creek (11.4 fish per 100 m^2; 100 $m^2 \approx$ 1,000 square feet), decreasing rapidly upstream (0.17 fish per 100 m^2 at the most upstream site). It is unknown if Chinook salmon spawn in S. Creek.

Steelhead/Rainbow Trout

Steelhead/rainbow trout are relatively abundant in lower S. Creek and both resident and anadromous life histories are present, with spawning in lower S. Creek documented in 1986 (IDFG 2004) and in 2012 (BLM 2012b). A BLM survey on May 1, 2012 of S. Creek from the BLM/private land boundary below the mouth of Bruno Creek upstream to the historic Redbird Mine documented eight steelhead adults and one spawning redd in progress. A subsequent survey on May 10, 2012 documented three steelhead adults and two completed redds (BLM 2012b). Steelhead in S. Creek have been supplemented by releases of B-run steelhead smolts into S. Creek, as well as from South Butte Pond. In addition, resident rainbow trout have been stocked in S. Creek and South Butte Pond. During IDFG surveys in 2003, many of the larger rainbow trout sampled appeared to be stocked fish; either stocked steelhead that adopted a resident life history or one of the other strains of stocked rainbow trout (IDFG 2004).

Cutthroat/rainbow trout hybrids have been collected at both S. Creek monitoring sites since 1980 (Table 3.8-4). All age classes have been present, indicating the population includes resident fish. However, adult abundance is generally low, indicating the population may include a migratory life history component as well (GEI 2011). A statistically significant decline in fish density has occurred at the downstream site (SQ2) since 1980, which indicates a decline in the quality of fish habitat (GEI 2011). As sampling methodology and sample site locations were consistent between years (other than the years when fish were counted by snorkeling, with such data excluded from analysis), this decline is probably not an artifact of sampling. GEI (2011) reports an increase in macroinvertebrate density and taxa richness, which can correlate with improved conditions. However, other factors such as changes in habitat, an increase in width/depth ratio, or changes in stocking may also be involved (GEI 2011).

Westslope Cutthroat Trout

As discussed above for steelhead/rainbow trout, hybrid trout are prevalent in S. Creek with both resident and migratory life histories likely present. Population dynamics for westslope cutthroat trout at the TCM monitoring sites are also the same as discussed above for steelhead/rainbow trout. The IDFG (2004) differentiated between rainbow trout and westslope cutthroat trout, and reports westslope cutthroat trout to be the most abundant species in S. Creek. The westslope cutthroat trout are primarily upstream of the mouth of Bruno Creek, with rainbow trout more dominant below the mouth of Bruno Creek, and one hybrid trout near the mouth of Bruno Creek. Westslope cutthroat trout were present in all tributaries, including Bruno Creek (discussed below).

Bruno Creek

Both cutthroat trout and rainbow trout were present in Bruno Creek in 1980, with a resident population of cutthroat trout indicated by the presence of both adults and juveniles (VTN 1980c). VTN (1980c) also states that the Bruno Creek fish populations would be lost due to construction of the TSF. The TSF eliminated fish habitat and any fish populations in the middle portions of the stream; however, the IDFG collected westslope cutthroat trout from the portions of the stream above and below the TSF in 2004 (IDFG 2004). Upstream of the TSF, the IDFG collected 25 westslope cutthroat trout ranging from 41 mm to 168 mm in length. However, there were no fish identified above the TSF in sampling conducted by the Forest Service in 2013. Downstream of the TSF, the IDFG collected 16 westslope cutthroat trout ranging from 81 mm to 251 mm in length. It is possible that fish in lower Bruno Creek could be resident or migrant fish moving up from S. Creek.

Mill Creek

Mill Creek has very minimal flow during much of the year and discharges into the SRD through the right abutment of the TSF main drain. As a result, there is no surface connection to the fish-bearing portions of Bruno Creek, and there are no known fish populations in Mill Creek.

Salmon River

The Salmon River supports various life stages of all species described for Thompson Creek and S. Creek (Table 3.8-1). The Salmon River is one of the major Chinook salmon and steelhead spawning and rearing waters in the Upper Salmon River watershed. The main Salmon River is also a migration corridor for sockeye salmon (BLM 1998). In addition to using tributary streams for spawning and rearing, most salmonids (including bull trout, Chinook salmon, and steelhead) will use the lower portions of tributary streams as thermal refuges from relatively high seasonal temperatures in the main Salmon River.

3.8.1.5. Benthic Macroinvertebrate Communities

Biological monitoring of benthic macroinvertebrate populations began in 1980 with two sites on Thompson Creek and two sites on S. Creek. The monitoring has since expanded to six sites on Thompson Creek, two sites on S. Creek, and two sites on the Salmon River (Figure 3.8-1). Benthic macroinvertebrate communities were sampled several times per year during 1980 to 2001, but have been sampled once annually (in summer) since 2001 (GEI 2011). The description of benthic macroinvertebrate populations uses data from 1980 to 2010. Discussion of the last year in the period of record (2010) is used to provide a snapshot of current conditions. However, due to natural variability that can occur in benthic macroinvertebrate communities, the long-term dataset is also used to describe the macroinvertebrate communities over time and highlight any trends.

On Thompson and S. creeks, three replicate Hess samples have been collected from riffle habitat at each site in all years. Sample collection on the Salmon River has been similar, but has varied slightly between years. Having three replicate samples at each site allows statistical analyses to be conducted on the data and on various metrics (GEI 2011). The common metrics analyzed in the annual reports are total macroinvertebrate density; total taxa richness; combined taxa richness for the orders Ephemeroptera, Plecoptera, and Trichoptera (referred to collectively as EPT taxa); and the percentage of the community composition made up of Ephemeroptera (percent Ephemeroptera abundance) (Barbour et al. 1999, Karr and Chu 1998).

In addition, the replicate data is composited to describe the composition of macroinvertebrate communities at each site and to calculate metrics used to determine the stream macroinvertebrate index (SMI) and the river macroinvertebrate index (RMI). The SMI and the RMI are indices developed by the IDEQ (Grafe 2002a, Grafe 2002b). Note that the composite data is not appropriate for use in statistical tests. Values from both the replicate and composite data are summarized in the following descriptions of macroinvertebrate communities.

Stream Macroinvertebrate Index

The SMI includes nine metrics that when scored produce an index that provides an overall measure of aquatic conditions present at the sampled site. Development of the SMI included sampling streams known to be minimally affected by anthropogenic factors (i.e., streams that include high-quality habitats and good water quality). The index is organized such that an overall higher score, derived as a sum of the nine metrics, indicates a stream is in good condition. A low score indicates the stream has been degraded relative to its potential score. The metrics used in the SMI are total taxa richness; EPT taxa richness; percent composition of Plecoptera (stoneflies); Hilsenhoff's Biotic Index (HBI); the percent dominance of the five most common taxa in the sample; percent composition of organisms in the "scrapers" feeding group; and percent composition of organisms in the "clinger" feeding group. SMI scores range from 0 to 100, with rating categories assigned based on score. For the central and southern mountains in Idaho, the rating categories are very good (80 to 100), good (59 to 79), fair (40 to 58), poor (22 to 43), and very poor (0 to 19) (Grafe 2002a).

River Macroinvertebrate Index

The RMI is similar to the SMI, but with only five metrics, as many of the SMI metrics had low predictive power in larger river systems (Grafe 2002b). The RMI metrics are total taxa richness; EPT taxa richness; percent composition of Elmidae; percent dominance of the most common taxa in the sample; and the percent composition of organisms in the "predators" feeding group. The indications provided by total taxa richness; EPT taxa richness, and; percent dominant taxa are as described above for the SMI. Both the relative abundance of riffle beetles in the order Elmidae and the percent composition of organisms in the predator functional feeding group are expected to decrease with decreases in water quality. Lower amounts of riffle beetles indicate the impairment of well-oxygenated riffle and run habitats, with a lower percentage of predators being an indication of reduced abundance and diversity in invertebrate prey (Grafe 2002b).

Chemicals (Metals)

Benthic macroinvertebrate organisms are exposed to metals in surface water through direct uptake from the water, through ingestion of contaminated food (periphyton, detritus, other invertebrates), or through incidental ingestion of sediment (Merritt and Cummins 1984). Although macroinvertebrate density (abundance) may be affected by elevated concentrations of metals, macroinvertebrate density does not typically provide a good measure of the effects of metals because metal-sensitive macroinvertebrate organisms may be replaced by metal-tolerant ones. Instead, the effects of elevated concentrations of metals on macroinvertebrate organisms are better evaluated from changes in macroinvertebrate community composition, with fewer metal-intolerant taxa such as EPT taxa. This may be particularly true for Ephemeroptera (mayflies) which have been shown to be particularly sensitive to metals pollution (Warnick and Bell 1969).

Thompson Creek

Samples of macroinvertebrate communities have been collected from TC4 and TC1 since 1980. An additional site (TC0) was added in 2005, with two more sites (TCR and TJM4) added in 2006 (Figure 3.8-1). The macroinvertebrate density increased downstream in 2010, as is common for mountain streams, with no statistically significant differences in total richness or EPT taxa richness between the six sites. The mean percentage of the community composed of Ephemeroptera taxa did differ statistically between sites, but the Ephemeroptera abundance was substantially lower at TCR than at TC4 or TC3A. Below TC3A, the Ephemeroptera abundance decreased downstream, with the abundance at TC0 statistically lower than at TC3A (GEI 2011). The decrease from TC3A (downstream of Buckskin Creek) through TC0 suggests possible effects from the mine. However, the lowest Ephemeroptera abundance was at TCR, which is upstream of the mine, and Ephemeroptera abundance did not differ statistically between TCR and TC1 (downstream of Pat Hughes Creek). As a result, the differences may be due to natural variation. In addition, the number of Ephemeroptera taxa (sensitive to metals) was higher (although not statistically comparable as it was taken from composite data) at downstream sites (TC-3A, TC-1, TC-0) than at TC-R or TC-4; the number of Ephemeroptera taxa at TJM4 was similar to that at the downstream sites.

The long-term data shows no clear trend in Ephemeroptera abundance between TC-4 (upstream of mine activity) and TC1 (downstream) (Chadwick 1984 to 1988, Chadwick 1990 to 2006, and

GEI 2007 to 2010). Furthermore, the values of the SMI metrics were similar between all sites in 2010. The values of the SMI metrics during 2006 to 2010 also show no clear difference between sites or between years, and no statistically significant difference has been detected in the long-term mean values of the SMI metrics or taxa richness between sites. The SMI scores in Thompson Creek have consistently rated in the "very good" and occasionally "good" categories (GEI 2011).

The values of the SMI metrics for TC4 (upstream of Buckskin Creek) and TC1 (downstream of Pat Hughes Creek) during 1980 to 2000 show a high degree of variability (i.e., no consistent pattern of one site always rating lower or higher than another) (Chadwick 2001). Furthermore, substantial annual variability in density and richness have been well documented over the monitoring period (GEI 2011). Despite the annual variability, regression analysis done on the long-term data shows increasing trends for density and richness, and historical data has shown total density and taxa richness to be negatively correlated with streamflow (GEI 2011). As a result, at least some of the variability may be due to natural variation. The number of Ephemeroptera taxa has consistently been high (rating very good) at all sites, which indicates low concentrations of metals in the water. Two metrics have consistently performed poorly: percent Plecoptera and the HBI (Chadwick 2001). Since Plecoptera abundance is low and the HBI is high (high HBI values indicate macroinvertebrate communities have a disproportionate number of species tolerant to low quality conditions) at both upstream and downstream sites, it appears that some activity other than the mine may be creating conditions that are less than ideal for Plecoptera. Overall, if macroinvertebrate communities have been affected by the mine, the effects have not been greater than that from natural variability.

S. Creek

Data from the two sites on S. Creek in 2010 (GEI 2011) indicate macroinvertebrate community composition was similar between the sites, with no statistically significant differences in density, taxa richness, or EPT taxa richness. However, the percent Ephemeroptera was statistically lower at SQ2. Ephemeroptera richness, Plecoptera richness, Trichoptera richness, and scraper taxa richness were also lower at SQ2 in 2010, and the percentage of the community dominated by the five most common taxa was higher at SQ2. Macroinvertebrate density and percent Plecoptera were higher at SQ2 than at SQ3. Although the lower values for some metrics in 2010 at SQ2 suggest that conditions for macroinvertebrate communities may have been degraded relative to SQ3, the long-term mean taxa richness and the long-term mean SMI scores are not statistically different between sites (GEI 2011). Rather, the values of the SMI metrics during 1980 to 2000 show the SMI rating for SQ2 has being highly variable, with some years being rated as very good and others poor (Chadwick 2001). The SMI scores for Site SQ3 were less variable during this time period (more consistently rated good to fair) (Chadwick 2001). Furthermore, the long-term data shows that the number of Ephemeroptera taxa has consistently been high (very good) at both sites (indicating low concentrations of metals) and both sites were rated good (SQ2) and very good (SQ3) on the SMI in 2010 indicating the streams at these sites continue to support healthy macroinvertebrate populations (GEI 2011).

As described for Thompson Creek, macroinvertebrate density appears to be inversely related to streamflow (GEI 2011). Also, the metrics for percent Plecoptera and HBI perform poorly, indicating less than ideal conditions for stoneflies and possible pollution, respectively. Note that water seeping from the TSF into Redbird Creek discharges upstream of SQ3. As a result, it is difficult to determine potential effects of the mine due to seepage to Redbird Creek based on analysis of the two monitoring sites. Inflow from Bruno Creek could affect conditions at SQ2; however, beaver activity at these sites and associated changes in sediment (Section 3.8.1.3.) may also be a factor in the poor scores for percent Plecoptera, the HBI, and some of the metrics at SQ2 in 2010.

Salmon River

Analysis of macroinvertebrate density in 2010 (GEI 2011) between sites using the replicate data shows a statistical difference in macroinvertebrate density between the two sites, with density higher at the downstream site (SR1) than at the upstream reference site (SR3). However, there were no statistical differences between taxa richness and EPT tax richness. Ephemeroptera abundance was statistically higher at SR3, and values for all RMI metrics calculated from the composite data were also higher than at SR3 than at the downstream site. As a result, aquatic conditions at SR3 in 2010 appear to be better than at SR1. However, the long-term data shows that there is no statistically significant difference in taxa richness between sites. Furthermore, the RMI metrics shows no clear trend of one site having consistently higher values, or of a decrease in values from year to year and there is no statistically significant difference between the long-term mean RMI scores at the two sites. Rather, interannual variability appears high at both sites.

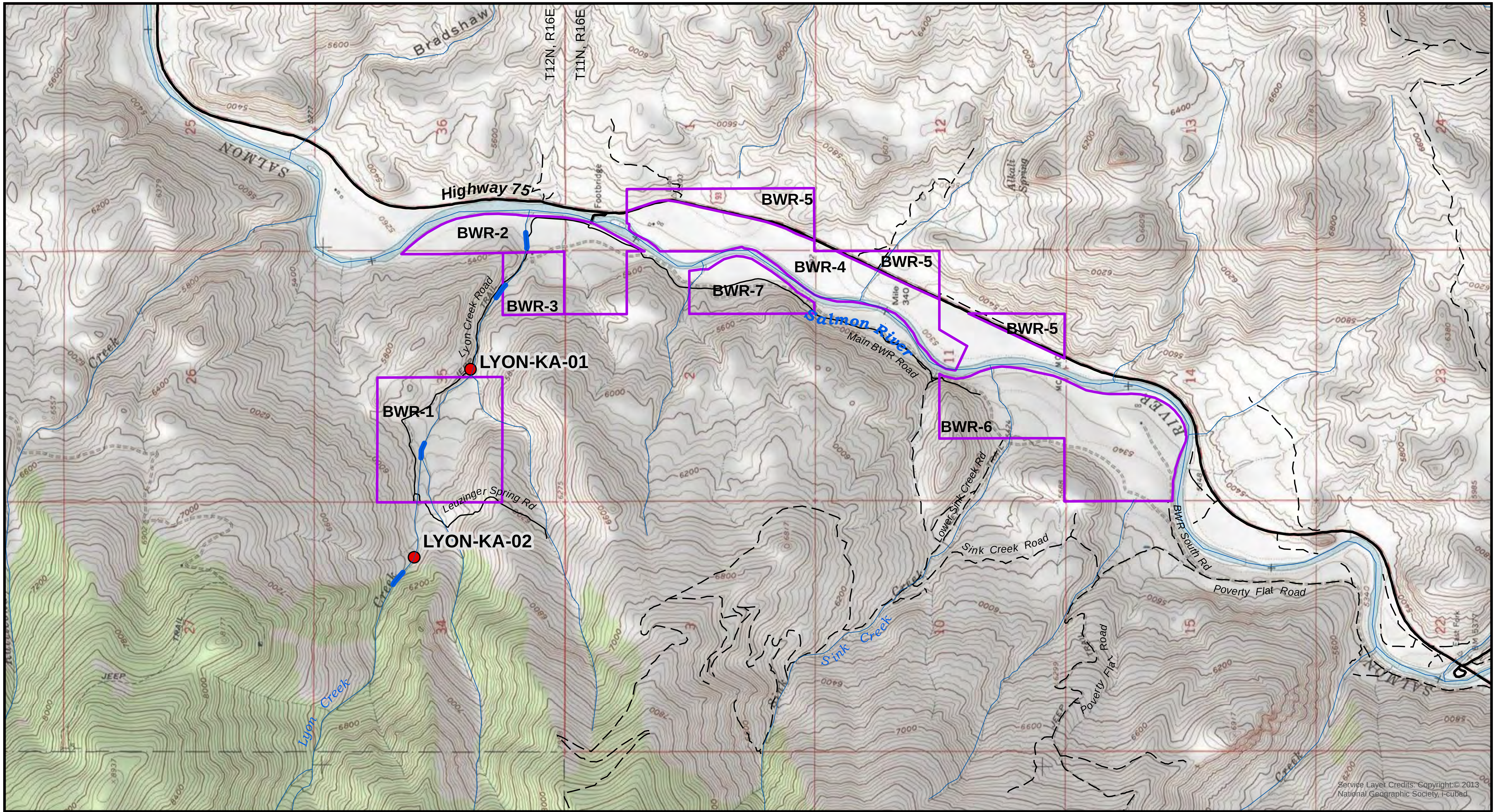
Variability in macroinvertebrate density at both sites since 2001 is substantial, and total taxa richness has varied substantially between 2001 and 2003, but has been less variable since 2004 (GEI 2011). Similar to Plecoptera richness for Thompson Creek and S. Creek, percent Elmidae was low at both sites in 2010, and has decreased since 2006. The lower percent Elmidae may indicate impairment of well-oxygenated riffle and run habitats. However, the value of this metric has declined at both sites, and has typically been lower at the upstream site. Therefore, the lower percent Elmidae does not appear to be due to the mine, and rather is probably due to natural variability.

3.8.2. Offered Lands - Broken Wing Ranch

The majority of the ranch is along the Salmon River bottom lands adjacent to the (ordinary high water mark) of the Salmon River. The ranch includes part of the adjacent Salmon River floodplain and the lower portions/mouths of several small tributary streams (Sink Creek and Lyon Creek, as well as unnamed tributaries). Most of the valley areas and Salmon River floodplain at the ranch are cultivated or otherwise disturbed for agricultural use. As a result, there is only scattered cottonwood along the Salmon River corridor. Lyon Creek has a more developed riparian corridor. The foothills at the ranch contain varying amounts of bare ground (gravel/cobble substrate) and grass and shrub vegetation.

3.8.2.1. Lyon Creek

The Lyon Creek watershed is 4,102 acres. Nearly all (93 %) of the watershed is Federal land administered by the BLM and Forest Service, with the remaining area of the watershed owned by TCMC. The status of benthic macroinvertebrate communities in Lyon Creek is unknown.



Legend

- Broken Wing Ranch
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- BLM temperature monitoring sites (2010-2011)
- Lyon Creek sample reaches

NEPA parcels for the Broken Wing Ranch from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Temperature monitoring sites and Lyon Creek sample reaches from BLM and IDFG
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:24,000
0 — 4,000 Feet
0 — 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.8-2
Survey and monitoring locations, Broken Wing Ranch
Thompson Creek Mine EIS

3.8.2.2. Fish Species Present

Both the Salmon River and Lyon Creek support populations of native fish, including anadromous and resident salmonids. In addition, other native species may be present in the Salmon River or may use Lyon Creek at some point in their life history (Table 3.8-5). It is likely that Lyon Creek has historically provided spawning and rearing habitat for Chinook salmon and steelhead, and may also have supported resident and fluvial westslope cutthroat trout, bull trout, and resident rainbow trout (IDFG 2010b). The species documented in Lyon Creek at varying extents of occupancy include steelhead/rainbow trout, juvenile Chinook salmon, bull trout, shorthead sculpin, and longnose dace (IDFG 2010b). A pond/dam and an undersized culvert outlet near the mouth of Lyon Creek creates a substantial impediment to upstream migration by anadromous and fluvial fish under most flow conditions. As a result, the fish community upstream of the pond appears to be mostly resident rainbow trout. However, BLM sampling indicates some fish passage may occur seasonally (BLM 2011).

Special Status Species

There are four fish species listed as threatened or endangered that use components of the analysis area for a portion of their life history: bull trout, Chinook salmon, sockeye salmon, and steelhead (Table 3.8-5). Resident rainbow trout are also present in the analysis area. The Salmon River is designated critical habitat for bull trout, Chinook salmon, sockeye salmon, and steelhead. Lyon Creek is designated critical habitat for Chinook salmon, but not for bull trout, sockeye salmon, or steelhead.

3.8.2.3. Aquatic Habitat

The aquatic data collection sites on the ranch include a site near the mouth of Lyon Creek below the small earthen dam and pond, another site just upstream of the pond, and one site further upstream in BWR-1 (Figure 3.8-2). The water quality in Lyon Creek is good, with temperatures generally less than NMFS criteria for Chinook salmon or steelhead spawning, and near or less than USFWS thresholds for bull trout rearing (BLM 2011). The temperatures can be greater than those acceptable for bull trout spawning during late summer months (BLM 2011).

Limited data on sediment and turbidity is available. The BLM quantified the surface substrate at the upper site (LYON-KA-02) in 2011 and found the percentage of fine sediment to be approximately 14 percent (BLM 2011). However, the site is above some additional sources of sediment to lower Lyon Creek: a breached irrigation ditch flowing into Lyon Creek, livestock grazing, and a road (with a ford next to the Lyon Creek ranch house and a ford 450 feet downstream to access the north end of BWR-2) next to the lower portion of the stream. The lower portions of Lyon Creek on BLM land are also confined by steep hillslopes with relatively erodible fine volcanic soil (BLM 2011). Furthermore, lack of maintenance of the flood-irrigated BBR-1 has caused rills that may transport sediment seasonally to Lyon Creek. Sediment has also been seen entering Lyon Creek from the road in the same area. In addition, there are visible increases in turbidity when vehicles use the fords. However, even during the growing season, the fords are on average used less than once per week. In any case, the amount of fine sediment may be higher than ideal in some portions of Lyon Creek. Moreover, reduced streamflow due to irrigation diversions may limit the ability of the stream to transport sediment downstream, which would also increase the amount of sediment in the substrate.

There is a pond/earthen dam on Lyon Creek approximately 250 feet upstream of the mouth of Lyon Creek. A control gate and an undersized culvert outlet (1 foot in diameter) on the downstream end of the pond may impede upstream fish migration at a range of flows. However, two bull trout were found above the pond during a BLM fish survey in 2008. As discussed below for bull trout, the bull trout in Lyon Creek do not appear to be resident fish and thus some fish passage through the pond is inferred (BLM 2011). In addition, there are five other irrigation diversions upstream of the pond that may prevent upstream migration of smaller fish. The diversions are unscreened (one was subsequently screened in 2012) and may entrain fish (IDFG 2010b). There is also a portion of Lyon Creek (~ 1,600 feet) upstream of BWR-1 that appears to be intermittent where the water enters a subsurface channel before resurfacing 1.9 miles upstream of the mouth of Lyon Creek. Although this section probably has water during high flow, the section is a barrier to upstream migration at lower flows. The irrigation diversions on Lyon Creek, four of which were actively withdrawing water from Lyon Creek in 2009 (IDFG 2010b), also reduce streamflow relative to natural conditions.

Table 3.8-5. Fish Species in the Broken Wing Ranch analysis area.

Species	Status	Occurrence
SPECIAL STATUS SPECIES		
Bull trout	Threatened/MIS	**Present** Bull trout are present in the Salmon River and lower Lyon Creek (IDFG 2010b). The Salmon River is designated critical habitat for bull trout, but Lyon Creek is not.
Chinook salmon	Threatened/MIS	**Present** Chinook salmon are present in the Salmon River and lower Lyon Creek (IDFG 2010b) and both of these streams are designated critical habitat for Chinook salmon.
Steelhead/rainbow trout	Threatened (steelhead) MIS/BLM sensitive (rainbow trout)	**Present** Juvenile steelhead/rainbow trout (indistinguishable) are present in the Salmon River and lower Lyon Creek (IDFG 2010b). The Salmon River is designated critical habitat for steelhead, but Lyon Creek is not.
Sockeye salmon	Endangered	**Present** Sockeye salmon use the main Salmon River for migration to/from central Idaho lakes. The Salmon River is designated critical habitat for sockeye salmon (BLM 1998). Lyon Creek is not designated critical habitat for sockeye salmon.
Westslope cutthroat trout	Forest Service/BLM sensitive/MIS	**Present** Westslope cutthroat trout are present in the Salmon River and were likely historically present in Lyon Creek and may again be present if barriers to migration are removed (IDFG 2010b).

Species	Status	Occurrence
NON- SPECIAL STATUS SPECIES		
Bridgelip sucker		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Largescale sucker		**Possible** May be present in the Salmon River (BLM 1998).
Longnose dace		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Mottled sculpin		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).
Mountain whitefish		**Possible** Present in other streams in the Upper Salmon River watershed and may also be present in Lyon Creek.
Northern pikeminnow		**Possible** May be present in the Salmon River (BLM 1998).
Pacific lamprey		**Possible** Precise distribution data for Pacific lamprey is unavailable for much of the upper Salmon River; however, lamprey once migrated into all Idaho waters that salmon and steelhead migrated into (Simpson 1982). Lamprey have been found ~ 75 miles downstream of the analysis area (Curet 2013).
Redside shiner		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Shorthead sculpin		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).
Speckled dace		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).
White sturgeon		**Not Present** The Snake River population of white sturgeon occurs in the Snake River and in the mainstem Salmon River. White sturgeon are rarely seen above the North Fork Salmon River (~ 100 miles downstream of the analysis area) (IDFG 2005a).

3.8.2.4. Fish Populations

Lyon Creek

The fish community in the portion of Lyon Creek below the pond includes anadromous and fluvial fish, and is used by juvenile Chinook, steelhead/rainbow trout, and bull trout as rearing habitat and as refuge from high summer temperatures in the Salmon River (IDFG 2010b). Upstream of the pond the fish community is composed of what appear to be mostly resident rainbow trout, but some passage above the pond by anadromous and fluvial fish is possible (BLM 2008a, BLM 2011, IDFG 2010b). An intermittent portion of upper Lyon Creek appears to restrict rainbow trout to the lower 2 miles of Lyon Creek, with no fish sampled above this portion of the stream (IDFG 2010b).

Special Status Species

Bull Trout

Two bull trout (both ~ 200 mm in length) were sampled in the lower portion of Lyon Creek below the pond in 2009 (IDFG 2010b). In addition, two bull trout (both ~ 200 mm in length, 3 to 4 years old) were sampled in 2008 just upstream of the pond (BLM 2011). The dam and culvert are a velocity barrier to upstream movement under most flow conditions. However, the bull trout above the pond indicate that some fish passage may occur at low flows. Also, under high flow, a secondary channel may allow limited fish passage. Given the lack of bull trout in other samples of upper Lyon Creek, it is unknown if there are resident bull trout in Lyon Creek above the pond. Therefore, the two bull trout above the pond may have come from the Salmon River seeking refugia, foraging, or spawning habitat (BLM 2011). As mentioned above, the relatively cold water of Lyon Creek provides valuable refuge for fluvial bull trout from high temperatures in the Salmon River.

Chinook Salmon

Juvenile Chinook salmon were sampled on two dates in the portion of Lyon Creek below the pond in 2009: 4 and 29 individuals were identified on June 29 and July 28, respectively. The reach sampled was the same length on both dates, with 3 passes conducted on June 29 and a single pass on July 28. As the greater number of individuals was sampled with less sampling effort, the increase does not appear to be due to sampling error. Rather, the increase in individuals corresponded with an increase in the temperature of the Salmon River, which indicates Chinook salmon may use Lyon Creek as a thermal refuge, similar to the potential for bull trout (IDFG 2010b). No Chinook salmon have been found above the pond.

Steelhead/Rainbow Trout

Juvenile steelhead/rainbow trout of unknown origin have been present at all sites between the portion of Lyon Creek with intermittent streamflow and the pond (BLM 2008a, IDFG 2010b). The length distribution of rainbow trout (40 to 219 mm) sampled by BLM and IDFG is consistent with the length distribution of resident populations observed in other Salmon River tributaries and fish upstream of the pond are mostly, if not all, resident rainbow trout. However, the length distribution is also consistent with length attainment prior to down migration and the presence of steelhead remains uncertain, i.e., steelhead passage above the pond at low flows (prior to spring run-off) appears possible (BLM 2011). Fish below the pond may be juvenile rainbow trout from resident spawning in Lyon Creek, steelhead from spawning below the pond, or from elsewhere in the Salmon River system that are using the reach as rearing habitat (IDFG 2010b).

Westslope cutthroat trout

Westslope cutthroat trout were not sampled in Lyon Creek, although they are considered to have been present historically (IDFG 2010b).

3.8.3. Garden Creek Property

The portion of Garden Creek within the property is small (Section 3.6.3.) and is not known to support any salmonid fish populations, although small individuals of non-game species such as mottled sculpin, shorthead sculpin, and speckled dace are probably present.

3.9. Wetlands, Floodplains, and Riparian Areas

The analysis area for wetlands, floodplains, and riparian areas for the MMPO alternatives is the surface disturbance of the MMPO (Alternatives M2 and M3) and the wetlands, floodplains, and riparian areas downgradient and proximal to the MMPO (Alternatives M2 and M3). The analysis area for streams determined to be WUS (USACE 2011) is the surveyed stream channels above and/or below the MMPO area to the ends of the channels in Thompson Creek, S. Creek, and the Mill Creek drainage. The Mill Creek drainage is generally outside the MMPO area, but would be disturbed by mine reclamation. Streams determined to be WUS in the MMPO area are Buckskin Creek, Buckskin Creek tributary, Pat Hughes Creek, East Fork Pat Hughes Creek, Pat Hughes Creek tributary, No Name Creek, Bruno Creek, West Fork Bruno Creek, "Hawk's Nest" wetland/spring tributary to Bruno Creek, and Mill Creek (Table 3.9-1).

The analysis area for the land disposal alternatives is the selected and offered lands. Wetlands (land saturated with water, either seasonally or permanently), floodplains (streamside areas subject to flooding within a certain interval), and riparian areas (streamside vegetation with a hydrologic connection to the stream) function as natural environmental filters for sediment and chemicals, provide wildlife habitat, and are often comprised of diverse hydrophytic plant communities. Floodplains for this analysis are 100 year floodplains, the standard for flood hazard analysis.

Table 3.9-1. Streams (WUS), MMPO analysis area.

Stream	Linear Feet
Buckskin Creek and tributary	4,118
Pat Hughes Creek and tributary	4,371
East Fork Pat Hughes Creek	3,971
No Name Creek	7,584
Bruno Creek and tributaries	4,740
West Fork Bruno Creek	1,720
Mill Creek[1]	4,469
TOTAL	**30,973**

[1] Includes the Mill Creek channel in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

3.9.1. MMPO Area and Selected Land

3.9.1.1. MMPO Area

There are 4.61 acres (Alternative M2) and 4.66 acres (Alternative M3) of wetlands in the analysis area (Table 3.9-2., Table 3.9-3., Figure 3.9-1). The USACE has determined that 4.52 acres and 4.57 acres, respectively, of these wetlands are jurisdictional (i.e., regulated by the USACE). The USACE has not made a jurisdictional determination for the remaining 0.09 acre of wetlands, but these wetlands would not be affected by any of the MMPO action alternatives.

The wetlands comprise three Cowardin wetland types:[11] palustrine-forested (PFO), palustrine scrub-shrub (PSS), and palustrine-emergent (PEM) wetlands (Table 3.9-2., Table 3.9-3). Dominant wetland vegetation includes tufted sedge (*Carex lenticularis*), Torrey's rush (*Juncus torreyi*), redtop (*Agrostis stolinifera*), small-wing sedge (*Carex microptera*), leafy aster (*Aster foliaceus*), beaked sedge (*Carex rostrata* [*utriculata*]), Wood's rose, currant, willow, mountain alder (*Alnus incana*), quaking aspen (*Populus tremuloides*), and Engelmann's spruce.

Floodplains were not mapped along streams (WUS) in the MMPO area. Large, lowland rivers that are unconstrained by geology have extensive floodplains; however, smaller mountain streams are often constrained by geology and have narrow floodplains (Gregory et al. 1991). It is assumed that even the smallest streams in the MMPO have floodplains, and most are likely contained within the riparian zone or overlap with jurisdictional wetlands.

Streams in the MMPO are characterized by a riparian zone (a mosaic of riparian herbs, shrubs, and deciduous trees) of varying width and continuity, depending on geomorphic position of the stream and other factors. The most common riparian species observed in the MMPO include cottonwood, aspen, willow, alder, and Douglas-fir. Conifers generally dominate the lower hillslopes.

[11] the standard wetland classification system (Cowardin et al. 1979)

Table 3.9-2. Wetlands, MMPO analysis area (Alternative M2).

Wetland ID	Jurisdiction	Acres	Type[1]	JD[2] Status
BLM W-01	BLM	0.02	PSS	Yes
BLM W-02	BLM	0.01	PEM	Yes
2008 BR	Forest Service	0.12	PFO	Yes
BR2	Forest Service	0.032	PFO	Yes
PH Tributary Spring	BLM	0.05	PEM	Yes
PH1	BLM	0.21	PEM	Yes
WB1	Forest Service	0.025	PFO	Yes
WB2	Forest Service	0.108	PFO	Yes
WBWet1	Forest Service	0.004	PEM	Yes
WBWet2	Forest Service	0.003	PEM	Yes
Power line (PL)	Forest Service	0.06	PFO	Yes
MC1	Private	0.217	PEM	Yes
MC2	BLM and Private	1.03	PEM	Yes
MC3	BLM	0.21	PEM	Yes
MC4[3]	BLM	0.796	PEM	Yes
MC5	BLM and Private	0.14	PEM	Yes
MC6	BLM and Private	0.811	PEM	Yes
MC7	Private	0.153	PEM	Yes
MC8	Private	0.406	PEM	Yes
MC9[3]	Private	0.203	PEM	Yes
MC Spring	Private	0.002	Spring	Yes
TOTAL		**4.61**		

[1] Cowardin et al. (1979)
[2] jurisdictional determination
[3] Wetlands occur both in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

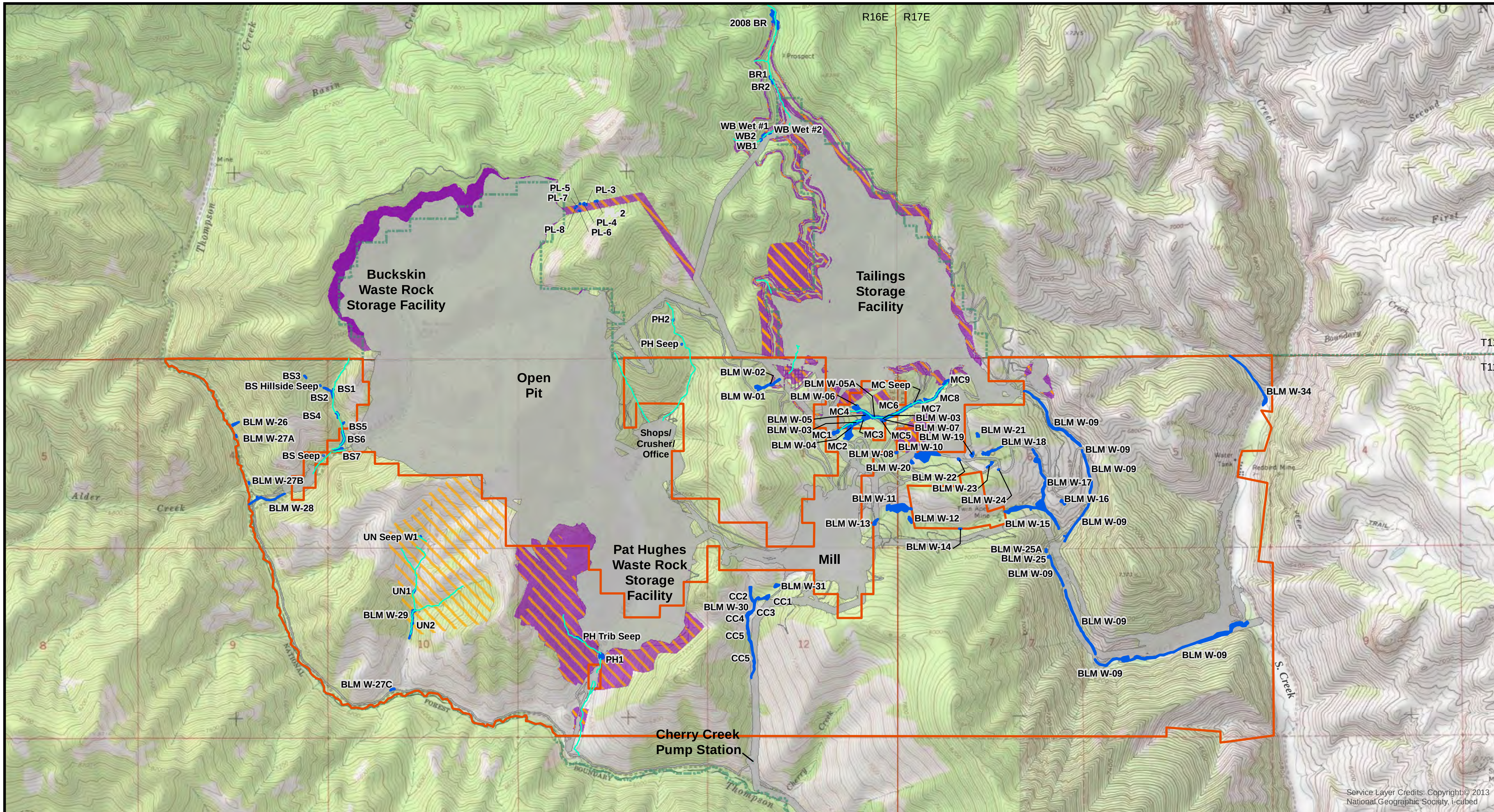
Table 3.9-3. Wetlands, MMPO analysis area (Alternative M3).

Wetland ID	Jurisdiction	Acres	Type[1]	JD[2] Status
BLM W-01	BLM	0.02	PSS	Yes
BLM W-02	BLM	0.01	PEM	Yes
2008 BR	Forest Service	0.12	PFO	Yes
BR2	Forest Service	0.032	PFO	Yes
PH Tributary Spring	BLM	0.05	PEM	Yes
PH1	BLM	0.21	PEM	Yes
UN1	BLM	0.03	PEM	Yes
UN2	BLM	0.02	PEM	Yes
WB1	Forest Service	0.025	PFO	Yes
WB2	Forest Service	0.108	PFO	Yes
WBWet1	Forest Service	0.004	PEM	Yes
WBWet2	Forest Service	0.003	PEM	Yes
Power line (PL)	Forest Service	0.06	PFO	Yes
MC1	Private	0.217	PEM	Yes
MC2	BLM and Private	1.03	PEM	Yes
MC3	BLM	0.21	PEM	Yes
MC4[3]	BLM	0.796	PEM	Yes
MC5	BLM and Private	0.14	PEM	Yes
MC6	BLM and Private	0.811	PEM	Yes
MC7	Private	0.153	PEM	Yes
MC8	Private	0.406	PEM	Yes
MC9[3]	Private	0.203	PEM	Yes
MC Spring	Private	0.002	Spring	Yes
TOTAL		**4.66**		

[1] Cowardin et al. (1979)
[2] jurisdictional determination
[3] Wetlands occur both in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

3.9.1.2. Selected Land

A total of 52 wetlands (49.69 acres) within three Cowardin wetland types (PEM, PSS, and PFO) were identified within the selected land (Table 3.9-4., Figure 3.9-1).



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Wetlands
- Surveyed stream segments

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Wetland Data from JBR (HDR) 2008 and 2009
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 Miles 1

0 Kilometers 1

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.9-1
Wetlands and streams, MMPO area and selected land
Thompson Creek Mine EIS

Note that because all portions of the MMPO area on BLM land overlap the selected land, the area of wetlands at the selected land includes all of the wetlands in the MMPO area previously described (Section 3.9.1.1).

As discussed in Section 3.9.1.1., floodplains were not mapped; however, floodplains of varying width and continuity occur along all streams (WUS) within the selected land, and most are likely contained within the riparian zone or overlap with jurisdictional wetlands.

Table 3.9-4. Wetlands, selected land.

Wetlands[1]						TOTAL	
PEM		PSS		PFO			
#	acre	acre	acre	#	acre	#	acre
30	5.81	19	40.04	3	3.84	**52**	**49.69**

[1] Cowardin et al. (1979)

Well-vegetated riparian areas were observed adjacent to S. Creek, Thompson Creek, and portions of Bruno Creek and Mill Creek. Dominant vegetation species vary by wetland type, and include alder, quaking aspen, cottonwood, red-osier dogwood, willow, rush (*Juncus* spp.), sedge (*Carex* spp.), bluejoint reedgrass, saxifrage (*Saxifraga* spp.), largeleaf avens (*Geum macrophyllum*), and bishop's cap (*Mitella* spp).

In general, the width of the riparian area on these streams varies from a few feet to approximately 50 feet. Buckskin Creek and Pat Hughes Creek support only an intermittent riparian corridor.

As part of the Wetland and Stream Mitigation Plan (Appendix 2A), more detailed information was collected for S. Creek. The riparian corridor along S. Creek is up to approximately 100 feet wide in some locations and is dominated by cottonwood, alder, willow, sedges, rushes, and pasture grasses. The riparian corridor and wetland meadows associated with S. Creek are grazed during the summer months. Both TCMC and the BLM administered land in this corridor for grazing, and some bank sloughing is present in several locations on S. Creek due to both cattle accessing the stream and natural erosion, particularly during high flows.

3.9.1.3. Offered Lands - Broken Wing Ranch

A total of 19 wetlands (36.98 acres) were identified on the Broken Wing Ranch (Table 3.9-5., Figure 3.9-2). Four wetlands are associated with ditches (W-9, W-10, W-11, and W-12) and one wetland is adjacent to the Salmon River (W-8). Cowardin wetland types on the ranch include PSS, PEM, and PFO wetlands. The dominant vegetation in each of the wetland types includes quaking aspen, cottonwood, red-osier dogwood, various willows, various rushes, Nebraska sedge (*Carex nebrascensis*), beaked sedge, Garrison creeping foxtail (*Alopecurus arundinaceus*), redtop, and timothy.

Table 3.9-5. Wetlands, offered lands.

Parcel	Wetlands[1]						TOTAL by Parcel	
	PEM		PSS		PFO			
	#	acre	#	acre	#	acre	#	acre
Broken Wing Ranch	7	26.72	10	8.87	2	1.39	**19**	**36.98**
Garden Creek property	0	0	1	0.7	0	0	**1**	**0.7**
TOTAL	**7**	**26.72**	**11**	**9.57**	**2**	**1.39**	**20**	**37.68**

1 Cowardin et al. (1979)

The 100 year floodplain for the Salmon River is present in many locations on the ranch (Figure 3.9-3). The river also has a well-developed riparian corridor (generally 5 to 25 feet wide). In some places, grazing has caused substantial trampling and compaction of the riparian area along the Salmon River at the ranch. Lyon and Sink creeks are perennial streams that flow through the ranch. Lyon Creek is a high-gradient stream with a riparian corridor (~ 20 feet wide) in the higher elevation area of the ranch (BWR-1). The riparian corridor on the lower portion of Lyon Creek (except where it is impounded) is well-vegetated but less than 10 feet wide. Sink Creek is an intermittent stream that flows through a pivot-irrigated agricultural field on the ranch. There are no riparian areas on the portion of Sink Creek on the ranch.

3.9.2. Offered Lands - Garden Creek Property

One wetland system (PSS) (0.7 acre) occurs on the north side of the property along Garden Creek (Table 3.9-5). There are no 100 year floodplains on the property. Garden Creek is a small stream with a well vegetated (riparian grasses, sedges and shrubs) riparian corridor less than 20 feet wide on the property.

Legend

- Offered lands
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream

Wetlands

BW W-01	BW W-02B	BW W-06A	BW W-09
BW W-01A	BW W-02C	BW W-06B	BW W-10
BW W-02	BW W-03	BW W-07A	BW W-11
BW W-02A	BW W-04	BW W-07B	BW W-12
	BW W-05	BW W-08	UPLAND

N

1:16,000

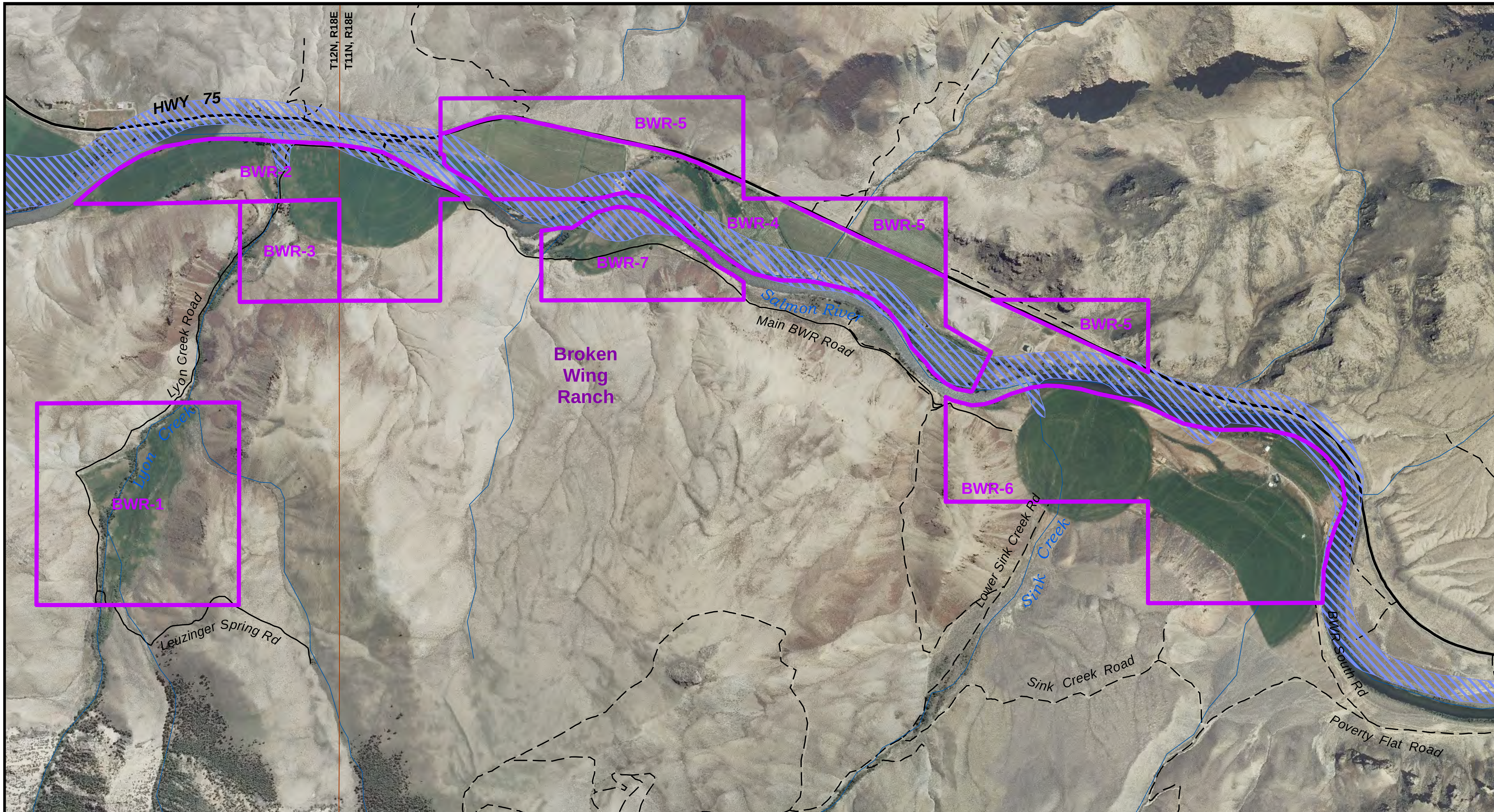
1,600 0 1,600
Feet

500 0 500
Meters

Wetland data from Atkins 2010
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.9-2
Wetlands, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- Special flood hazard areas (100-year floodplain)

Flood data from Federal Emergency Management Agency (1998).
2009 NAIP Imagery

N

1:15,000

0 — 2,500 Feet

0 — 0.75 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.9-3
Floodplains, Broken Wing Ranch
Thompson Creek Mine EIS

3.10. Air Quality, Noise, and Climate Change

The analysis area for air quality and noise for the MMPO alternatives is 1) a circle with a radius of 4 miles centered at the mine (26,870 acres), and 2) the primary access roads to the mine. The analysis area for climate for the MMPO alternatives is the mine site. The analysis area for the land disposal alternatives for air quality, noise, and climate is the selected and offered lands, and also any residents living within 1,000 feet of the offered lands. The analysis area for climate change is the mine, Idaho, the Northern Rocky Mountain region, the US, and the world.

3.10.1. Regulatory Framework

3.10.1.1. Air Quality

The Clean Air Act requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for certain air pollutants to protect public health (primary standards) and public welfare (secondary standards). To date the EPA has established NAAQS for six "criteria" pollutants: nitrogen oxides (NO), sulfur oxides (SO_x), particulate matter (PM subdivided into $PM_{2.5}$ and PM_{10}), carbon monoxide (CO), ozone (O_3) and lead (Pb) (Table 3.10-1.)[12] (EPA 2012a). Compliance with these NAAQS in Idaho is regulated by the IDEQ (IDEQ 2012a). Significant Impact Levels (SILs) are discussed below.

Pursuant to the Clean Air Act, four AQCRs have been designated in Idaho for the purpose of monitoring and maintaining or improving air quality (40 CFR 81.313). The analysis areas for the MMPO area, selected land, and Broken Wing Ranch are in AQCR 63. The Garden Creek property is in AQCR 61. All of the analysis areas are in locations the EPA has determined as *unclassifiable/attainment* (40 CFR 81.313).

The Clean Air Act also established a three-tier area classification scheme (Class I, Class II and Class III areas) to prevent significant deterioration of air quality. Class I areas have special natural, scenic, recreational or historic value. There are currently 156 Class I areas comprising national parks greater than 6,000 acres, wilderness areas greater than 5,000 acres, and the Roosevelt-Campobello International Park in Maine and Canada (EPA 2012b). All other areas are Class II as no Class III areas have been designated. The analysis areas are all in areas with the Class II designation.

Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) apply to new major sources or major modifications to existing sources for pollutants when the area in which the source is located is designated as *unclassifiable/attainment* (EPA 2012c). These regulations specify the maximum allowable increases of pollutants in the classified areas from a baseline condition for each pollutant; moderate increases are allowed in Class II areas. The PSD regulations also define SILs: de minimis thresholds (as opposed to significant NEPA effects) applied to individual facilities that apply for a permit to emit a regulated pollutant in an area that meets the NAAQS. The SILs are measures of whether a source may cause or contribute to a violation of a PSD increment or the NAAQS, i.e., a meaningful deterioration of air quality (EPA 2012d).

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[12] the standards are for NO_2 and SO_2 which represent NO_x and SO_x, respectively

Performance standards, also required under the Clean Air Act, are set by the EPA for metallic mineral processing plants such as the crusher and mill at the mine site that are stationary sources of air pollutants. Also pursuant to the Clean Air Act, the EPA has established a series of emissions limits (Tier 1 through Tier 4) for non-road diesel engines and sulfur limits in diesel fuel that apply to portions of mine operations.

Table 3.10-1. Criteria pollutant standards for SILs and NAAQS.

Pollutant	Effects to Humans	Averaging Period	Class II SIL[1] (μg/m³)	Primary NAAQSs (μg/m³)[2]
CO	can limit oxygen intake	8 hours	500	10,000[3]
		1 hour	2,000	40,000[3]
Pb	toxic at low exposure	quarterly	none	1.5
		rolling 3 month avg.	0.03[4]	0.15
NO_2	pungent, irritating effect	1 hour	7.5[4]	188.7[5]
		annual	1	100
O_3	adversely affects respiratory system	1 hour	none	235[6]
		8 hours	none	146.9[7]
PM_{10}	can pass into respiratory system	24 hours	5	150[8]
$PM_{2.5}$	can pass into respiratory system	annual	0.3	12[9]
		24 hours	1.2	35[10]
SO_2	can reduce lung function	1 hour	10[4]	196[11]

EPA (2012a)
[1] 40 CFR 51.165(b)(2) except as noted
[2] converted to μg/m³ for consistency
[3] not to be exceeded more than once per calendar year
[4] based on interim EPA guidance
[5] To attain this standard the 3 year average of the 98th percentile of the daily maximum 1 hour average at each monitor in an area must not exceed 100 parts per billion (ppb) (effective 22 January 2010).
[6] not to be exceeded more than once per calendar year
[7] 3 year average of 4th maximum
[8] not to be exceeded more than once per year on average over 3 years
[9] 3 year weighted average; reduced from 15 micrograms per cubic meter (μg/m³) on 14 December 2012
[10] 3 year average of annual 98th percentile value
[11] Final rule signed 02 June 2010. To attain this standard the 3 year average of the 99th percentile of the daily maximum 1 hour average at each monitor in an area must not exceed 75 ppb.

Air quality permit requirements

The PSD regulations (pursuant to Title V of the Clean Air Act) set PSD permitting de minimis conformity thresholds by which stationary sources of criteria air pollutants are classified as major or minor. A Title V (Tier 1) operating permit is required for any stationary source classified as *major*. A Tier II operating permit is required for most stationary sources classified as *minor*. The mine is currently permitted under a Tier II operating permit and is considered a Title V synthetic minor source because its stationary emissions do not reach any of the major thresholds with required emission controls, but would reach one or more of the thresholds without the emission controls (IDEQ 2012b).

Tier II operating permits are administered in Idaho by the IDEQ, which is responsible for reviewing proposed new or modified industrial activities and reviewing the permits every five years. The current (facility-wide) Tier II operating permit (P-2008.0159) for the mine was issued by the IDEQ on 27 January 2009. The permit includes requirements for baghouses to control dust on seven processes including crushers, bins, and transfer points, and wet scrubbers other processes including: ore feeders, three dryers, and the leach plant. The permitted emissions are well below the PSD permitting de minimis conformity thresholds for a major source (IDEQ 2009a, 2009b, 2012c).

The Rules for the Control of Air Pollution in Idaho (IDAPA 58.01.01) define State air pollution control requirements. Applicable requirements for the mine, which duplicate EPA requirements, include that all reasonable precautions be taken to prevent PM from becoming airborne (IDAPA 58.01.01.651), and a prohibition on the discharge of any air pollutant into the atmosphere from any point of emission for a period or periods aggregating more than 3 minutes in any 60 minute period with an opacity greater than 20 percent (IDAPA 58.01.01.625).

Other air quality permits associated with the mine

Most of the molybdenum concentrate from the mine is converted from molybdenum sulfide to molybdenum trioxide at the Thompson Creek Metals Company (parent company of TCMC) roasting facility in Langeloth, Pennsylvania. The facility operates under a Title V operating permit issued by the Pennsylvania Department of Environmental Protection that limits facility-wide emissions of all criteria pollutants to less than 250 tons per year. Emissions from the Langeloth facility during 2008 to 2010 averaged 88.8 tons per year of sulfur dioxide, and less than 10 tons per year of all other criteria air pollutants. However, because the molybdenum concentrate from the mine could be roasted at other facilities in the US with different emissions, the Langeloth facility is not evaluated in this EIS.

3.10.1.2. Noise Levels

There are no noise standards (State, county, city) applicable to the MMPO and land disposal alternatives other than general nuisance laws (52 Idaho Statutes 101 *et seq*.) and vehicle noise abatement laws (e.g., 67 Idaho Statutes 7125).

MSHA regulations requires a mine operator to assure that no miner is exposed during any work shift to noise that exceeds the permissible instantaneous exposure level of 115 A-weighted decibels (dBA), or an 8 hour time-weighted average sound level (TWA_8) of 85 dBA (or equivalently a dose of 50 percent, integrating all sound levels from 80 dBA to at least 130 dBA) (30 CFR 62.130).

3.10.2. Climate Overview

This section provides a general discussion of climate applicable to all of the analysis areas, with site-specific climate information subsequently provided for each analysis area. Additional precipitation data as well as evaporation data is also provided for the mine site in the water resources section (Section 3.6.).

The air flow over central and southeastern Idaho is predominantly westerly bringing maritime air from the Pacific Ocean to the region (480 miles to the mine and 620 miles to the Garden Creek property), with local variations due to elevation, topography (e.g., canyon winds), and vegetation. For example, coastal mountain ranges act as a natural barrier to the moist maritime air and create a rain shadow resulting in relatively low precipitation over the region. In addition, mountainous terrain breaks up and weakens winter storms in the regions, which generally results in a dry and cool to cold continental climate. However, mountainous terrain also channels wind and sometimes blocks or intensifies passing weather systems.

The climate is characterized by long winters generally persisting from November through April, and short, hot, dry summers. The regions receive their most intense precipitation in late spring. In the summer, moisture-laden air occasionally arrives from the south (Gulf of Mexico and Caribbean) at high levels to produce thunderstorm activity in high-intensity, short-duration (< 1 hour) events (WRCC 2012).

Summer thunderstorms provide measurable moisture, but the summer climate is generally characterized by low (< 25 %) relative humidity and abundant sunshine. A dry fall season is typical, and can extend into December. Winds may blow in all directions, but mountain-valley wind patterns are prevalent, i.e., colder air rises upslope in the mornings and the reverse in the evenings. Idaho has no destructive storms such as hurricanes, and an extremely small incidence of tornadoes. Windstorms associated with cyclonic systems, and their cold fronts, do some damage to trees each year, but only minor damage to structures in Idaho. Such storms may occur from October to July. The highest wind velocities occur during summer thunderstorms, which have the greatest incidence in Idaho in mountainous areas, where lightning often causes wildfires (WRCC 2012). However, the dominant cause of wildfires in the regions is humans.

Smoke haze from wildfires or prescribed fires may occur for a few days in the regions several times during the spring and summer months when forests or agricultural lands are burning locally. Smoke haze generally persists for a few days to several weeks when smoke is carried by prevailing winds to the region from large wildfires in Idaho, Montana, Nevada, or California (BLM 1998). However, such smoke haze persisted during August and September 2012 due to the Halsted wildfire (181,798 acres) west of Challis (USFS 2012a). The smoke haze was most distinct during the evenings, and caused elevated 24 hour $PM_{2.5}$ concentrations of 20 to 90 $\mu g/m^3$, and as high as 146 $\mu g/m^3$ (USFS 2012b). A general area of smoke haze throughout cities and downwind plumes from scattered rural residences are common during winter due to the burning of wood for heating. For example, the 24 hour $PM_{2.5}$ concentrations in Salmon are typically 3 to 6 $\mu g/m^3$ during the spring and 20 to 30 $\mu g/m^3$ during the winter (IDEQ 2013). Dust pollution can be locally quite severe on more frequently traveled unpaved roads. However, such dust pollution is rapidly dispersed by prevailing winds (BLM 1998).

3.10.3. MMPO Area and Selected Land

3.10.3.1. Climate

The analysis area is relatively dry with wide daily and monthly variations in temperature. The highest average monthly maximum temperatures in the area during the period from 1971 to 2000 ranged from 70 °F at the higher elevations to 82 °F at the lower elevations, and occurred in July and August. The average daily maximum temperatures were below freezing at the upper elevations in December and January, but rarely below freezing at the lower elevations. The lowest average monthly minimum temperatures during that period ranged from 5 °F at the lower elevations to 9 °F at the higher elevations, and occurred in January and February (PRISM 2006a, 2006b, TCMC 2010). A temperature inversion of 2 to 4 °F is typical on the coldest days in January, September, and December. The average daily minimum temperatures were below freezing at all upper elevations by October and remained below freezing at the lower elevations through April and at the upper elevations through May.

The average annual precipitation during the period from 1971 to 2000 at the analysis area ranged from 15.5 inches at the lower elevations to 26.0 inches at the higher elevations with an average annual precipitation of 20.7 inches. At the lower elevations, approximately 1 inch fell each month except for approximately 2 inches in May and in June. At the higher elevations, 1.8 inches fell each month except for approximately 3.5 inches in May and June (PRISM 2006c). Thunderstorms are predominant in late spring and occasionally through the summer. Approximately 70 percent of the precipitation in the area falls as snow (October through March). From 1961 to 1990 the area received an average annual snowfall of 65 inches at the lower elevations and 129 inches at the higher elevations. Most of the snowfall was during November to March, with lesser amounts falling April to June and in October (PRISM 2000). Avalanches can occur on the steeper slopes during the winter (VTN 1980a).

Winds in the analysis area are generally from the west with daily velocities generally highest in the evenings and just prior to dawn. The area displays typical mountain-valley wind patterns. The average monthly wind velocities are lowest during May through September (2 to 7 miles per hour [mph]) and highest during October through April (9 to 12 mph), with an average annual wind velocity of 8 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 45 mph, with an average annual occurrence of four peak gusts greater than or equal to 50 mph (NCDC 2002). Two regional extreme wind events that occurred in January 1990 and January 1993 were both from the south. However, these events produced wind velocities of up to only 19.9 mph at the analysis area (ICBEMP 1997b). Extreme wind velocities due to thunderstorms and wind channeling along local topographic features are probably less than 67 mph, based on the NCDC data and a peak gust of 44 mph at the Bonanza weather station 11 miles to the west-northwest (WRCC 2011a). The locality receives approximately 40 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.3.2. Air Quality

The air quality of the analysis area is primarily influenced by regional (as opposed to mine-related) vehicle emissions and PM from wildfires, prescribed fires, burning wood for space heating, agriculture and ranching activities, recreational activities, and natural wind erosion. However, the relevant sources of mine-related criteria pollutants for the analysis area are mine-related highway traffic, on-site traffic, on-site stationary sources, and, in the case of PM, various non-point sources. The emissions from these mine-related sources are provided below, along with the concentrations of the relevant three criteria pollutants for ambient air at the mine perimeter. Also provided are current background (non-mining) concentrations of criteria pollutants, and the concentrations of these pollutants at the nearest sensitive receptor. There is no discussion of Pb which is not emitted in meaningful quantities related to the mine. In addition, the relatively small amounts of nitrogen dioxide and volatile organic compounds (VOCs) related to the mine preclude the generation of meaningful ground-level ozone related to the mine.

The annual contributions of carbon dioxide and nitrogen dioxide (there was no meaningful sulfur dioxide, PM or VOCs) from mine-related highway traffic were calculated as 36.5 and 3.65 tons, respectively, and determined to have no meaningful effect to air quality (VTN 1980d). More recent calculations of the current annual emissions from this traffic (commuter and vendor traffic as well as concentrate shipments to Pennsylvania) are approximately 100 tons carbon monoxide, 13 tons NO_2, 81 tons PM_{10} (3.5 tons from exhaust, 77.5 tons from fugitive dust), 1 ton sulfur dioxide, and 23 tons VOCs (TCMC 2012c).

The current annual emissions from on-site traffic (e.g., haul trucks and pickup trucks) are approximately 250 tons carbon monoxide, 800 tons nitrogen oxides, 450 tons PM_{10} (49.5 tons from exhaust as $PM_{2.5}$, 386.6 tons from fugitive dust as mostly coarse PM_{10}), 0.2 tons sulfur dioxide, and 80 tons VOCs. The annual emissions from on-site stationary sources are 21.2 tons carbon monoxide, 86.8 tons nitrogen dioxide, 20.8 tons PM_{10}, 21.2 tons sulfur dioxide, 7.54 tons VOCs, a maximum potential single hazardous air pollutant (HAP) of 5.58 tons (total organic carbon), and a maximum potential combined HAPs of 5.59 tons (total organic carbon plus metals) (Doughty 2012, IDEQ 2012c). Unlike many areas in the US, central and southeast Idaho have distinct wet and dry seasons. During the dry season much of the soil is prone to yielding fugitive dust, particularly in areas with high winds or frequent surface disturbance. The primary sources of fugitive dust in the analysis area include ground disturbing activities at the mine (e.g., drilling, blasting, ore and waste rock haulage, waste rock disposal, tailings management), as well as general vehicle traffic on unpaved roads, local and regional wildfires, plowed fields, and all of the natural ground with relatively fine soil and sparse vegetation.

Fugitive dust controls employed by TCMC currently include speed limits, water sprayed from water trucks, and magnesium chloride applications. In addition, most of the haul roads have relatively low (~ 3 %) silt content from many years of use. These and other factors mean the current annual emissions of PM_{10} and $PM_{2.5}$ from the mine during molybdenum production are approximately 1,980 tons and 290 tons, respectively.

The only criteria pollutants from stationary sources of potential concern to ambient air quality (the perimeter of the mine) are PM_{10}, sulfur dioxide, and nitrogen dioxide. However, the contributions of these pollutants from stationary sources at the mine would not cause the concentrations of these pollutants in the ambient air to be greater than any of the primary NAAQSs (IDEQ 2012c).

Non-point sources of PM_{10}, sulfur dioxide, and nitrogen dioxide are too small and too widely distributed to meaningfully contribute to the concentrations of these pollutants from stationary sources in ambient air. Regardless, the concentration of each criteria pollutant from the combined emissions (non-point and stationary) at the mine were calculated (Table 3.10-2.) for the nearest sensitive receptor in the analysis area: the few (~ 2 to 4) people that occupy a cabin for a few weeks during the summer on the Redbird property (Section 3.10.3.4.). The cabin is 3.0 miles east of the center of the mine site. Note that the calculated concentrations are highly conservative, e.g., it was assumed that all pollutants from all non-point and stationary sources at the mine are concentrated in a single narrow plume directed at the receptor with no topographic shielding.

Table 3.10-2. Criteria pollutants, MMPO area and selected land.

Pollutant	Averaging Period	Background ($\mu g/m^3$)	Sensitive Receptor ($\mu g/m^3$)
CO	1 hour	NA	1.74
	8 hour	200[1]	0.61
NO_2	1 hour	0.5	5.68
	annual	≤ 2	0.061
PM_{10}	24 hours	6 to 10	2.59
$PM_{2.5}$	24 hours	5	0.38
	annual	3	0.02
SO_2	1 hour	3 to 7	0.137

[1] average annual concentration; the 8 hour maximum would be even greater

3.10.3.3. Noise

The quantity typically used to measure the "strength" of a sound wave in noise analysis is (effective) sound pressure level (SPL or L_P). The SPL is a relative measure dependent on the environment of the source and receptor of a sound wave. The SPL is typically expressed in decibels (dB) on a logarithmic scale of 0 dB to 194 dB, for which every increase of 10 dB is equivalent to an increase in sound level by a factor of 10. The base of the scale corresponds to 20 µPa (micropascals), the threshold of average human hearing, and the range of sounds in normal human experience is 0 to 140 dB (Table 3.10-3). A 3 dB change is barely perceptible, a 5 dB change is clearly perceptible, and a 10 dB change is perceived as being twice or half as loud (CERES 1996); changes less than 5 dB are generally insignificant (EPA 1974).

Low frequency sound (10 to 200 Hz) becomes dominant over large distances as higher frequency sound is preferentially attenuated. Mining equipment is a noted source of low-frequency sound (BHP 2008, Roberts 2004). In general, constant sounds are less noticeable than irregular or periodic sounds.

The SPL diminishes due to distance from its source, topographic reflection or blocking, atmospheric absorption, ground absorption and foliage absorption. For example, sound waves can be completely blocked from a receptor in places in the analysis area by topography. More specifically, the mine is at higher elevations than any residences in the area, and is completely surrounded by a series of ridges and valleys. In addition, as sound waves travel down a canyon they are reflected and scattered when they encounter the canyon walls. The analysis area is comprised of steep-walled canyons that surround the mine. These canyons form an irregular pattern such that much of the sound reflected off one canyon wall would encounter reflections off another canyon wall. This back scatter would cause a large overall attenuation in the SPL, but with some amplification in any particular valley by the valley walls. Moreover, sound waves are also distinctly absorbed (e.g., 60 dBA/1,000 feet for 4,000 hertz (Hz) in dense evergreen forest) on contact with foliage and by repeated scattering by tree trunks and limbs (VTN 1980e). Therefore, the sounds of even the loudest equipment (gyratory crusher, 116 dBA) (VTN 1980e) are not audible off the mine site, and sounds of individual vehicles on roads (e.g., heavy trucks at 84 to 86 dBA at 50 feet) are not audible at a distance of 1,000 feet.

Table 3.10-3. Sound levels-thresholds associated with ordinary sound sources.

Source-effect Level	(dBA)	Subjective Description
Loudest sound possible	194	deafening
Death of hearing tissue	180	deafening
12 gauge shotgun blast	165	deafening
Short-term exposure may cause permanent damage	140	deafening
Level at which pain begins; ambulance	125	deafening
Commercial jet take-off at 200 feet; average snowmobile	120	deafening
Sandblasting	115	deafening
Thunder; chainsaw	110	deafening
Road construction jackhammer	100	very loud
Sustained exposure may result in hearing loss	90-95	very loud
Busy urban street	90	very loud
MSHA 8 hour exposure permissible exposure limit	85-90	loud – to very loud
Telephone dial tone; busy street	80	loud
Construction equipment at 50 feet	75-80	loud
Freeway traffic at 50 feet	70	loud
Sound mitigation level for residential areas	67	loud
Normal conversation at 3 to 6 feet	60-65	moderate
Sound mitigation level for undisturbed land	57	moderate
Typical office (interior)	50	moderate
Typical residence (interior); whisper in library at 6 feet	30	faint
Threshold of average human hearing	0	very faint

Chepesiuk (2005), FHA (2006), BBA (2009), EPA (2009a), Galen Carol Audio (2012)

Outdoor SPLs of less than 55 dBA L_{DN}[13] are desirable to protect against speech interference and sleep disturbance for residential areas and areas with educational and healthcare facilities. The value is based on an indoor limit of 45 dBA L_{DN} with an outdoor to indoor reduction of 15 dBA and a 5 dBA safety margin. Outdoor sound levels are as low as 20 to 30 dBA L_{DN} in quiet wilderness areas, with levels typically of 40 dBA L_{DN} in rural residential areas, and levels as high as 85 to 90 dBA L_{DN} in noisy urban areas. Most people in urban areas experience outdoor sound levels of 43 to 72 dBA L_{DN} with a median value of 59 dBA L_{DN}. Most people in rural or non-urban areas experience outdoor sound levels of 35 to 50 dBA L_{DN} (EPA 1974). Some people have difficulty falling asleep at indoor sound levels of 40 to 50 dBA L_{DN}, and there is a 30 to 60 percent probability of people being awakened by a peak sound level of 70 dBA L_{DN} (EPA 1981). The US Department of Housing and Urban Development regulations specify that sites are acceptable for residential use if exposed to outdoor sound levels not exceeding 65 dBA L_{DN}, normally unacceptable if exposed to outdoor levels of more than 65 but not exceeding 75 dBA L_{DN}, and unacceptable if exposed to outdoor levels of more than 75 dBA L_{DN} (24 CFR 51.103).

No known sound level data has been collected in the ambient (non-mining) portion of the analysis area. However, background (pre-mining) sound levels for the Idaho Cobalt project, 58 miles north of the analysis area, were determined from two measurements near the Idaho Cobalt project: 34 dBA equivalent continuous noise level (L_{EQ}) (~ 32 dBA L_{DN}) and 48 dBA L_{EQ} (~ 54 dBA L_{DN}), with the higher value due to flowing water very near the measurement station. Apart from water, the primary sound sources were birds, insects, and wind (USFS 2008). The Idaho Cobalt project also had recreational, noise-sensitive receptors, and is in an environment very similar to that of the analysis area. Therefore, the pre-mining sound levels in the analysis area were probably approximately 35 dBA L_{DN} except for particular isolated areas and areas near flowing water, the Thompson Creek Road, or the S. Creek Road.

The main sources of sound in the analysis area are ambient conditions (wind, flowing water, birds, insects), and, at the mine, the additional sound from heavy equipment and blasting. The stationary equipment at the mine typically generates 98 to 113 dBA L_{EQ} at 50 feet (VTN 1980e), except all of this equipment is contained in structures (e.g., conveyor, ball mills) or buried in the ground (i.e., gyratory crusher) so that sound levels are below 80 dBA L_{EQ} outside of structures at the mine. All of the mobile heavy equipment at the mine produces sound levels below 90 dBA L_{EQ} or L_{max} at 50 feet (Table 3.10-4). Workers are very rarely within 50 feet of this equipment, except for equipment operators who are inside closed-cabs in which all equipment sound levels are below 80 dBA, e.g., Caterpillar 160M grader cab sound level is 70 dBA with the hydraulic fan at maximum speed (Caterpillar 2012). Commercial air flights do not typically generate sound in the analysis area, but low-flying private aircraft or military jets may be heard a few times a year in the analysis area.

Blasting has occurred regularly at the mine since 1980 and people do not notice blasting vibrations or blasting sound (low rumble, dull "thud") off the mine site. For example, vibrations from only the largest blasts are faintly perceptible to people at the administration building, and are not perceptible to people at the bases of the WRSFs or in the Thompson Creek drainage. The

[13] L_{DN} is the equivalent day-night sound level for a 24 hour period with 10 dBA added to the sound levels during 10 PM to 7 AM. L_{EQ} is the equivalent steady sound level of pressure measured over a period of time.

low rumble of even the largest blasts is rarely noticed by employees on the mine site, and is less audible than the general sound from much of the heavy equipment (e.g., engines, drilling, back-up signals, metal-on-rock scraping, etc.) (Doughty 2012, Natoli 2012). The increase in the SPL 50 feet from SH 75 from mine-related, highway traffic during molybdenum production was estimated at 1.8 dBA (VTN 1980e).

Sound levels at the mine vary from approximately 35 dBA L_{DN} (e.g., the north end of the TSF) to 105 dBA L_{DN} in certain noisy work areas (e.g., the operator position for the gyratory crusher) (VTN 1980e). Sound levels in the ambient portion of the analysis area (more than 1,000 feet or only a few hundred feet where trees are abundant from the mine) are equivalent to pre-mining levels, e.g., approximately 30 dBA L_{DN} in the quietest areas and up to approximately 55 dBA L_{DN} in areas near flowing water.

Table 3.10-4. Typical sound level of selected mining equipment/operations.

Source	Maximum Sound Level (L_{max}) at 50 feet (dBA)
Blasting	94[1]
Bulldozer, Caterpillar D9	85-87
Bulldozer, Caterpillar D11	82[2]
Backhoe	85
Front end loader, Caterpillar 966	77-85
Haul truck, 170 ton	88
Haul truck, 195 ton, Caterpillar 789C	81[2]
Grader, Caterpillar 16H	85 (81)[2]
Pick-up truck	75
Water truck, Caterpillar 777	82[2]
Blast hole (rock) drill	85[1] (82)[2]

VTN (1980e), FHA (2006), Warrior et al. (2006), BHP (2008)
[1] typical contract limit, i.e., unmitigated sound is typically below the limit and no one at the mine is anywhere near within 50 feet of a blast; sound level for anyone near pit during a blast is probably < 80 dBA
[2] L_{EQ} at 50 feet from cyclic operations

3.10.3.4. Sensitive Receptors

The sensitive receptors for noise and air quality in the analysis area are the few people that seasonally use the Redbird property (3.0 miles east of the center of the mine site; 2.2 miles east of the mill); several people that live (year round and seasonally) near the mouth of Thompson Creek; the people that visit or pass through the area for dispersed recreation or wood cutting; and wildlife that live, forage and pass through the area.

3.10.4. Offered Lands - Broken Wing Ranch

3.10.4.1. Climate

The highest average monthly maximum temperatures at the ranch during the period from 1971 to 2000 ranged from 85 °F at the lower elevations to 81 °F at the higher elevations, and occurred during July and August. The average daily maximum temperatures dropped below freezing at the upper elevations in December and January, but rarely dropped below freezing at the lower elevations. The lowest average daily minimum temperature (no distinct variation with elevation) during that period was 7 °F, and occurred in December, January, and February. Monthly average daily minimum temperatures were below freezing for 7 months, from October through April (PRISM 2006a, 2006b).

The average annual precipitation at the ranch ranged from 10 inches at the lower elevations to 14 inches at the higher elevations (PRISM 2006c). From 1961 to 1990 the ranch received an average annual snowfall of 24 inches at the lower elevations and 54 inches at the higher elevations, with most of the snow falling from November to January, and lesser amounts falling from February to April (PRISM 2000).

Winds at the ranch are generally from the west and southwest. The average monthly wind velocities range from less than 2 to 5 mph during April through October, and from 7 to 9 mph during November through March. The average annual wind velocity is 5.1 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 45 mph, with an average annual occurrence of four peak gusts greater than or equal to 50 mph (NCDC 2002). The ranch locality receives approximately 35 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.4.2. Air Quality

The air quality of the analysis area is affected primarily by traffic on SH 75 (carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide), regional vehicle and equipment emissions, and PM from wildfires, prescribed fires, vehicles traveling on unpaved roads, agricultural tilling, aggregate stockpiles at the nearby Idaho Transportation Department (ITD) sand and gravel pit, sparsely vegetated and dry soils in the locality, operations at the Three Rivers Stone quarry, burning wood for space heating, cattle movement, etc. The background concentrations of criteria pollutants in the analysis area are equivalent to those in the analysis area for the MMPO area and selected land (Section 3.10.3.2.). The only pollutant concentration that could approach a NAAQS in the analysis area for the ranch would be the 24 hour $PM_{2.5}$ due to intense wildfire smoke. The most distinct effect to PM_{10} in the analysis area is from agricultural tilling which during high winds may generate elongated light-colored dust clouds up to approximately 1,000 feet in length that disperse within approximately 1 minute (and therefore do not meaningfully affect 24 hour or annual PM concentrations). Perhaps once a month a fugitive dust cloud generated by very high winds at the Three Rivers Stone quarry may reach the southern end of the ranch (0.7 miles north of the quarry) in its final stages of dispersion (Gardner 2012b).

Due to the distance of the mine from the analysis area, criteria pollutants from the mine would not be measurable using standard air quality equipment in the analysis area for the ranch. Therefore, air quality is not discussed further in this DEIS for this analysis area as there would be no meaningful change in the ambient concentrations of criteria pollutants in the analysis area due to any of the land disposal alternatives.

3.10.4.3. Noise

State Highway 75 and wind are the primary sources of ambient sound in the analysis area, with small amounts of ambient sound produced by ranching activities (cattle, tractors, vehicles, etc). The ambient sound levels are approximately 45 to 50 dBA and 35 dBA L_{DN} within 50 feet and 300 feet, respectively, of the highway (VTN 1980e), comparable to typical outdoor sound levels of 35 to 50 dBA L_{DN} for rural areas (EPA 1974). Commercial air flights do not typically generate sound in the analysis area, but low-flying private aircraft, military jets, and helicopters (e.g., IDFG spawning surveys) may be heard a few times a year in the analysis area. Sound from the Three Rivers Stone quarry or the mine is not audible at the Broken Wing Ranch. The sensitive receptors in the analysis area for noise are residents on the ranch (two residences), residents living within 1,000 feet of the ranch (two residences near the north end and approximately five residences near the southeast end of the ranch), and dispersed recreationalists.

3.10.5. Offered Lands - Garden Creek Property

3.10.5.1. Climate

The highest average monthly maximum temperature at the property during the period from 1971 to 2000 was 78 °F in July. The average daily maximum temperatures were below freezing during December and January. The lowest average monthly minimum temperature was 14 °F in January. Average minimum temperatures were below freezing during November through April (PRISM 2006a, 2006b).

The average annual precipitation during the period from 1971 to 2000 was 37 inches, with approximately 4 inches each month from November to May, and approximately 1.5 inches each month from June to September, with 2.6 inches in October (PRISM 2006c). From 1961 to 1990 the property received an average annual snowfall of 132 inches. Most of the snowfall was during November through April with the highest snowfall during December (30.5 inches) (PRISM 2000).

Winds at the property are generally from the south during June through February, and from the west during March through May. The average monthly wind velocities are 2 to 5 mph throughout the year, with an average annual wind velocity of 2 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 47 mph, with an average annual occurrence of six peak gusts greater than or equal to 50 mph (NCDC 2002). The Garden Creek locality receives approximately 85 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.5.2. Air Quality

There are no sources of meaningful amounts of criteria pollutants at or near the property. The nearest Title V major air pollutant sources are the Ashgrove cement facility in Inkom and the JR Simplot Don Plant facility 10 miles to the northeast and north, respectively. These facilities are too far from the property to meaningfully affect air quality at the property. Fugitive dust at the property is negligible because of the lack of public vehicle access and the distinctly vegetated ground surface. Wildfires in the locality may occasionally cause elevated concentrations of $PM_{2.5}$ (e.g., a 24 hour $PM_{2.5}$ of 20 to 70 $\mu g/m^3$) for a few days or weeks at the property. Therefore, criteria pollutants are not discussed further for the analysis area as there would be no meaningful change in the ambient concentrations of these pollutants in the analysis area due to any of the land disposal alternatives.

3.10.5.3. Noise

Ambient sound levels at the property are primarily from wind and wildlife, and are approximately 30 to 40 dBA L_{DN} based on values typical of non-residential rural areas. Vehicle traffic in the vicinity is extremely rare and does not meaningfully contribute to sound at the property. There may occasionally be intermittent air traffic over the property due to the small Pocatello airport approximately 10 miles to the north. Such overflights would have short-term effects up to approximately 60 dBA L_{DN} a few times per day. The sensitive receptors for noise in the analysis area are the few recreationalists who occasionally visit the private property. There are no residences at or within 1,000 feet of the property.

3.10.6. Climate Change

The subject of climate change in recent decades has become a dominant topic in science, politics, and the media. *Climate* refers to the average weather conditions at a given location over time, but also includes more complicated statistics such as the average daytime maximum temperature each month and the frequency of storms or droughts. *Climate change* most generally refers to changes in these statistics over years, decades, and even centuries. However, *climate change* herein refers more specifically to anthropogenic (human-caused) climate change, also known as anthropogenic global warming. Most scientists agree that anthropogenic emissions of GHGs (primarily carbon dioxide) are a substantial cause of the global warming that has occurred since the industrial revolution began (~ 1750). For example, the IPCC (2007) concludes that the probability is greater than 90 percent that most of the increase in global average temperatures since the mid-20th century is due to the increase in anthropogenic concentrations of GHG in the atmosphere. These GHGs result mostly from the burning of fossil fuels for energy, industrial processes, and transportation. JBR (2012j) summarizes the current science of climate change. However, the scope of climate change in this DEIS is limited to the potential effects of the mine on climate change, and the potential effects of climate change on the mine (Section 4.10).

3.10.6.1. Potential Effects of the Mine on Climate Change

The effects of a project on climate change are the project's emissions of GHGs relative to other emissions of GHGs. Therefore, this section provides quantitative background information for current and projected emissions of GHGs from the MMPO alternatives, Idaho, the Northern Rocky Mountain region, the US, and the world. The GHGs for this analysis are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

It is important to note that emissions of GHGs may be reported as *direct* emissions, *total* (direct and indirect) emissions, or *net* (total minus sinks) emissions, and that all values of GHG emissions cited below are anthropogenic emissions. Also, only *direct GHGs* (those that directly cause atmospheric warming) and not *indirect GHGs* (that contribute to the formation or destruction of GHGs) are evaluated in this section.

It is also important to note that *direct* and *indirect* are used differently for emissions of GHGs than for the NEPA. Direct emissions are those from sources owned or controlled by an entity such as fossil fuel burned on site and emissions from entity-owned or entity-leased vehicles. Indirect emissions are those resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the entity; and emissions from sources not owned or directly controlled by the entity but related to the entity's activities such as employee commuting and travel, contracted solid waste disposal, etc. Indirect emissions also include those resulting from land use changes, N_20 from the atmospheric deposition of nitrogen from ammonia (NH_3) and NO_x, etc.

The carbon dioxide-equivalent (CO_2e) quantities herein are for global warming potentials of 100 years ($GWPs_{100}$) using the most current values (IPCC 2007), except as noted "IPCC (1996) $GWPs_{100}$." Regardless, either set of GWPs will yield very similar quantities because, e.g., whereas the GWP_{100} for CH_4 increased from 21 to 25, the GWP_{100} for N_2O decreased from 310 to 298. Note that for consistency with the generally available data, all values for CO_2e are in metric tons (T) or million metric tons (MT), as opposed to short tons[14] used elsewhere in the document.

3.10.6.2. World Emissions of GHGs

The trend in world total net emissions of GHGs is a distinct and steady increase, apart from a slight decrease from 2008 to 2009 due to the worldwide economic recession: an average of 0.5 percent per year[15] during 1990 to 2000, and an average of 2.3 percent per year during 2000 to 2009. Overall the emissions increased 5 percent during 1990 to 2000, and 23 percent during 2000 to 2009. Particularly notable is the increase of 61 percent during 2000 to 2009 from Asia, primarily due to China (Table 3.10-5., Table 3.10-6). World total net emissions are projected to be 57,000 MT to 60,000 MT in 2020 (UNEP 2012, Case 1).

Table 3.10-5. World total net emissions of GHGs by region.
(MT CO_2e except as noted)

Region	1990	2000	2009	2009 (%)
Asia	10,828	12,921	20,772	42.1
Europe	10,835	8,784	8,243	16.7
North America	7,209	8,287	7,867	15.9
Sub-Saharan Africa	3,491	3,176	4,149	8.4
Middle East	1,747	2,471	3,323	6.7

[14] 1 metric ton (T) = 1.102311 short tons
[15] all annual averages herein are calculated as [natural logarithm (last value) - natural logarithm (first value)] / number of intervening years x 100

Region	1990	2000	2009	2009 (%)
South America	2,712	2,674	2,849	5.8
International aviation/shipping	663	837	1,011	2.0
Oceania	589	735	801	1.6
Central America/the Caribbean	182	350	314	0.6
World TOTAL	**38,258**[1]	**40,234**[1]	**49,329**[1]	**100.0**[1]

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
JRC/PBL (2012) using IPCC (1996) $GWPs_{100}$

Table 3.10-6. Countries with the largest total net emissions of GHGs in 2009.
(MT CO_2e except as noted)

Country	1990	2000	2009	2009 Per Capita (T CO_2e)
TOP 12 COUNTRIES BY LARGEST 2009 EMISSIONS				
China	3,870	5,073	10,608	8.0
US[1]	6,115	6,983	6,515	21.2
Indonesia	1,161	1,445	2,620	11.4
India	1,376	1,873	2,584	2.2
Russian Federation	3,582	2,647	2,481	17.5
Brazil	1,605	1,463	1,433	7.4
Japan	1,302	1,412	1,318	10.4
DR Congo	1,377	1,037	1,077	16.3
Germany	1,254	1,048	982	12.0
Canada	604	736	709	21.0
Australia	482	605	667	30.2
México	489	569	644	6.0
TOP 12 COUNTRIES BY LARGEST PER CAPITA 2009 EMISSIONS				
Falkland Islands	1.2	1.2	1.2	468.2
Guyana	16.7	14.46	171.3	218.3
Montserrat	0.1	0.4	0.6	113.8
Central African Rep.	251.6	191.0	459.6	100.4
Iceland	21.8	21.3	22.7	75.8
Qatar	20.8	44.4	93.3	66.7
Guinea	65.2	57.9	566.9	52.4
Brunei Darussalam	18.4	17.1	19.9	49.8

Country	1990	2000	2009	2009 Per Capita (T CO_2e)
United Arab Emirates	72.1	115.0	193.7	42.1
Trinidad and Tobago	15.1	23.2	54.1	41.6
Netherlands Antilles	3.0	6.0	8.2	39.3
Bahrain	17.1	18.3	29.8	37.3
World TOTAL	**38,258**	**40,234**	**49,329**	**7.3**

[1] The difference in the value for the US in this table compared to the (net) value in Table 3.10-6. is an example of the differences that result from different GHG inventory methodologies; only ~ 2 % of the difference is from using different $GWPs_{100}$): 6,633.2 MT using the IPCC (1996) $GWPs_{100}$ versus 6,767.5 MT using the IPCC (2007) $GWPs_{100}$ (EPA 2011).

JRC/PBL (2012) using IPCC (1996) $GWPs_{100}$

3.10.6.3. US Emissions of GHGs

US total emissions of GHGs (excluding sinks) in 2009 were 6,767.5 MT CO_2e, of which 81.3 percent (5,505.2 MT) was CO_2 produced mostly (94.6 %) from fossil fuel combustion. Notable is the dramatic increase (44,000 %) from 0.3 MT CO_2e in 1990 to 132.3 MT CO_2e in 2009 of HFCs due to substitution of O_3-depleting substances (Table 3.10-7., Table 3.10-8.) (EPA 2011). US total emissions of GHGs (excluding sinks) increased an average of 1.4 percent per year during 1990 to 2000, and *decreased* an average of 0.8 percent per year during 2000 to 2009.

3.10.6.4. Regional Emissions of GHGs

The topography and climate of southeastern Idaho are most closely related to the neighboring Northern Rocky Mountains states of Montana, Wyoming and Utah, which have somewhat similar climatic, ecological and population attributes. The total emissions of GHGs, population, and per capita emissions in Idaho are similar to the averages for the region (Table 3.10-9). Note that the emissions include sinks (e.g., large negative values for Montana due to extensive forests), and are consumption-based (i.e., excluding emissions associated with exported electricity). The increase in total emissions of GHGs from Idaho, Montana, Utah, and Wyoming during 1990 to 2009 was 39.4 percent, 88.2 percent, 68.9 percent and 72.4 percent, respectively. During this period the US total emissions of GHGs increased 7.3 percent.

3.10.6.5. Idaho Emissions of GHGs

The largest sources of total emissions of GHGs by consumption sector in Idaho are currently transportation and agriculture. The per capita total emissions of GHGs in 2009 were 24.5 T, compared to per capita emissions of 13.1 T, 22.0 T, 42.3 T and 22.0 T for Montana, Utah, Wyoming, and the US, respectively (Table 3.10-9., Table 3.10-10).

3.10.6.6. Mine Emissions of GHGs

The NEPA analysis of a project's potential effect on climate change is based on annual, *direct* emissions of GHGs with a threshold value of 25,000 T per year (CEQ 2010). The focus on direct emissions is appropriate because indirect emissions (e.g., those from contracted solid waste disposal; vendor supply chains; off-site electricity production,[16] transportation and distribution; etc.) are outside the control of a project proponent. In addition, there is insufficient information to reasonably calculate the quantities of many indirect emissions.

Table 3.10-7. US emissions of GHGs by source (MT CO_2e).

Gas/source	1990 (MT CO_2e)	2000 (MT CO_2e)	2009 (MT CO_2e)
CO_2	**5,099.7**	**5,975.0**	**5,505.2**
Fossil fuel combustion	4,738.4	5,594.8	5,209.0
Non-energy use of fuels	118.6	144.9	123.4
Iron and steel production	99.5	85.9	41.9
Natural gas systems	37.6	29.9	32.2
Cement production	33.3	40.4	29.0
Land use, land-use change, and forestry (sink)	-861.5	-576.6	-1,015.1
CH_4	**803.4**	**785.6**	**817.0**
Natural gas systems	226.0	249.2	263.4
Enteric fermentation	157.3	162.5	166.4
Landfills	175.5	132.9	139.8
Coal mining	100.1	71.9	84.6
N_2O	**303.0**	**327.8**	**284.2**
Agricultural soil management	190.1	198.8	196.7
Mobile combustion	42.2	51.1	23.0
Manure management	13.9	16.4	17.2
Nitric acid production	17.0	18.7	14.0
Stationary combustion	12.3	14.0	12.3
HFCs	**46.6**	**116.9**	**139.5**
Substitution of O_3-depleting substances	0.3	80.4	132.3

[16] Regardless, most of the electricity (~ 90 %) used by the mine is hydroelectricity purchased from the Bonneville Power Administration (Leuzinger 2013), and no emission factors are currently used in emission inventories for hydroelectricity (IPCC 2013). More specifically, there are no direct emissions of GHGs from hydroelectricity, and the only indirect emissions of GHGs are from the construction of the facilities and biomass decomposition from reservoir flooding. Research is on-going to try to determine acceptable emission factors for these indirect emissions, which currently range from 0.5 kilogram (kg) CO_2e/megawatt-hour (MWh) to 152 kg CO_2e/MWh, still very small compared to the emissions (direct and indirect) of coal-fired power plants (~ 1,000 kg CO_2e/MWh) (Steinhurst et al. 2012). The remainder of the electricity used by the mine is nuclear energy (Leuzinger 2013), which also has no direct emissions of GHGs, and similarly unknown but relatively small indirect emissions of GHGs, e.g., 1.4 kg CO_2e/MWh to 288 kg CO_2e/MWh, with an average value of 66 kg CO_2e/MWh (Sovacool 2008).

Gas/source	1990 (MT CO_2e)	2000 (MT CO_2e)	2009 (MT CO_2e)
HCFC-22 production	46.1	36.2	6.8
PFCs	**24.4**	**16.2**	**7.5**
Semiconductor manufacture	2.9	6.3	5.6
Aluminum production	21.6	9.9	1.9
SF_6	**32.8**	**19.2**	**14.2**
Electrical trans. and distribution	27.1	15.3	12.2
Magnesium prod. and processing	5.2	2.9	1.0
TOTAL	**6,309.9**	**7,240.7**	**6,767.5**
NET (Sources and Sinks)	**5,448.4**	**6,664.1**	**5,752.4**

Only the largest sources in 2009 are shown for each GHG (EPA 2011, from Annex 6 using IPCC 2007 $GWPs_{100}$), i.e., the subtotals under the bold values do not total.

Table 3.10-8. US net emissions of GHGs in 2009.

Gas	MT CO_2e	(%)
CO_2	5,505.2	81.35
CH_4	817.0	12.07
N_2O	284.2	4.20
HFCs	139.5	2.06
SF_6	14.2	0.21
PFCs	7.5	0.11
TOTAL	**6767.5**[1]	**100.00**

[1] The total is correct but the sum of the values does not total exactly due to independent rounding.
EPA (2011)

Table 3.10-9. Regional net emissions of GHGs (MT CO_2e except as noted).

Total Emissions of GHGs					
State	**1990**	**2000**	**2009**	**% (of region)**	**2020**
Idaho	27.2	35.6	37.9	28.1	42.9
Montana	6.8	10.7	12.8	9.5	16.3
Utah	36.3	52.9	61.3	45.4	83.1
Wyoming	8.0	15.4	23.0	17.0	32.9
Region	78.3	114.6	135.0	100.0	175.2

2009 Population				
Idaho	**Montana**	**Utah**	**Wyoming**	**Region**
1,545,801	974,989	2,784,572	544,270	5,849,632
2009 Per Capita Emissions (T CO_2e)				
24.5	13.1	22.0	42.3	30.0

Baile et al. (2007a, 2007b), Roe et al. (2007), Strait et al. (2008), US Census Bureau (2012b), IPCC (1996) $GWPs_{100}$

Table 3.10-10. Net emissions of GHGs for Idaho (MT CO_2e except as noted).

Sector	1990	2000	2009[1]	2009 (%)	2020
Transportation	7.2	10.0	10.8	27.7	12.2
Agriculture	6.8	9.0	9.7	24.9	10.0
Residential/commercial	5.1	6.8	6.6	16.9	7.7
Electricity	3.9	4.9	5.3	13.4	7.3
Forestry/land use	3.6	3.6	3.6	9.2	3.6
Waste management	1.0	1.2	1.5	3.7	1.8
Industrial processes	0.4	0.8	1.2	3.2	1.9
Fossil fuel industry	0.3	0.4	0.4	1.2	0.6
Source emissions	**28.4**[2]	**36.8**[2]	**39.12**[2]	**100.0**[2]	**44.98**[2]
Agricultural soils	-1.2	-1.2	-1.2		-1.2
TOTAL	**27.2**[2]	**35.6**[2]	**37.92**[2]		**43.78**[2]

[1] The 2009 data is interpolated between the 2005 and 2010 data.
[2] The totals are correct but the sum of the values does not total exactly in all cases due to independent rounding.
Strait et al. (2008), IPCC (1996) $GWPs_{100}$

However, to be conservative, the emissions of mine-related GHGs presented below include the indirect emissions from commuter traffic over which TCMC has slight control (e.g., shuttle buses); the indirect emissions from the removal of forest (via decreased carbon sequestration) at the mine would be negligible.[17] Essentially all of the emissions of GHGs attributed to the mine are indirect (NEPA) emissions from mining activity (mostly the onsite vehicle fleet) on non-Federal lands. The only direct (NEPA) emissions would be a very small fraction (< 1 %) of the emissions from the vehicle fleet attributable to hauling and placing waste rock on Federal lands.

The emissions of GHGs were determined for four mining scenarios: 1) molybdenum mining (~ 400 employees) during which the emissions of past, present and future molybdenum mining were considered to be the same, 2) core reclamation after molybdenum production has ceased (~ 230 employees) during 3 years following the end of molybdenum mining, 3) late-stage reclamation (~ 20 employees) for 5 years following core reclamation, and 4) subsequent long-term reclamation (~ 5 employees) for the foreseeable future. Note that the values for the mine are in T and not MT (Table 3.10-11., Table 3.10-12., Table 3.10-13., Table 3.10-14).

Table 3.10-11. Annual emissions of GHGs for mine, molybdenum mining (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	4,302.9	0.0	0.2	0.0	4,303.1
Onsite TCMC vehicle fleet	33,158.6	280.9	422.3	152.1	34,013.9
Ore shipments to PA refinery	3,455.7	71.3	5.8	186.4	3,719.2
TCMC commuters	6,802.1	17.7	1.6	40.4	6,861.8
Shipments to/from mine	544.2	1.4	0.1	3.2	548.9
TOTAL[1]	**48,263.4**	**371.3**	**430.1**	**382.1**	**49,446.9**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012), IPCC (2007) $GWPs_{100}$

[17] carbon sequestration for average US forest = 0.33 T carbon/acre/year (EPA 2011b); 364.1 acres of forest removed; 364.1 acres x 0.33 T carbon/acre/year x 3.664 T CO_2e/1 T carbon = 440 T CO_2e/year

Table 3.10-12. Annual net emissions of GHGs for mine, core reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	2,474.4	0.0	0.1	0.0	2,474.3
Onsite TCMC vehicle fleet	19,066.2	161.5	242.8	87.4	19,558.0
Ore shipments to PA refinery	1,987.0	41.0	3.3	107.2	2,138.5
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	312.9	0.8	0.1	1.9	315.6
TOTAL[1]	**23,840.2**	**203.4**	**246.4**	**196.5**	**24,486.5**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012), IPCC (2007) $GWPs_{100}$

Table 3.10-13. Annual net emissions of GHGs for mine, late-stage reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	0.0	0.0	0.0	0.0	0.0
Onsite TCMC vehicle fleet	1,657.9	14.0	21.1	7.6	1,700.7
Ore shipments to PA refinery	172.8	3.6	0.3	9.3	186.0
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	27.2	0.1	0.0	0.2	27.4
TOTAL[1]	**1,857.9**	**17.7**	**21.4**	**17.1**	**1,914.1**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012), IPCC (2007) $GWPs_{100}$

Table 3.10-14. Annual net emissions of GHGs for mine, long-term reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	0.0	0.0	0.0	0.0	0.0
Onsite TCMC vehicle fleet	414.5	3.5	5.3	1.9	425.2
Ore shipments to PA refinery	43.2	0.9	0.1	2.3	46.5
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	6.8	0.0	0.0	0.0	6.9
TOTAL[1]	**464.5**	**4.4**	**5.4**	**4.3**	**478.5**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.

TCMC (2012), IPCC (2007) $GWPs_{100}$

3.10.6.7. Offered Lands

There are no meaningful emissions of GHGs related to the offered lands. The largest direct emissions are probably from vehicles driving to and from the lands, or perhaps livestock on the Broken Wing Ranch. However, although livestock produce substantial emissions of GHGs on a global basis, the 300 AUMs at the ranch would produce de minimis (< 25,000 T/year direct) GHG emissions. For example, the entire 51,000 AUMs authorized by the BLM Challis Field Office (BLM 1999) produce annually some 700 to 17,600 T of direct emissions of GHGs (Gardner 2011a). Therefore, emissions of GHGs related to the offered lands are not further analyzed.

3.11. Visual (Aesthetic) Resources

The analysis area for visual (aesthetic) resources for the MMPO alternatives are the landscape views centered on the mine that are visible from the KOPs (Table 3.11-1., Figure 3.11-1). The analysis area for the land disposal alternatives is the selected and offered lands.

Most of the selected land and the portion of the mine on BLM land are in an area designated under the VRM program as Class III. The selected land and the portion of the mine on BLM land nearest Thompson Creek are in an area designated as Class II (Figure 3.11-1). The objective of Class III, Partial Retention, is to design proposed alterations to partially retain the existing character of the landscape. Contrasts to the basic elements (form, line, color and texture) caused by a management activity may be evident and begin to attract attention in the characteristic landscape. The objective of Class II, Retention, is to design proposed alterations to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer (BLM 1999).

Note that these objectives are not legal standards. Rather, the BLM will require visual mitigation, if technologically and economically feasible, when visual mitigation would cause a project to meet the designated VRM class from a KOP that would otherwise not be met. Portions of the mine are also in Forest Service management areas (MAs) 6 and 9. The management prescriptions for these areas provide no specific guidance for management of visual resources. The general VQO for this portion of the NFS land is Modification "…management activities may visually dominate the original characteristic landscape" (Figure 3.11-1.) (USFS 1974).

No KOPs were identified for the offered lands because the proposed BLM administration of these lands would not materially change the landscapes of the Broken Wing Ranch or Garden Creek property, or, in the case of the ranch, the potential material changes (e.g., an Idaho Department of Parks and Recreation campground) would be too speculative to analyze in this DEIS. Regardless, the visual characteristics of the offered lands are briefly described in this section. All of the KOP photos of the MMPO area and selected land in the following sections are from September 2009.

Table 3.11-1. Key observation points.

KOP	Description
1	Custer Lookout
2	No Name Drainage
3	South Butte
4	SH 75
5	Railroad Ridge
6	Pat Hughes WRSF

3.11.1. MMPO Area and Selected Land

3.11.1.1. KOP 1 – Custer Lookout

The Custer Fire Lookout KOP is on Custer Peak (9,753 feet elevation) in the SCNF 3.25 miles northwest of the MMPO area and selected land. The lookout is no longer utilized by the Forest Service and receives no regular maintenance. However, the lookout is a distinctive landmark and point of interest along a popular trail with expansive views in all directions. The KOP is on the trail below the lookout, with the mine visible to the southeast in the background of the panoramic landscape (Photo 3.11-1). The western edge of the selected land is also visible in the center of the photo.

Photo 3.11-1. KOP 1 – View southeast from trail below Custer Lookout.

The KOP is at a higher elevation than the surrounding topography allowing a clear view of the landscape elements of the MMPO area. The viewshed is characterized by distinctly mountainous terrain. The dissected landscape comprises massive, angular mountains and ridges that contrast distinctly against adjacent deep, shadowed valleys and ravines. Irregular, horizontal ridgelines become less distinct as they overlap one another and recede into the background. Mountainsides are covered with a medium-textured, gray-green understory of shrubby sage and vertical grasses, punctuated with varying degrees of spiky dark green conifers. The uneven pattern of vegetative cover accentuates and reveals the underlying landforms, especially drainages.

The mine appears as a thin tan or white line with dust emanating from it in the center of the middle ground. The mine provides a noticeable color and texture contrast between a patch of smooth-textured, light tan against the medium-textured, darker gray green matrix described above. The mine also has created a flat surface that somewhat contrasts with the more rugged form of surrounding mountains and ridges. However, the dominant line at the mine site is the natural angle of the top of Buckskin-Basin Creek divide (middle ground, photo left). The mine is the only human-made feature visible in the landscape, and somewhat draws the attention of the casual observer.

3.11.1.2. KOP 2 – No Name Drainage

The No Name Drainage KOP is on Thompson Creek Road, 1 mile due south of the pit. The road is in the deep valley along the Thompson Creek drainage. Thompson Creek (centerline) is the division between BLM and NFS lands. The view from KOP 2 is north toward the open pit (not visible behind the farthest ridge) and of an upslope, moderately closed landscape (Photo 3.11-2). The landscape comprises steep mountainsides of pyramidal and trapezoidal form, with the slopes forming diagonal lines in the middle ground and the slopes forming rough-ridged diagonal lines and a short horizontal line in the center of the view in the background. The mountainsides are covered with a medium-textured, gray-green understory of shrubby sage and vertical grasses, punctuated with varying degrees of spiky dark green conifers. Rock outcrops near the horizon in the background are rough and angular, gray-brown in color with deep shadows. No human-made features are visible from KOP 2.

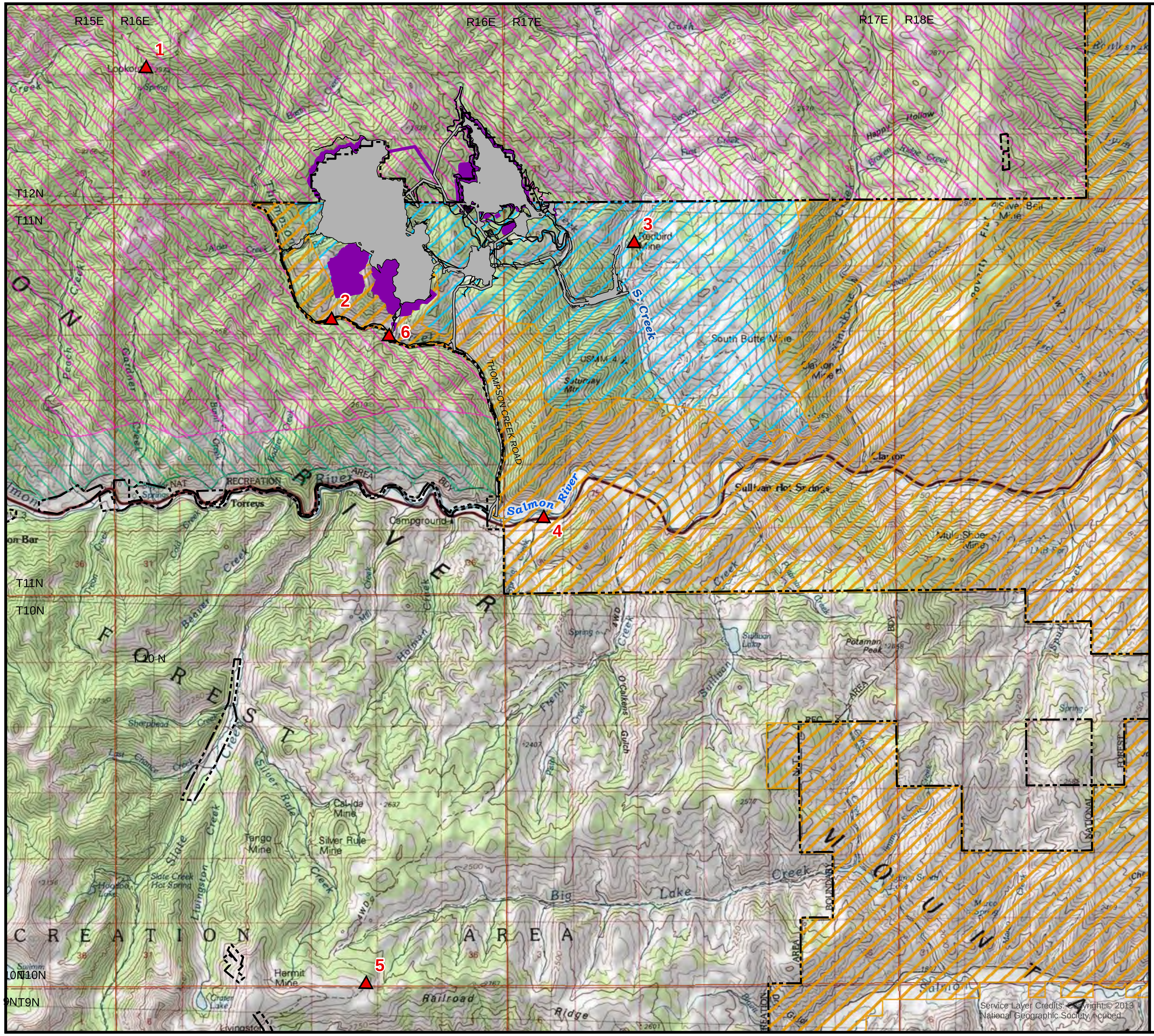
Photo 3.11-2. KOP 2 – View north.

3.11.1.3. KOP 3 – South Butte

Due to topography, the mine is not visible from S. Creek Road. Therefore, the South Butte KOP is on BLM land 2.5 miles southeast of the TSF along a two-track access road upslope of S. Creek Road. The KOP provides a panoramic view of the landscape, with a focus on the TSF embankment in the middle ground (Photo 3.11-3). Rugged mountains in the middle ground and distance have pyramidal and trapezoidal form with several diagonal lines as the landforms overlap. The open vegetated meadow in the foreground and mountains contrasting with the sky at the horizon in the background create generally undulating horizontal lines. Vegetation in the foreground is coarse-textured, gray-green to tan, short, shrubby to grassy transitioning to medium-textured in the middle ground. Vegetation in the middle ground and distance is patchy shrubs and grasses, and very dark green conifer forest. The TSF embankment is a light gray, inverted pyramid with a distinct horizontal line on top that draws the viewer's attention.

Photo 3.11-3. KOP 3 – View west.

The TSF embankment has a northeast to southwest axis. The light tan to pale gray color of the embankment contrasts distinctly with the brown to dark green, almost black, vegetated mountain slopes. The top of the embankment creates a smooth, flat, horizontal line in the middle of the diagonal lines of multiple soft, rolling mountain slopes. The embankment is obvious to the casual observer, but does not dominate the landscape. Aside from the embankment, no human-made features are visible from KOP 3.



Legend

- Existing mining disturbance
- MMPO areas/Alternatives M2 and M3
- Forest Service Boundary

KOP Locations

- 1 - Custer Lookout
- 2 - No Name Drainage
- 3 - South Butte
- 4 - Highway 75
- 5 - Railroad Ridge
- 6 - Pat Hughes Waste Rock Storage Facility

Visual Resource Management Classes

- II
- III

Visual Quality Objectives

- M
- R

N

1:100,000

1 0 1

Miles

1 0 3

Kilometers

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Visual Resource Management Area (VRM) from Bureau of Land Management, Idaho State Office. Visual Quality Objections (VQO) from USFS Corporate Data
Topographic background from USGS 100,00-scale metric topographic map and NAIP 2009 imagery.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.11-1
Visual resource information, MMPO area and selected land
Thompson Creek Mine EIS

3.11.1.4. KOP 4 – SH 75

The KOP is 5.3 miles south-southwest of the TSF embankment adjacent to SH 75 in front of the Old Sawmill Station (store, deli, RV and trailer park, gas station). The area is 4.1 miles west of Clayton near the mouth of S. Creek. In addition to the Old Sawmill Station, the area has a variety of residences. The highway in front of KOP 4 is at the base of the valley containing the Salmon River, and the highway is the main travel route southwest of Challis to Stanley, Sun Valley, Ketchum, Shoshone, etc.

The view from KOP 4 is northwest toward the MMPO area and selected land (neither visible) of a closed landscape of rolling hills with distinct diagonal lines along the slopes (Photo 3.11-4). An undulating horizontal line is formed where the hills meet the sky. The valley bottom along the highway is flat. The foreground appears blotchy, containing fine to medium textured bright green and tan grasses.

The middle ground has medium textured vegetation with gray-green and tan shrubs and grasses. Vegetation toward the background is patchy with dark green stands of conifer. The highway, fence and power line provide distinct horizontal to slightly diagonal lines in the foreground that are slightly broken by individual and small groups of trees. Low buildings lining the road echo the horizontal elements and offer slight diagonal elements in gray and white.

Photo 3.11-4. KOP 4 – View north.
View from Sinclair gas station at Old Sawmill Station adjacent to SH 75 at milepost 218.6.

3.11.1.5. KOP 5 – Railroad Ridge

The Railroad Ridge KOP is on NFS land 11 miles south of the mine in the Sawtooth National Recreation Area (SNRA). The open, panoramic landscape of the KOP provides distant views of numerous mountains and ridges, with those in the middle ground forming subtle diagonal lines, and those in the background forming an irregular horizontal line where they contrast with the sky (Photo 3.11-5). Medium-textured, short, vertical tan grasses in the foreground transition to broken views of patchy, fine-textured stands of conifer in the middle ground. The expanses of grasses in the foreground are dotted with scattered, large white rocks. In the background, fine- to medium-textured vegetation is patchy gray-green to dark green. The only human-made features visible from KOP 5 are a portion of the pit, the Upper Buckskin WRSF, and a portion of the top of the TSF.

Photo 3.11-5. KOP 5 – View north.

The pit and Upper Buckskin WRSF appear as mottled light tan and brown (middle ground, photo center) and the embankment appears more smooth light brown (middle ground to background, left of photo center). These colors contrast with the surrounding dark green to blue colors of the conifer vegetation, making the mine clearly visible, and a portion of the embankment somewhat visible. The upper edges of the pit and Upper Buckskin WRSF also appear as a light gray, horizontal band. The TSF embankment appears as a thin, light gray, horizontal band. The patchy vegetation and landforms in the landscape somewhat reduce the overall contrast, particularly for the embankment. Because the landscape is a complex combination of multiple lines, colors, patterns and textures, and because of the distance between KOP 5 and the mine, the mine features do not dominate the landscape.

3.11.1.6. KOP 6 – Pat Hughes Waste Rock Storage Facility

The Pat Hughes WRSF KOP is on BLM land at the entrance to a gated area adjacent to the north side of Thompson Creek Road, 0.30 mile south-southeast of the Pat Hughes WRSF. The view from KOP 6 is focused on the WRSF, at the convergence point of diagonal slope lines in an enclosed landscape. The light yellow white to tan and gray colors of the waste rock, contrast moderately with the surrounding darker land and vegetation. The smooth, flat, horizontal line at the top of the facility adds a horizontal element that repeats the horizontal line where the flat topography of the foreground meets the gentle slopes of the middle ground. The texture of the facility is smooth to slightly stippled and contrasts distinctly with the surrounding vegetation. The combination of these visual characteristics causes the WRSF to dominate the view from KOP 6.

Photo 3.11-6. KOP 6 – View north-northeast.

3.11.2. Mine Lighting and Dark Night Skies

Only 38 percent of the US is below the threshold for light pollution, i.e., artificial sky brightness is less than 11 percent of natural night sky brightness above 45 degrees of elevation. However, most of Custer County is below this threshold except for Challis, Mackay and Stanley (up to 100 % artificial night sky brightness), and the mine (up to 300 % artificial night sky brightness) (Figure 3.11-2). Some areas in the US have more than 2,700 percent artificial night sky brightness (Cinzano et al. 2001). The mine typically operates 24 hours per day. Lighting is required at night for safe operations (30 CFR 56.17001). This lighting produces a distant glow above the mine visible at night from areas from which the mine would not otherwise be visible. In addition, the centerline of the TSF embankment is lit with 26,400 watt sodium vapor lights (Doughty 2012). These sodium vapor lights contribute substantially to the nighttime glow of the mine. The lights on the TSF embankment are also individually visible at night as a line of yellowish dots from the KOPs from which the embankment is visible. The attention of the casual observer is distinctly drawn to the glow/lights from KOP 1, KOP 3, and KOP 6. The attention of the casual observer is slightly drawn to the glow/lights from KOP 5.

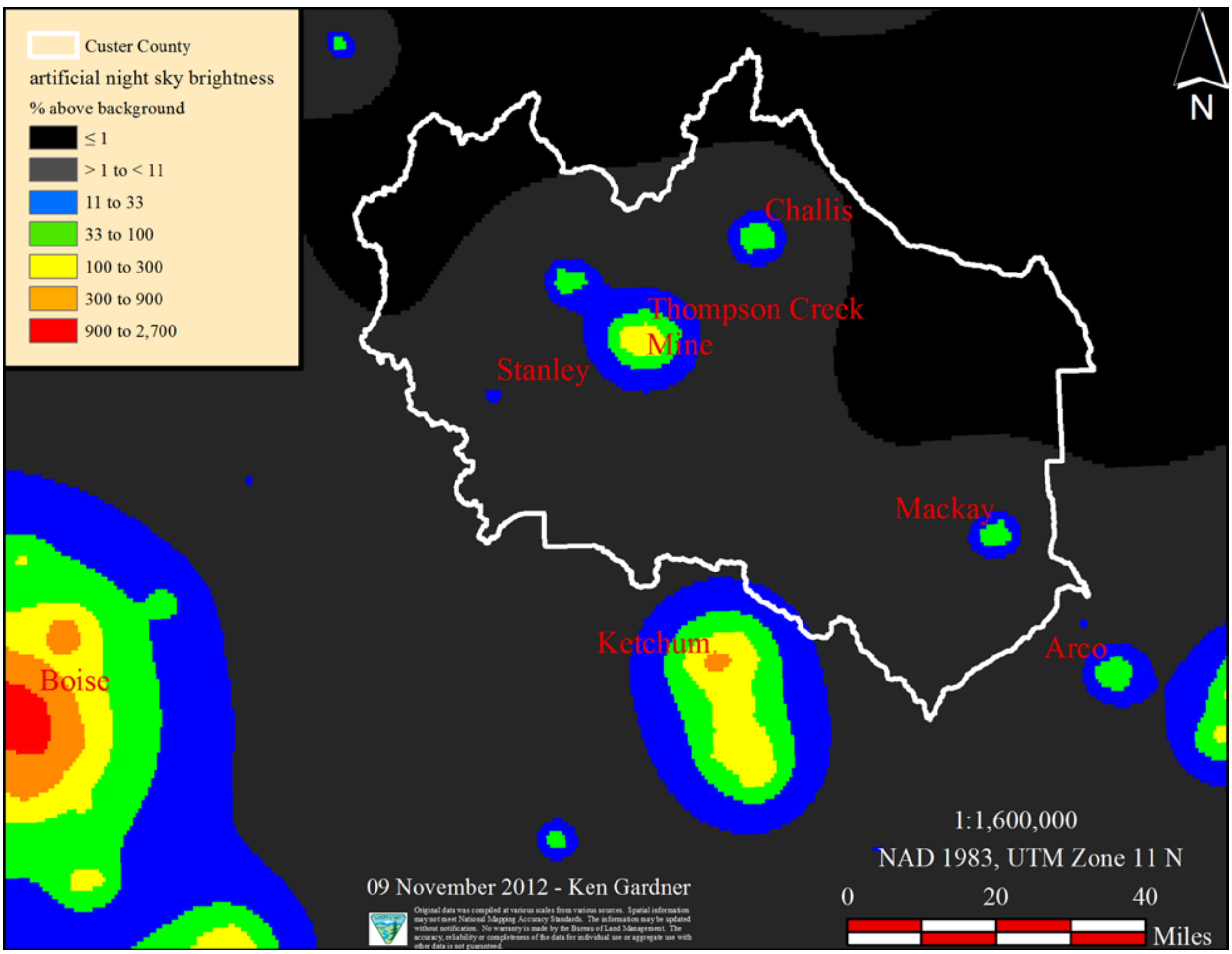


Figure 3.11-2. Percent artificial night sky brightness.

gray areas are unpolluted, but show how far light propagates from sources; bright area northwest of the mine is the former Grouse Creek mine (brightness data is from 1996-1997) (Cinzano et al. 2001)

3.11.3. Offered Lands - Broken Wing Ranch

The ranch is in an enclosed landscape in a flat valley bottom along the Salmon River (Photo 3.11-7). The valley bottom is bounded on either side by steep, undulating slopes capped with weathering rock (talus). The valley bottom is broken by the meandering course of the Salmon River, with rugged mountains forming the background. The ranch provides a pastoral setting, which includes grazing cattle, cultivated fields, irrigation systems, a few farm structures, and a combination of wood rail and barbed wire fencing. Some of the structures appear more than 50 years old, indicating farming has occurred on the ranch for many decades. The three residential complexes provide a variety of point light sources visible at night.

Photo 3.11-7. Broken Wing Ranch, view to south from adjacent to SH 75 (June 2009).

3.11.4. Offered Lands - Garden Creek Property

The property is in an area of gently sloping mountains. The property is heavily forested with mature conifers and aspen, and contains small, enclosed meadows of grasses and low shrubs. The meadows offer views of the surrounding mountain peaks with little indication of human development (the only evidence of human development on the property are fences and a few cut tree stumps).

3.12. Land Use and Recreation

The analysis area for land use and recreation for the MMPO is the MMPO area. The analysis area for the land disposal alternatives is the selected land; the Salmon River corridor enclosing the Broken Wing Ranch; the Garden Creek property; and the BLM and NFS lands adjacent to and in the vicinity (e.g., within a few miles) of the property. The analysis areas also include the recreational access routes to the MMPO area, selected land, Broken Wing Ranch, and Garden Creek property. This section also identifies the special management areas (SMAs) in the region of each analysis area, and briefly discusses the SMAs that include any portion of an analysis area.

In general, there are many types of SMAs on NFS and BLM lands including wilderness areas, wilderness study areas (WSAs), lands with wilderness characteristics, national parks, national monuments, national wildlife refuges, national conservation areas, NRAs, wild and scenic river corridors, areas of critical environmental concern (ACECs), extensive recreation management areas (ERMAs), special recreation management areas (SRMAs), IRAs, herd management areas (HMAs), etc.

3.12.1. MMPO Area and Selected Land

3.12.1.1. Land Use

The BLM Challis Field Office area contains 792,567 acres of BLM land administered under the Challis RMP. The majority (90.2 %) of the land is in Custer County, and the remainder is in Lemhi County (BLM 1998). The NFS land associated with the MMPO area is administered by the SCNF Challis–Yankee Fork Ranger District under the Challis National Forest LRMP[18] (USFS 1987). The SCNF contains 4,235,940 acres of NFS land, of which 1,772,469 acres are in the Salmon National Forest and 2,463,471 acres are in the Challis National Forest. Most of the Challis National Forest (1,873,004 acres, 76 %) is in Custer County (USFS 2012c). Under Alternative M2 there would be additional disturbance on 446.7 acres on private, BLM, and NFS land (Figure 1.2-1., Table 3.12-1). The selected land is 5,142 acres of BLM land, which surrounds and includes all of the BLM land in the MMPO area. The selected land is surrounded by NFS, BLM, and private land (Figure 1.2-1).

Table 3.12-1. MMPO area (Alternative M2) jurisdiction.

Land Status	Private (TCMC) (acres)	BLM Land (acres)	NFS Land (acres)
Permitted[1]	18.1	6.5	2.3
Unpermitted	76.9	191.8	151.9
TOTAL	**95.0**	**198.3**	**154.2**

[1] permitted for mine development in 1980 (USFS 1980)

The analysis area, apart from the mine, consists of undeveloped, rocky or forested land. The area has historically been used for mining; limited commercial timber harvest; very limited livestock grazing (Section 3.5.1.); very limited wood cutting (firewood and post/poles); and dispersed recreation. Mining disturbs 451 acres of the selected land including a widely distributed network of sedimentation ponds, access roads, and utility corridors.

[18] The Salmon and Challis national forests were administratively combined in 1995, but are managed under separate land use plans.

The MMPO area and selected land are within a block of approximately 17,000 acres of patented and unpatented mining claims owned or controlled by TCMC. The core of the MMPO area consists of 2,686 acres of patented mining claims (TCMC private property), all of which have mine disturbance. The other mining claims are unpatented, i.e., the land remains under Federal title but a private entity (TCMC) has asserted a right of possession of locatable (e.g., molybdenum) minerals under the General Mining Laws of the US. These laws also allowed TCMC to receive title to its patented mining claims, but only for the area for which mining was imminent (most but not all of the approved Phase 7 operations). Congress has subsequently prohibited the BLM from accepting patent applications under the General Mining Laws of the US. Consequently, mining companies now sometimes propose land exchanges with Federal land management agencies to acquire fee simple ownership of mine sites instead of acquiring such ownership under the General Mining Laws of the US. Mining companies always desire fee simple ownerships of their mine areas to better control access, minimize political risk, obtain bank loans, etc.

The Federal easements, leases, or permits associated with the selected land are the current MPO (IDI-33145) and a variety of ROW grants. All of the current mining, including related power lines, roads, fiber optic lines, pipelines, etc. are authorized by the MPO under the General Mining Laws of the US. However, TCMC has also obtained ROWs under the FLPMA for some of this infrastructure, particularly the infrastructure that is more peripheral to the core mine operations such as the power lines and/or pipelines along Thompson Creek Road, Cherry Creek Road, Pat Hughes Creek Road, and Buckskin Creek Road (IDI-20155). In addition, TCMC has exclusive (non-public) ROWs for the Bruno Creek, Cherry Creek, Pat Hughes, and Buckskin roads (IDI-27080).

Other ROWs in the analysis area include a road ROW reserved to the BLM for the Bruno Creek Road (IDI-017135), Thompson Creek Road (IDI-017139), and Buckskin Road (IDI-017138); a telephone cable ROW and fiber optic cable ROW granted to Custer Telephone Cooperative along S. Creek Road and Bruno Creek Road (IDI-16925); a fiber optic cable ROW granted to Custer Telephone Cooperative along S. Creek Road (IDI-35891); a road ROW for S. Creek Road granted to the Forest Service (IDI-012511); a road ROW from S. Creek Road to a water facility (headgate and fish screen) ROW on S. Creek granted to the IDFG (IDI-35531) for an irrigation ditch owned by TCMC; and a road ROW for S. Creek Road granted to Custer County (IDI-20147).

The ROWs, or their portions on the selected land, would be relinquished by TCMC at title transfer if TCMC were to acquire the selected land. In such case, the other holders of ROWs would be given the opportunity to amend their ROWs to perpetual terms or convert their ROWs to easements prior to title transfer, such that the ROWs and/or easements would be recognized as valid existing rights in title that TCMC might acquire. The power lines along S. Creek Road and Bruno Creek Road are authorized only by the current MPO. However, the BLM would amend an existing ROW to Salmon River Electric Cooperative to include these power lines if the power lines would no longer be authorized by a MPO, but would still be necessary for the locality. All of the mining claims on the selected land (~ 500) would be relinquished at the time of title transfer.

The BLM land in the analysis area is in the Challis ERMA (~ 750,000 acres of BLM land not in a more specific SRMA). The primary recreation in this region of the ERMA is hiking, fishing, hunting, camping, antler shed collection, nature photography, horseback riding, and recreational driving (depending on access). People also cut wood for firewood and posts/poles in the ERMA. These activities are widely dispersed and are difficult to manage. There are three off-highway vehicle (OHV) plans that designate portions of the ERMA as open, limited or closed to OHV use (BLM 2009b). The ERMA is managed according the general guidance in the Challis RMP (1999).

The BLM, NFS, and State lands in the analysis area are also in the Challis Experimental Stewardship Program Area. The area was designated pursuant to the Public Rangelands Improvement Act of 1978 (43 USC 1901 *et seq*.) with the overall goal of fostering greater cooperation among the managing agencies and the Federal land users. More specific goals include providing incentives to the holders of grazing permits or leases whose stewardship results in an improvement of the range condition of lands under permit or lease, and cooperative range management projects designed to foster a greater degree of cooperation and coordination between the Federal and State agencies charged with the management of the rangelands and with local private range users (43 USC 1908).

The S. Creek IRA (06-005; 99,620 acres) is on NFS land generally north, west and south of the analysis area. North of the analysis area, the perimeter of the IRA is along the top of the Buckskin-Basin Creek ridgeline, as close as 200 feet to the MMPO area (Alternative M2). The northernmost support facilities for the TSF extend 750 feet into the IRA, which in this area also contains a network of historic mining roads (some of which are used to access the Cinnabar mining claims north of the TSF). Elsewhere, the perimeter of the IRA is typically at least 0.2 mile from the analysis area (centerline of Thompson Creek), but is adjacent to the selected land along 0.4 mile of Thompson Creek upstream of the mouth of the Pat Hughes drainage. None of the selected land is in the S. Creek IRA. Approximately 60 percent of the Challis National Forest is designated IRA, and the IRA designation does not place any restrictions on locatable mining operations.

The nearest other SMAs are the Spring Basin IRA (06-006) (700 feet northeast of the northeast corner of the selected land on the east side of S. Creek Road); Challis SRMA (1 mile south of the selected land); the Sawtooth NRA (2 miles south of the selected land); Railroad Ridge IRA (06-922) (3 miles south of the selected land); Birch Creek ACEC (10 miles northeast of the selected land); Germer Basin/Malm Gulch ACECs (11 miles northeast of the selected land); Jerry Peak, Jerry Peak West and Corral-Horse Basin WSAs (12 miles southeast of the selected land); and Frank Church River of No Return Wilderness Area (12 miles northwest of the mine) (BLM 2012b, USFS 2012d).

3.12.1.2. Recreation

The mine site – including the gated Bruno Creek, Pat Hughes, and Buckskin roads – is not open to the public. The rest of the analysis area is only accessible to the public by hiking through extremely rugged terrain (no authorized, motorized public access), apart from portions of upper Thompson Creek Road (along the southwest portion of the selected land), a short section of the lower No Name Creek Road, and S. Creek Road (the east sideline of S. Creek Road forms the east side of the selected land). These roads are authorized for travel all year, but the No Name Creek Road is not maintained, the upper Thompson Creek Road (north of a TCMC gate on the road near the mouth of Thompson Creek) is not maintained in the winter, and the S. Creek Road is not maintained in the winter north of the Bruno Creek access road. There is no public access across the Thompson Creek Bridge. Therefore, upper Thompson Creek Road is accessible to the public only by "North Slate Creek Road" (Forest Service Road #40040, authorized for travel all year but not maintained in the winter), which begins at the Slate Creek Bridge on SH 75. A section of the North Slate Creek Road passes through TCMC property near the mouth of Thompson Creek, but the Forest Service has an easement from TCMC for non-exclusive (administrative and public) access on this section of the road. More detailed information on transportation and access is in Section 3.16.1.

The Thompson Creek Road ends approximately 3 miles north of the selected land at the start of Trail 161 (one trail to the Custer Fire Lookout). From Trail 161, one may also reach the end of Trail 162 leading up from Cinnabar Creek. The uppermost portion of the road is fairly primitive and recreational use is very low for most of the year.

One reason for the very low recreational use is the nearby and more accessible and developed localities of the Yankee Fork Road to the west and S. Creek Road to the east. These roads provide access to numerous trails and the Yankee Fork Road provides access to several campgrounds (Camper 2010). However, even S. Creek Road receives very light vehicle roundtrips (non-TCMC) during fall, and even less vehicle roundtrips during the rest of the year. The lower S. Creek Road is part of the Tour of Idaho, a 1600 mile dirt bike ride that begins in the Malad Range of southern Idaho and ends in the Selkirk Mountains near the Canadian border. The Tour of Idaho is very likely one of the most difficult long dirt bike rides in the US (Tour of Idaho 2013). Lower S. Creek Road receives of the order of 100 one-way trips by riders on the Tour of Idaho each summer.

No Name Creek Road (faint two-track part way up the No Name drainage) is very rarely used. The non-TCMC traffic on these roads is recreation-focused, and when it occurs it is generally on weekends. Recreation thus occurs mostly in the fall, with lesser amounts in the spring and summer, and the least recreation occurring in the winter. There are no BLM trails, campgrounds or other developed recreation sites in the analysis area. The closest BLM campground is the East Fork campground on the Salmon River approximately 7 miles east of the analysis area on SH 75. The major reasons for the very low recreational use of the analysis area are the lack of high quality recreation values, particularly since most of the area is near extensive mining operations, and the extremely rugged terrain without trails or public roads.

The recreation in the analysis area (selected land only, outside of sites developed with mining facilities) is typically hunting, camping, antler shed collection, recreational driving (highway vehicles and OHVs), hiking, and general enjoyment of the outdoors. There is very rare horseback riding, fishing, skiing, mountain biking, rockhounding, wildlife/wild flower viewing, nature photography, berry picking, backpacking, scenic viewing, etc. (Camper 2010). Most of the SCNF is open to personal use wood cutting (firewood and posts/poles) by permit. However, people rarely cut wood in the area due to the lack of dead trees at least 300 feet from water (permit condition) that are also near roads; the distance of the area from population centers; and the rough roads leading to the area. Hunting typically occurs in only three small areas in the southwest, southeast, and northeast portions of the selected land, but hunting activity is low (e.g., few people per year).

The BLM has classified the BLM land in the MMPO area as *middle country* on the recreation settings matrix (RSM). The *middle country* classification indicates an area with a mostly retained natural landscape within ½ mile of motorized routes, and in which the sounds of people may occasionally be heard. The Forest Service has classified the NFS land in the MMPO area as *rural* on the ROS. The *rural* classification indicates an area with a modified natural setting in which dominant modifications are continually noticeable.

The BLM has classified the selected land on the RSM as a mixture of *back country*, *middle country*, and *front country*. The *back country* classification indicates an area with a retained natural landscape in which any modifications are not visually obvious; there are no motorized routes within ½ mile, only non-motorized use is allowed, and the sounds of people are infrequently heard. The *front country* classification indicates an area with a modified natural landscape (e.g., roads, structures, utilities, etc.) with passenger vehicle routes within ½ mile, and in which the sounds of people are regularly heard.

3.12.2. Offered Lands - Broken Wing Ranch

3.12.2.1. Land Use

The ranch, owned by TCMC, is 813 acres in Custer County. The ranch is surrounded by BLM land except for small areas of private property to the southeast and north, and ½ mile of State land along the northeast (Figure 1.3-1). There are no Federal easements, leases, or permits for land that is part of the ranch (private property). However, there are five ROWs on BLM land related to the ranch: a ROW grant to TCMC for a buried pipeline from a diversion on Lyon Creek between BWR-1 to BWR-3 (IDI-37282); a ROW grant to the IDFG for a fish screen and bypass pipeline for the diversion on Lyon Creek, and for access on Lyon Creek Road to the facilities (IDI-37303); a ROW grant to TCMC for a water pipeline to BWR-4 (IDI-16391); a ROW grant to TCMC for a pipeline extension from Sink Creek to BWR-6 (IDI-31814), and an assertation for a pre-FLPMA ditches and canals ROW from Sink Creek to BWR-6 (IDI-32227). The TCMC ROWs/ROW assertion would be moot and relinquished at title transfer. The other ROWs would be modified to include the relevant portions of the ranch. Any ROWs granted to others for land that is part of the ranch would be amended or relinquished as appropriate. The ranch is an operating cattle and agricultural ranch with a variety of associated uses (Table 2.2-1).

Residential development is steadily increasing on private land in the Salmon River corridor, including a subdivision of land that once belonged to the southeast portion of the ranch along the Salmon River. A portion of this piece of the former ranch has also been developed as a gravel pit by the ITD. The ranch is in the Upper Salmon River SRMA which comprises 42,160 acres in the following land jurisdictions: BLM land (18,860 acres, 45 %), private land (22,790 acres, 54 %), IDFG land (250 acres, 0.6 %), and IDL land (260 acres, 0.6 %). The overall management objective for the SRMA is to preserve its natural, scenic, and undeveloped qualities while enhancing high-quality recreation opportunities (BLM 1986). The SRMA is incorporated into the Challis RMP (BLM 1999).

The portion of the Salmon River that runs through the ranch is part of an all-inclusive list of river segments designated eligible for further study for suitability for inclusion in the National Wild and Scenic River System by National Park Service in 1982 and updated in 1993 (NPS 1993). The outstandingly remarkable values for the eligibility designation are recreational, fisheries and geological, and the classification would be recreational as opposed to wild or scenic (BLM 1999, p. 77). Therefore, one of the goals of the BLM in administering land along this segment of the Salmon River is to avoid degradation to these values (BLM 1999). The portion of SH 75 along the ranch is also a part of the Idaho Salmon River Scenic Byway. Several commercial outfitters have BLM or Forest Service special recreation use permits for guided fishing and/or floating along the Salmon River, including the segment (below the ordinary high water mark) through the ranch. The eastern portions of the ranch are adjacent to the Challis Wild Horse and Burro HMA (there are no burros in the HMA), which comprises the BLM land east of SH 75, west of US Highway 93, and north of the Herd Creek-Road Creek ridgeline and East Fork Road. The BLM, NFS, and State lands in the analysis area are also in the Challis Experimental Stewardship Program Area (Section 3.12.1.1.). The ranch is surrounded by two BLM grazing allotments: the Bald Mountain Allotment (~ 16,600 acres, 446 AUMs) to the west, and the Split Hoof Allotment (~ 8,520 acres, 187 AUMs) to the east.

The nearest other SMAs are the S. Creek IRA (06-005, 1.0 mile west); East Fork Salmon River Bench ACEC (1.3 miles south); Germer Basin/Malm Gulch ACECs (2.5 miles northeast); Corral-Horse Basin WSA (4 miles southeast); Railroad Ridge IRA (06-922) (4 miles southwest); Sawtooth NRA (5 miles southwest); Sand Hollow ACEC (6 miles southeast); Jerry Peak and Jerry Peak West WSAs (7 miles south); and Frank Church River of No Return Wilderness Area (18 miles northwest) (BLM 2012b, USFS 2012d).

3.12.2.2. Recreation

State Highway 75 bisects the ranch and provides direct access to the ranch parcels east of the Salmon River. The parcels west of the river are accessed by either the Poverty Flat Road (public to where a spur road intersects the ranch) from the south, or the Lyon Creek Bridge (private) to the north. There are many two-track roads throughout the ranch, and one of these roads extends 1 mile up Lyon Creek. Motorized travel is allowed on BLM land in the analysis area on most existing roads and trails. However, certain areas have seasonal motorized travel closures or are permanently closed to motorized travel, and certain roads and trails are closed to motorized travel, e.g., the Malm Gulch road is closed in the analysis area approximately 2 miles from SH 75. Snowmobiling (on authorized routes) may occur during winter. More detailed information on transportation and access is in Section 3.16.2.

Custer County is nationally recognized for river rafting, steelhead and salmon fishing, and big game hunting (BLM 1998). Recreation occurs in the analysis area throughout the year due to the somewhat mild climate of the region. The peak season for recreation is summer followed by fall (hunting). There are no public recreation opportunities on the (private) ranch. However, the past owners have enjoyed recreation on the ranch such as big game hunting, bird hunting (upland birds and waterfowl), fishing, antler shed collection, scenic/wildlife viewing and photography, hiking, apple picking, etc. The ranch and the Federal land readily accessed via the ranch also provide excellent recreational opportunities such as small game hunting, backpacking/camping, recreational driving (highway vehicles and OHVs), antler shed collection, horseback riding, mountain biking, rockhounding, wild flower viewing, berry picking, and general enjoyment of the outdoors. In addition, there are 4.4 miles of ranch frontage along the Salmon River, which is used extensively in the analysis area for fishing and float boating (Photo 3.12-1).

Photo 3.12-1. Salmon River in front of Broken Wing Ranch (Lyon Creek Bridge).

Steelhead trout fishing occurs during October through May, with most fishing concentrated in March and early April. During this time there are hundreds of people fishing each day along the Salmon River in the Clayton-Challis-Ellis region. The end of spring marks the start of the general recreational tourist season. In recent years there has been a Chinook salmon fishing season during certain periods of time during May, June or July. During some years the Chinook salmon fishing season includes the portion of the Salmon River in the analysis area. Trout fishing, float boating, camping, sightseeing and general recreating continue through the fall when hunting begins.

The (private) ranch is not subject to any Federal recreation classifications. However, the BLM land adjacent to the ranch is classified as *rural* under the RSM, and the ranch would conform to this classification. The *rural* classification indicates a landscape considerably modified by agriculture, residential or industrial uses (including boat launches and campgrounds). Such landscapes are generally within ½ mile of paved or primary roads, and the sounds of people can frequently be heard in the landscapes. In many cases *rural* lands are moderately regulated with various permit and reservations systems (BLM 1998).

3.12.3. Offered Lands - Garden Creek Property

3.12.3.1. Land Use

The property (82 acres) is a forested track of private land in Bannock County. There is no active management of the property, which has not been commercially harvested or managed for grazing (Section 3.5.3.). There are no Federal easements, leases, or permits associated with the (private) property. The property is surrounded by NFS land to the east and north and by BLM land to the south and west (Figure 1.3-1).

The property is in the Pocatello ERMA (558,600 acres), but the ERMA does not apply to private property. The nearest SMA is the Scout Mountain IRA, adjacent to the east side of the property. The IRA extends southwest to north except that Scout Mountain Top Road is excluded. The nearest other SMAs are Mink Creek IRA (6 miles northwest); Oregon National Historic Trail (6 miles south); Indian Rocks ACEC (6 miles northeast); Robbers Roost Creek ACEC (10 miles northeast); Petticoat Peak wilderness study area (18 miles east); and Downey Watershed ACEC (18 miles southeast) (BLM 2012b, USFS 2012d).

3.12.3.2. Recreation

The only road access to the property is Scout Mountain Top Road (Forest Service Road #009, open June 1 to November 15), which touches the north edge of the property before ending 4.1 road miles north at Scout Mountain (Section 3.16.3.). The road has two lanes with a gravel surface, and begins at South Fork Mink Creek Road (Forest Service Road #163, open May 15 to November 15). There are no roads or public recreation opportunities on the (private) property, which is visited by perhaps one or two people for less than a day each year. The Federal land near the property is relatively inaccessible and little used by the public, except for the Scout Mountain trail complex (Trail 164, Trail 184, Trail 186, and Trail 192) and trails open to motorcycles (Trail 148, Trail 178, and Trail 195) approximately 1 mile north of the property. The trail complex is at the end of Scout Mountain Top Road. There are no roads or trails in the vicinity of the property to the south and southeast, which is in the Scout Mountain IRA. More detailed information on transportation and access is in Section 3.16.3.

Recreation on the property is limited to those with permission from TCMC. However, recreation in the analysis area is typically hunting, camping, antler shed collection, recreational driving (highway vehicles and OHVs), hiking, and general enjoyment of the outdoors. There is very rare horseback riding, fishing, skiing, mountain biking, rockhounding, wildlife viewing, photography, berry picking, backpacking, etc. Hunting opportunities are big game (e.g., deer, elk, mountain lion, wolf, moose, bighorn sheep, etc.), upland birds (e.g., quail, chukar, crow, dove, partridge, grouse and pheasant), small game (e.g., rabbit/hare and furbearers), and water fowl (e.g., goose, duck, coot and snipe).

The (private) property is not subject to any Federal recreation classifications. The adjacent BLM land has not been classified on the RSM (Patterson 2011). The adjacent NFS land is classified on the ROS as semi-primitive, non-motorized (Tiller 2011), which corresponds to a natural setting with some subtle modifications. The Garden Creek property would best match this ROS classification.

3.13. Socioeconomic Factors

The analysis area for socioeconomic factors for the MMPO alternatives is Custer County because all of the mine operations are in the county and 73 percent of TCMC's workforce resides in the county. However, Lemhi County is also briefly discussed because 19 percent of the mine workforce resides in Lemhi County. Similarly, the analysis area for the land disposal alternatives is also Custer County (selected land and Broken Wing Ranch), with a brief discussion of Bannock County (Garden Creek property); however, there would not be any substantial socioeconomic effects to Bannock County related to the land disposal.

3.13.1. Molybdenum Economics

Molybdenum reserves and production capacities are concentrated in four countries (Table 3.13-1). Molybdenum reserves at the largest (by annual production) two primary molybdenum mines in the US were 210,540 tons (Henderson mine, 7.1 % of US reserves) and 123,849 tons (TCM, 4.2 % of US reserves) in 2011 (InfoMine 2012b, Marek and Lechner 2011). The world production of molybdenum increased by 3.3 percent from 2010 to 2011. The TCM (~ 20 million pounds/year) is the fourth largest primary molybdenum producer in the world. The mine produced a record 25.3 million pounds of molybdenum in 2010, or 4.6 percent of world production and 17.9 percent of US production. However, the mine typically produces 15 million to 20 million pounds per year of molybdenum, representing 2.7 to 3.6 percent of world production and 10.6 to 14.2 percent of US production.

Table 3.13-1. World molybdenum mine production and reserves.

	Mine Production (million pounds)		**Reserves (short tons)[1]**	**Reserves (%)**
Country	**2010**	**2011**	**2011**	**2011**
China	206.36	207.24	4,740,000	43.0
US	130.96	141.1	2,980,000	27.0
Chile	0.82	83.78	1,320,000	12.0
Peru	37.48	39.68	500,000	4.5
Other	76.72	79.36	1,480,000	13.4
World TOTAL	**533.52**	**551.16**	**11,020,000**	**100.0[1]**

[1] total is correct but sum of individual values does not total exactly due to independent rounding (USGS 2012a)

The molybdenum price (for "tech moly," MoO_3) is expected to be approximately $15 and $20 per pound during the next two decades, but in the last decade has ranged from an annual average of $2.36 per pound in 2001 to $30.30 per pound in 2007. The spot price is currently $11 per pound (in November 2012), and will continue to be highly cyclical. Molybdenum consumption historically has had a strong growth rate of approximately 4 percent per year, and the growth rate is expected to be 4 to 5 percent per year during the next two decades. The growth rate is driven primarily by consumption in China (Gardner 2008). The TCM production to date is worth $6.8 billion at a typical price of $17.50 per pound. The mine is expected to produce 73 million pounds of molybdenum during 2012 through the middle of 2016 (Alternative M1).

3.13.2. Socioeconomic Factors by County and Offered Lands

TCMC is the largest employer in Custer County and typically has 400 employees distributed among the mine, mill and administration. Approximately 73 percent of these employees reside in Custer County (Idaho Economics 2008, projected data). TCMC had approximately 390 employees in 2011 with a payroll of $27.4 million and additional benefits of approximately $11.0 million (Doughty 2012).

The mine is a major contributor to the economy of both Custer County and Idaho. Approximately one out of every five payroll jobs in Custer County in 2009 were as direct employees of TCMC. The TCMC payroll in 2011 of $27.4 million was 46.9 percent of all 2010 payroll wages in the county. TCMC also purchased $68 million of goods and services in Idaho and $133.4 million in the US and Canada in 2010. Approximately $17 million was spent in Custer County. Purchases from businesses in Lemhi County totaled $1.2 million in 2009 (Idaho Economics 2008, projected data).

The mine is a major source of tax revenue for Custer County from taxes paid by TCMC on real property and net profits of its mining operations. For example, the taxes paid by TCMC in 2010 ($807,921) were 27.8 percent of the total property tax collections in 2010 in the county (Doughty 2012, ISTC 2012b, James 2012). In addition, TCMC employees paid property taxes estimated in 2011 as $90,000 in Custer County and $25,000 in Lemhi County, as well as other local taxes such as vehicle registration fees. Note that despite the steady production in any mine plan, mining operations are cyclical due to the cyclical prices of commodities in the world market.

3.13.2.1. Custer County

Custer County is a large rural county in central Idaho. The county comprises 4,921 square miles (3^{rd} among Idaho counties) and is sparsely populated with just 4,368 people in 2010 (38^{th} among Idaho counties), or 0.89 person per square mile in 2010 (2^{nd} among Idaho counties) (US Census Bureau 2012c). Most of the county is Federal land (Table 3.13-2). The county population has been nearly constant since 2000. In contrast, the Idaho population increased during 2000 to 2010 by 21.1 percent (US Census Bureau 2012b). The four cities in the county are Challis (county seat), Mackay, Stanley, and Clayton. The county has no metropolitan areas, and is distant from urban areas with most residents (61.8 %) living in unincorporated areas (Table 3.13-3.) (US Census Bureau 2012b). The county has no traffic stop lights.

The county has been dominated by mining, agriculture, and ranching since the county was created in 1881. The county is highly dependent on mining jobs which are distinctly cyclical due to the inherent volatility of commodity prices. For example, mining accounted for 18 percent of all payroll jobs in the county in 1998, and there were more than 500 new residents when development of the TCM began in 1980, and 300 residents left the county when the Hecla Grouse Creek mine closed in April 1997. By 2002 mining accounted for just 8 percent of all payroll jobs. Since then mining's share of payroll jobs has steadily increased to 21 percent in 2009, with almost half of the county's payroll jobs occurring in government and mining. Most recently, TCMC laid off 105 employees in October 2012 (TCMC 2012a). Other important cyclical events in the county are large-scale forest fires (IDLR 2012c, 2012d).

Table 3.13-2. Custer County land jurisdiction (legal acres).

Land Jurisdiction (2000)	(acres)	(%)
Federal lands	2,937,675	93.19
BLM	813,965	25.82
National Forest System	2,123,710	67.37
National Parks Service	0	0.00
Tribal lands	0	0.00
State lands	53,901	1.71
Endowment lands	52,626	1.67
Fish and Game	1,253	0.04
Parks and Recreation	22	0.00
Private	158,503	5.03
County	2,300	0.07
City	5	0.00
Water	5,720	0.18
TOTAL[1]	**3,152,384**	**100.0**

[1] except water and indented subcategories, e.g., BLM under Federal lands
EPS-HDT (2011), IDC (2012)

Table 3.13-3. Custer County population data.

Geographic Area	1980	1990	2000	2010
Challis	758	1,079	909	1,081
Clayton	43	26	27	7
Mackay	541	574	566	517
Stanley	99	71	100	63
Unincorporated	1,944	2,407	2,740	2,700
Custer County	**3,385**	**4,157**	**4,342**	**4,368**

IDLR (2012c), US Census Bureau (2012b, 2012d, 2012e)

Demographics and Employment

The age structure of the county has shifted toward an older population since 2000, e.g., persons of retirement age (≥ 65 years) accounted for 14.5 percent of the population in 2000, and 18.7 percent of the population in 2010, substantially higher than the Idaho value of 12.4 percent in 2010. Consequently, the median age in the county increased from 41.2 in 2000 to 48.0 in 2010. Over this same period the working age population (ages 18 to 64) increased marginally by 3.4 percent. Such a small increase is probably mostly the result of limited job opportunities in the county with working age persons leaving to seek employment elsewhere. The aging population and near constant working age population has resulted in a distinct decline of 34.5 percent in the school age population (ages 5 to 18) from 2000 to 2010, and a decline of 6.4 percent in persons under the age of 5 (Table 3.13-4).

Table 3.13-4. Custer County demographics.

	2000	2010	2000 Population (%)	2010 Population (%)	Change (%)
Total Population	4,342	4,368			-0.6
Median Age	41.2	48.0			16.5
< 5 years	234	219	5.4	5.0	-6.4
5-17 years	641	420	14.8	9.6	-34.5
18-64 years	2,603	2,692	59.9	61.6	3.4
> 64 years	630	818	14.5	18.7	29.8
Male	2,219	2,318	51.1	53.1	4.5
Female	2,123	2,050	48.9	46.9	-3.4

US Census Bureau (2012f, 2012g)

Custer County is predominately white (96.4 %), with a small Hispanic/Latino population (4.0 %). The race and ethnicity of the county has changed little during 2000 to 2010, except for large percentage increases in Asian, Native Hawaiian/Pacific Islander and American Indian/Alaska Native populations (Table 3.13-5).

Table 3.13-5. Custer County race and ethnicity.

	2000		2010		Change
	(#)	(%)	(#)	(%)	(%)
Not Hispanic or Latino	4,159	95.8	4,192	96.0	0.8
Hispanic or Latino	183	4.2	176	4.0	-3.8
POPULATION OF ONE RACE					
White	4,224	97.3	4,209	96.4	-0.4
Black of African American	0	0.0	8	0.2	NA
American Indian, Alaska Native	24	0.6	27	0.6	12.5
Asian	1	Z	10	0.2	900.0
Native Hawaiian/Pacific Islander	1	Z	4	0.1	300.0
Other	51	1.2	66	1.5	29.4

Z = Value is greater than zero, but less than half of smallest unit shown (US Census Bureau 2012f, 2012g)

The median household income (unadjusted for inflation) in the county increased from $32,174 to $41,910 during 1999 to 2010, and the value in 2010 was somewhat lower than the average of $46,423 for Idaho in 2010. The per capita income increased from $15,783 to $22,625 during 1999 to 2010, similar to the value of $22,518 for Idaho in 2010. The percentage of people living in poverty in the county decreased from 14.3 percent to 13.8 percent during 1999 to 2010, and the 2010 value was slightly higher than the average of 13.6 percent for Idaho in 2010 (US Census Bureau 2012c) (Table 3.13-6).

Table 3.13-6. Custer County income and poverty.

	1999 ($)	2010 ($)	Change (%)
Median household income	32,174	$41,910	30.3
Per capita income	15,783	$22,625	43.4
	%	**%**	**%**
Population living in poverty	14.3	13.8	-0.5

US Census Bureau (2012c)

The unemployment rate in Custer County was higher than that of either Idaho or the US early in the last decade. The rate dipped in 2003 to match the State and national rates, and then slipped below both rates. The civilian labor force steadily decreased from 2001 to 2006 and has changed little since. The unemployment rate of 3.2 percent in 2007 was the lowest in the past decade, but has risen since then due to the national recession (IDLR 2012c) (Table 3.13-7). Seasonally unadjusted unemployment peaked at 11.2 percent in January 2011, and is currently (January 2012) at 10.5 percent (BLS 2012b).

Table 3.13-7. Custer County labor force and unemployment trends.

	2001	2003	2005	2007	2009	2011
Civilian labor force	2,692	2,523	2,568	2,324	2,664	2,507
% of labor force unemployed	6.0	6.0	4.7	3.2	5.3	7.7

IDLR (2012c)

The dominant employment sectors in the county are government, mining, leisure and hospitality; and trade, utilities and transportation (Table 3.13-8). Almost every sector had job losses in 2009 compared to 2008, with the largest declines in the leisure and hospitality, mining, and construction. The leisure and hospitality sector and the construction sector lost seven and four jobs, respectively, in 2010, whereas the mining sector gained 33 jobs. Approximately half of the county's covered jobs were in the government and mining sectors in 2010.

The average covered wage in the county was $34,913 in 2010, an increase of 8.3 percent compared to in 2009. The average wage increased at an annualized rate of 3.9 percent during 2000 to 2010 (Table 3.13-8). The largest decline in the wage for a sector during the last decade was in mining which decreased by 18 percent ($77,338 to $63,401) from 2008 to 2009. The mining sector wage peaked at $84,082 in 2006, and the sector comprised 44.4 percent of all wages in the county in 2010. The average wage paid by TCMC in 2011 was $70,284, twice the average 2010 wage (2011 data not yet available) of the county, and the TCMC payroll of $27.4 million (390 employees) was 46.9 percent of the total 2010 wages (2011 data not yet available) in Custer County. Wages in the mining sector are higher than all other industry sectors and almost twice the average for all jobs in the county. The mining sector is essentially the payroll base of the county (IDLR 2012c) (Table 3.13-8). In addition to the wages, TCMC also provides its employees benefits that are approximately 40 percent of their wages.

Table 3.13-8. Custer County average annual wage by industry sector.

Industry Sector	2000 ($)	2009 ($)	2010 ($)	Total 2010 ($)	2010 (%)
Agriculture	17,331	20,828	21,632	778,752	1.3
Mining	ND	63,401	67,244	25,956,184	44.4
Construction	38,108	29,090	31,099	1,492,752	2.6
Manufacturing	15,092	ND	41,149	123,447	0.2
Trade, utilities and transp.	16,397	21,425	22,568	5,438,888	9.3
Information	30,467	41,855	45,139	1,399,309	2.4
Financial activities	13,845	16,748	18,354	936,054	1.6
Prof. and business services	17,387	28,418	34,596	1,971,972	3.4
Edu. and health services	9,096	15,612	17,289	1,071,918	1.8
Leisure and hospitality	12,179	13,691	13,465	3,595,155	6.2
Other services	25,095	31,172	31,093	684,046	1.2
Government	26,983	31,938	32,665	15,385,215	26.3
TOTAL	**23,655**	**32,248**	**34,913**	**58,409,449**	**100**[1]

[1] total is correct but values do not sum to exact total because of independent rounding (IDLR 2012c)

Total personal income (TPI) in the county was $135.1 million in 2008, a gain of $9.6 million (7.7 %) from 2007. In contrast, TPI for Idaho increased by 2.4 percent in 2009. Net earnings (adjusted for residence of workers) were $74.7 million (55.3 % of TPI) in 2008. Income from dividends, interest and rent was $35.8 million (2.5 %) followed by personal current transfer receipts (PCTRs) of $24.6 million (18.2 %). Compared to Idaho, earnings comprise a much smaller share of the county TPI and a slightly larger share of PCTRs. The changing economic base of the county is evident by changes in the sources from which personal income is derived. For example, in 1990 net earnings were 66.1 percent of TPI, dividends, interest and rent were 22.5 percent, and PCTRs were 11.4 percent (BEA 2012).

Per capita personal income in the county increased 5.4 percent from $30,545 in 2007 to $32,203 in 2008. In contrast, per capita personal income in Idaho increased 0.5 percent from $32,837 in 2007 to $32,994 in 2008. Income from PCTRs has been increasing more quickly than all other sources of income in the county, e.g., an annualized increase of 6.9 percent during 2000 to 2008. In comparison, the annualized increase in income from earnings was 3.3 percent during 2000 to 2008, and the annualized increase in dividends, interest, and rent during this time period was 4.0 percent (BEA 2012). The PCTRs component of personal income is primarily retirement and disability insurance benefits (e.g., 47.0 % in 2008) and medical benefits (e.g., 37.5 % in 2008) (BEA 2012).

Government Funds

The finances of the county comprise the revenues and expenditures of county government. Total revenue was $4.75 million in 2009, composed of revenue from local sources ($2.55 million, 53.7 %) and intergovernmental transfers ($2.20 million, 46.4 %). The revenue from local sources was primarily from property taxes ($1.21 million, 47.5 %) and payments in lieu of taxes (PILTs) ($898,234, 35.2 %). County expenditures were $3.93 million primarily for general government ($1.70 million, 43.2 %), street and road maintenance ($0.98 million, 24.9 %), and public safety ($0.84 million, 21.5 %) (Custer County 2010).

Property taxes are collected by *taxing districts*, an entity authorized by law to levy taxes to provide services to residents of the district. In addition to Custer County, there are approximately 20 taxing districts in the county including cities, schools, cemeteries, highways, ambulance, abatements, and fire districts. The Custer County blended (urban and rural) property tax rate for all taxing entities in the county (including county government) is typically the lowest tax levy in Idaho, i.e., 0.36 percent versus 1.29 percent in 2011 (ISTC 2012a). The selected land is in Custer County Tax Code Area 07 and Tax Code Area 50, which have an approximate levy rate of 0.2 percent. The Broken Wing Ranch is in Custer County Tax Code Area 11 with a levy rate of approximate 0.25 percent (James 2012). The net profits of the tax on TCMC are part of property taxes in Idaho, and are based on the valuation of net mining profits. These profits are treated as personal property and taxed at the same rate as other real and personal property.

The mine is a substantial source of property tax revenue in Custer County. TCMC pays tax on its real property as well as its net profits, amounting to $807,921 in 2010 (including $437,123 net profits tax) or 27.8 percent of all property taxes collected by the county (Doughty 2012, James 2012). Increases or decreases in the net profits tax distinctly affect the amount of property tax borne by residential property owners. During boom periods, TCMC has paid as much as one-third of the county’s property tax bill. The property tax paid by the TCMC for government services is dispersed throughout the county, but the property taxes paid by TCMC to other taxing districts in north Custer County remain in that area. To the extent that taxing districts in north Custer County are unable to find other sources of revenue, they will rely on increasing property taxes to make up the difference by increasing their tax levies (James 2010, The Challis Messenger 2010).

Recognizing the inability of local governments to collect property taxes on Federally-owned land, Congress enacted the Payment in Lieu of Taxes (PILT) Act in 1976 (31 USC 6901-6907). The act provides for payments to local governments containing certain types of Federal lands to help compensate the counties for tax revenue that cannot be collected on Federal lands, yet such lands may still have demand for services such as fire protection, police, longer roads to skirt Federal lands, etc. Due to the relatively large size and small population of Custer County, the PILT for the county has always been calculated as the county population multiplied by the payment cap, and totaled $687,385 in 2011 (Table 3.13-9.) (Corn 2011, USDOI 2012).

Table 3.13-9. Custer County PILT.

Year	PILT ($)	PILT (acre)
2000	216,188	2,937,675
2001	327,901	2,936,739
2002	344,225	2,936,769
2003	380,688	2,936,754
2004	391,379	2,936,679
2005	390,504	2,935,550
2006	400,357	2,935,450
2007	394,676	2,935,965
2008	641,630	2,935,740
2009	655,924	2,935,636
2010	683,585	2,935,636
2011	687,385	2,935,509

USDOI (2012)

Changes in the number of Federal acres would affect a PILT only if it were calculated using method 1 or method 2 because of the population payment cap provision. Accordingly, Custer County would need to lose 852,525 qualified Federal acres before the county's PILT would be affected (Table 3.13-10).

Housing and Agriculture

Housing in Custer County consists of owner and rental housing units with very high vacancy rates (37.6 % in 2010). A large percentage of the vacant units (79.5 % in 2010) are classified as seasonal, recreational, or occasional use units (Table 3.13-11). The majority of the units are single family units, with rental units comprising a small percentage (4.7 % in 2000) of the total units. Much of the housing stock in 2010 (95.0 %) was built prior to 2000, with 60.4 percent of the stock built during 1970 to 1999 (US Census Bureau 2012f, 2012g).

There has been little residential construction in the county since 2000, with just 49 building permits (47 for single-family units) issued in the county during 2001 to 2009 (US Census Bureau 2000). No permits were issued in the county during this time period for low-income or high-density housing. Housing stock in the county increased from 2,986 in 2000 to 3,036 in 2008, including new construction and other units such as mobile homes. The increase of 1.7 percent in housing stock is in sharp contrast to the increase in Idaho of 21 percent during the same period (US Census Bureau 2012f).

Table 3.13-10. PILT sample calculations for 2011 (legal acres).

Method 1	
Qualified Federal lands (acres)	2,935,509
2011 rate	$2.42
Deductions for Federal lands receipts[1]	$0.00
PILT	$968,718
Method 2	
Qualified Federal lands (acres)	2,935,509
2011 rate	$0.33
PILT	$968,718
Population Payment Cap	
Population	4,218
Per capita payment	$162.9765
Maximum PILT	$687,385
Loss in Acres Necessary to Affect PILT	
Maximum PILT	$687,385
2011 rate	$0.33
Qualified Federal lands to equal maximum PILT (acres)	2,082,984
Current qualified Federal lands (acres)	2,935,509
Loss necessary to affect PILT (acres)	852,525

[1] Custer County receives negligible Federal land receipts.

Table 3.13-11. Custer County housing occupancy.

	2000		2010	
	(#)	(%)	(#)	(%)
Housing units	2,983	100.0	3,103	100.0
Occupied	1,770	59.3	1,936	62.4
owner-occupied	1,326		1,471	
renter-occupied	444		465	
Vacant	1,213	40.7	1,167	37.6
for seasonal/recreation/occasional use	747		928	

US Census Bureau (2012f, 2012g)

The number of farms in the county has been relatively constant since at least 1992, but the average farm size has decreased from 527 acres in 1992 to 476 acres in 2007. During this period the total farmland declined 11.7 percent from 140,701 acres to 124,191 acres. Although agriculture plays a large role in the identity and social life of the county, outside employment is commonly necessary to augment household farm income (Table 3.13-12.) (USDA 1992, 1997, 2002, 2007). Land used for ranching has experienced considerable pressure for subdivision and development as retired people and quality-of-life-focused people have moved into the upper Salmon River Valley and purchased retirement and recreation homes.

Table 3.13-12. Custer County agricultural overview.

	1992	1997	2002	2007
Number of farms	267	268	285	261
Land in farms (acres)	140,701	147,913	131,571	124,191
Average size of farms (acres)	527	552	462	476
Primary Occupation of Principal Operator				
Farming	167	145	170	134
Other	100	123	115	127

USDA (1992, 1997, 2002, 2007)

Education

There are two school districts in the county: Challis Joint School District #181 (4 schools) and Mackay Joint School District #182 (2 schools) (IDE 2010a). Total enrollment in public schools in the county was 630 during the 2009 to 2010 school year (IDE 2010a). The decline in the percentage of the population under the age of 18 is reflected in declining school enrollments, and enrollments in both school district are at their lowest levels since the mid-1990s (Table 3.13-13.) (IDE 2010b). A portion of the decline in both districts is due to the Hecla Mine closure in 1997.

Public Services

Custer County has a fully developed basic infrastructure with numerous public and semi-public facilities and services including law enforcement, fire protection, water supplies, waste disposal, electricity service, and communications. Electricity is the primary power source for the county and is provided by two cooperatives: Lost River Electric Cooperative (LREC) and Salmon River Electric Cooperative (SREC). The SREC also operates and maintains a 230 kV transmission line, substations, and various transmission lines for TCMC (SREC 2012). TCMC is the largest consumer of electricity in the county, using two-thirds of the total electrical load or about 220,000 MW-hours of electricity annually; a typical house in Idaho uses 12,500 kW-hours annually (EIA 2011). Most of the electricity used by TCMC is purchased by the SREC from the Bonneville Power Administration (Dizes 2010).

Table 3.13-13. Custer County fall school enrollments.

School year	Challis Joint District		Mackay Joint District	
	Enrollment	Change	Enrollment	Change
2009-2010	411	-28	219	10
2008-2009	439	-28	209	-4
2007-2008	467	5	213	-20
2006-2007	462	14	233	-14
2005-2006	448	-13	247	19
2004-2005	461	-48	228	4
2003-2004	509	-11	221	-25
2002-2003	520	-38	246	-12
2001-2002	558	-37	258	-19
2000-2001	595	-10	277	-7
1999-2000	605	-33	284	-1
1998-1999	638	-11	285	-21
1997-1998	649	-51	306	19
1996-1997	700	-5	287	-7
1995-1996	705	--	294	--

IDE (2010a, 2010b)

Offered Lands

The property tax revenue to Custer County from the Broken Wing Ranch was $2,070 in 2009. The Garden Creek property (tax parcel R4221000302) is in Bannock County Tax Code Area 19 with an approximately levy rate of 1.3 percent (Bannock County 2012). The average market price for cattle in 2012 in Idaho was $1,230 or $102.50 per AUM assuming 12 AUMs input (USDA 2012a). In Idaho in 2011 the average private grazing fee was $14.50 per AUM (USDA 2012b), and the average local hay price during September 2012 through May 2013 was $194 per ton ($77 per AUM) (USDA 2013). The BLM grazing fee in 2012 was $1.35 per AUM.

The property tax revenue to Bannock County from the Garden Creek property was $100 in 2009. Bannock County is one of Idaho's most populated counties with a well-diversified and growing economy. The county population increased from 75,565 in 2000 to 82,839 in 2010. Total employment in the county in December 2010 was 36,713 and the unemployment rate was 8.7 percent, below the Idaho rate 9.8 percent. The median household income was $44,848 and 14.0 percent of the population was below the poverty level in 2010, compared to 13.6 percent for Idaho (IDLR 2012c, US Census Bureau 2012h).

3.13.2.2. Lemhi County

The socioeconomic effects of the project would be concentrated in Custer County, but Lemhi County would experience some minor socioeconomic effects. Lemhi County is a large rural county north of Custer County in central Idaho comprising 4,564 square miles (4th among Idaho counties) with a population density of only 1.74 persons per square mile in 2010 (6th among Idaho counties). The population was 7,936 in 2010 (32nd among Idaho counties). The county has only two cities: Salmon with a population of 3,112 in 2010, and Leadore with a population of 105 in 2010 (IDLR 2012a, US Census Bureau 2012a, 2012b).

The county has been highly dependent on mining for most of its history, as reflected by economic trends over the past decade. For example, mining employment was approximately 18 percent of all non-farm jobs in the county in 1999. With the closure of the Beartrack Mine near Leesburg, mining employment was only 47 percent by 2006, but increased to 85 percent in 2008 due to increased activity at the Idaho Cobalt Mine between Challis and Salmon and the TCM (~ 70 % of the employees of TCMC live in Custer County) (Chabra 2010, IDLR 2012a, 2012b, US Census Bureau 2012a).

The unemployment of the county was 11.4 percent in 2011. Seasonally unadjusted employment reached 15.4 percent in February 2011, and is currently (January 2012) 14.3 percent (BLS 2012a). The per capita income in 2010 was $21,699, and the average wages of mining jobs in 2009 were $78,988 (IDLR 2012a, US Census Bureau 2012a, 2012b). In the past several years Lemhi County has embarked on diversification efforts to help offset the cyclical ("boom-bust") nature of the mining industry. These projects include a business incubation center, a large hospital, and the Sacajawea Education and Interpretive Center (IDLR 2012a).

3.13.3. Non-market Environmental Monetary Values

Monetary value can theoretically be placed on items not traded in markets such as the quality of air, cultural resources, fisheries, public access, recreation opportunities, vegetation, water, wildlife, etc. Such *non-market* monetary value may be inferred by three general approaches: market price, circumstantial evidence, or surveys. There are a variety of methods for each of these approaches. For example, in the market price approach the travel cost method infers the (minimum) value of a particular recreation site by assuming the value is equal to the cost of traveling to the site for the relevant population. However, all of the methods have substantial limitations, including extreme complexity for all but the simplest situations (e.g., Pearce et al. 2006, Venn and Calkin 2011). In addition, some of the methods are highly controversial (Arrow et al. 1993).

3.14. Tribal Treaty Rights and Interests

The analysis area for tribal treaty rights and interests for the MMPO alternatives and the selected land component of the land disposal alternatives is the Federal lands in the BLM Challis Field Office area and in the SCNF. The analysis area for the offered lands component of the land disposal alternatives is the BLM land in the Challis Field Office area (for the Broken Wing Ranch) and the BLM land in the Pocatello Field Office area (for the Garden Creek property).

American Indians and Alaska natives have a special and unique legal and political relationship with the Government of the US as defined by history, treaties, statutes (e.g., American Indian Religious Freedom Act of 1978), Executive Orders (EO 12898, EO 13007, EO 13175, SO 3206), court decisions, and the US Constitution. Treaties are negotiated contracts made pursuant to the Constitution of the US and take precedence over any conflicting State laws. The trust responsibility of the Federal government includes an obligation to protect and preserve treaty rights.

The Federal Government has a unique trust relationship with Federally-recognized American Indian tribes including the Shoshone-Bannock Tribes and the Nez Perce Tribe. More specifically, the Federal Government has a responsibility and obligation to consider and consult on potential effects to natural resources related to the tribal treaty rights or cultural use. Formal Government-to-Government consultation and informal coordination with the tribes is summarized in Chapter 6. Resources or issues of interest to the tribes that could have a bearing on their traditional use and/or treaty rights include tribal historic and archaeological sites, sacred sites and traditional cultural properties, traditional use sites, water, fisheries, traditional use plant and animal species, vegetation (including weeds), air and water quality, wildlife, access to lands and continued availability of traditional resources, land status, and the visual quality of the environment.

The MMPO area, selected land, and the offered lands are all in eastern Idaho, which is recognized by the Shoshone-Bannock Tribes as part of their aboriginal homeland and subsistence ground, and land for which the Shoshone-Bannock Tribes have treaty rights. The Nez Perce Tribe also has treaty rights on this land. Therefore, tribal treaty rights, as defined, are applicable to the project area. The natural characteristics of the land are ethnographically important; they are tied to lifeway values inseparable from the culture. The lands provided wildlife, plants, waters, travel ways, and other elements of aboriginal subsistence. These lands provide resources also important in contemporary and traditional cultural use, perhaps with a greater emphasis placed on natural character, solitude, and spiritual retreat. The current condition and nature of affected resources associated with these tribal rights and interests are described in the other sections of this chapter. Tribal treaty rights pursued on unoccupied Federal lands in the analysis areas include fishing for anadromous and resident game fish species, hunting large and small game, and gathering natural resources for subsistence and medicinal purposes.

3.14.1. Shoshone-Bannock Tribes

The Fort Bridger Treaty of July 3, 1868 (15 Stat. 673), between the US and the Shoshone-Bannock Tribes, reserves the Tribes' right to hunt, fish, gather, and exercise other traditional uses and practices on unoccupied Federal lands. In addition, the Shoshone-Bannock Tribes have the right to graze Tribal livestock and cut timber for Tribal use on those lands of the original Fort Hall Indian Reservation that were ceded to the Federal government under the Agreement of February 5, 1898, ratified by the Act of June 6, 1900 (31 Stat. 672).

The Fort Hall Indian Reservation (540,764 acres in 2010) (SBT 2013), home of the Shoshone-Bannock Tribes, is in southeast Idaho between the cities of Pocatello (population 58,255) to the south and Blackfoot (population 11,899) to the north (US Census Bureau 2012b). The Reservation economy exhibits unemployment and household poverty levels far greater than the average unemployment and poverty levels for the US, Idaho or four surrounding counties. Given the poverty level of the majority of people living on the Reservation, it is possible that resources hunted for, fished for, or gathered in the analysis areas through the exercise of Tribal treaty rights could be an important or essential component of personal subsistence for Tribal members. In addition to contributing to Tribal members' economic subsistence, resources from the analysis areas have important social and cultural values to the Tribes.

Due mostly to privacy issues, only a few "traditional use sites" have been documented through consultation with the Shoshone-Bannock Tribes. For the effects analysis in Chapter 4, it is assumed that the BLM and NFS lands were, and are, used for traditional practices such as hunting, fishing, and gathering. It is also assumed that Tribal members utilize these Federal lands for traditional activities such as ceremonies and religious practices. The following information is from "Shoshone-Bannock Tribes" published by the Shoshone-Bannock Tribal Cultural Committee and Tribal Elders.

> *Spirituality and religious ceremonies have always played a significant role in Indian cultures. Natural resources played an integral part of these ceremonies. Items such as sweet sage and tobacco made from a variety of plants were and are used in ceremonies. The Indians gathered many plants for medicinal purposes, including chokecherry, sagebrush, and peppermint. A myriad of other plants were gathered for food and to provide shelter. Rocks and clays were also used for ceremonies, ornamentation and shelter. Some bands inhabiting the upper Snake region were known as the "sheepeaters" since bighorn sheep were a staple of their diet. Buffalo, elk, deer and moose were also hunted and used by the aboriginal people. The Shoshone and Bannock bands also relied on upland game birds and small mammals. Salmon fishing was an integral part of aboriginal culture. Geysers, thermal pools and other water features were also utilized heavily by the Shoshone-Bannock Tribes.*

These traditional and subsistence activities are still practiced today across eastern Idaho although the extent of those activities is unknown. Many Tribal members hunt, fish, and gather for subsistence and to maintain their traditional way of life.

3.14.2. Nez Perce Tribe

The Camp Stevens Treaty of June 11, 1855 (12 Stat. 957), between the US and the Nez Perce Tribe, reserves the Tribe's right to hunt, fish, gather, and exercise other traditional uses and practices on unoccupied Federal lands. The MMPO area and the selected and offered lands are not in lands traditionally used by the Nez Perce Tribe, nor are in the typical area-of-interest of the Tribe (ICBEMP 1995). However, eastern portions of the SCNF are in the typical area-of-interest of the Tribe. In addition, the Tribe is interested in the MMPO alternatives because of potential affects to anadromous fish, which migrate to lands traditionally used by the Tribe.

3.14.3. MMPO Area and Selected Land

There are 793,081 acres of BLM land in the Challis Field Office area and 4,235,940 acres of NFS in the SCNF. In each of these jurisdictions the Federal lands are nearly all (98 to 99 %) unoccupied, i.e., subject to tribal treaty rights. Occupied lands include roads, campgrounds, ROWs, mining, etc., but not mining claims for which there is no authorized mining (Gardner 2011a). All of the BLM and NFS lands in the MMPO area are/would be occupied

Federal lands (i.e., Alternative M1, ~ 630 acres; Alternative M2, ~ 980 acres, Alternative M3, ~ 1,150 acres). Approximately 450 acres (9 %) of the selected land is occupied by the mine. The nearest tribal reservation to the mine and selected land is the Fort Hall Indian Reservation, 126 miles to the southwest.

3.14.4. Offered Lands - Broken Wing Ranch

The Challis Field Office area contains 792,567 acres of BLM land (BLM 1998), of which 98 to 99 percent is unoccupied. The ranch has been private property since the early 1900s and therefore is not currently subject to tribal treaty rights. Approximately 240 acres (30 %) of the ranch would be unoccupied land (i.e., not developed or cultivated) if the ranch were Federal land. The nearest tribal reservation to the ranch is the Fort Hall Indian Reservation, 120 miles to the southeast.

3.14.5. Offered Lands - Garden Creek Property

The Pocatello Field Office area contains 613,800 acres of BLM land (BLM 2012a), of which approximately 98 percent is unoccupied Federal land. The Garden Creek property has been private since 1919 and thus is not currently subject to tribal treaty rights. All of the property would be unoccupied Federal land (i.e., subject to tribal treaty rights) if the property were Federal land. In such case, the Shoshone-Bannock Tribes would also have the right to graze Tribal livestock and cut timber for Tribal use on the property, because the property is within the ceded boundary of the Fort Hall Indian Reservation (239,837 acres ceded in 1889 and 418,560 acres ceded in 1900) (SBT 2013).

3.15. Cultural Resources

The analysis area for cultural resources for the MMPO alternatives is the MMPO area and a buffer zone extending 1 mile outward around the area. The analysis area for cultural resources for the land disposal alternatives is the selected and offered lands and buffer zones extending 1 mile outward around the lands.

Cultural resource sites are defined as any location of past human activity identifiable through field survey, historical documentation, and/or oral evidence. Cultural resource sites have many values and provide data regarding past technologies, settlement patterns, subsistence strategies, and many other aspects of history. The term "cultural resources" can apply to "those parts of the physical environment – natural and built – that have cultural value of some kind to some sociocultural group." The term includes archaeological resources, historic resources, Native American cultural items, historical objects, spiritual places, religious practices, cultural uses of the natural environment, community values, or historical documents (King 1998, pp. 7, 9).

The term "heritage resources," used by the Forest Service, encompasses not only cultural resources but also traditional and historic use areas by all groups (Native Americans, Euro-Americans, etc). Heritage resources include lifeways or the way humans interact and survive within an ecosystem. Objects, buildings, places, and their uses become recognized as "heritage" through conscious decisions and unspoken values of particular people, for reasons that are strongly shaped by social contexts and processes (Avrami et al. 2000). Heritage resources define the characteristics of a social group (i.e., community, families, ethnic group, disciplines, or professional groups). Places and objects are transformed into "heritage resources" through values that give them significance. Public disclosure of the location of cultural resource sites (i.e., historic properties under the NHPA) is generally prohibited under 16 USC 470hh(a); this prohibition protects sensitive cultural resources from potential vandalism and other harm.

3.15.1. MMPO Area and Selected Land

Twenty-six cultural resource inventories have been conducted in the analysis areas (Table 3.15-1). A project-specific cultural resource inventory of the selected land was conducted by Smith (2009). At the request of the Idaho State Historic Preservation Office (SHPO), an attempt was made during this inventory to relocate previously recorded prehistoric sites within the permitted mine area including one prehistoric site (10CR325) located just outside the MMPO and selected land boundary on Forest Service land. In addition, previous inventories and associated data were summarized by Hearne (2008). The previous inventories (Table 3.15-1.) documented 24 cultural sites (Table 3.15-2). Eleven of these sites are in the MMPO area and selected land, and all have been determined as not eligible for the NRHP with SHPO concurrence (SHPO 2011). Twelve sites are in the currently permitted mine area and area that was disturbed by mining activities; these sites were determined ineligible by SHPO in 1981 (SHPO 2011) and were not relocated during the project-specific inventory (Smith 2009). Two sites were determined eligible for the NRHP (SHPO 2011); one is located on a privately owned in-holding and the other is near the selected land.

Table 3.15-1. Previous cultural resource inventories, MMPO and selected land

Project Number	Year	Project Name	Author	Inventoried (acre)
Not applicable (NA)	1974	Antiquities Assessment of the Cypress Mining Region	Max Pavsic	Unknown
NA	1977	Archaeological Inventory of Challis Planning Unit, Bureau of Land Management	Terrence Epperson	Unknown
NA	1979	Cultural Resource Inventory of the Proposed ROW for the 269kV Moore Substation to S. Creek Salmon Electric Co-Op power line	Robert Butler	1,200+
CRM-CH-0039	1979	Cultural Resource Inventory of the Cyprus Mines Mineral Exploration Roads and Drill Sites	Marion McDaniel	5
CH-79-47	1979	Thompson Creek-Cyprus Mines Project	George Rubelmann and Joseph Moore	Unknown
CRM-CH-47	1980	Cultural Resource Update of the Thompson Creek-Cyprus Mine Project	Jerry Wylie and Marion McDaniel	NA
CH-80-0064	1980	Thompson Creek C&H Allotment Fencing	Marion McDaniel	1
CH-80-0065	1980	Cultural Resource Inventory of the Cyprus Mines Roads	Marion McDaniel	Unknown
ID4C81035	1981	Archaeological Investigations and	F. Hauck, AERC	2,400+

Project Number	Year	Project Name	Author	Inventoried (acre)
CH-81-0076		Cultural Resource Evaluations in the Thompson Creek Locality		
NA	1982	Archaeological Survey for the Cyprus Water Pipeline Project	Mary Rossilon	260+
ID4C89027	1989	Buckskin/Twin Apex Reforestation Project	Nancy Anderson	20
CH-91-0297	1991	Sheelite Jim Mine Acid Waste Cleanup	Marion McDaniel	6
CH-94-0366	1994	Thompson Creek Mine Borrow Source	Marion McDaniel	4
ID4C94042	1994	Rock Crusher Timber Sale	Linda Clark	90
ID4C97009	1997	Thompson Creek Road Maintenance	Linda Clark	1
ID4C02012	2002	Cypress Post and Pole Sale	Carol Hearne	10
CH-02-0616	2002	Cyprus-Thompson Land Sale	Dan Tyree	Unknown
ID4C04031	2004	Thompson Creek Mining Co. Pipeline ROW	Carol Hearne	10+
ID4C06006	2006	Proposed Ross Williams Land Sale	Bill Harding	350
CH-07-0716	2007	Pat Hughes Creek Repository Testing	John Rose	7
ID4C08036	2008	Golder and Associates	Thomas Hoffert	45
CH-08-0758	2008	Thompson Creek Power Line Project	Claudia Taylor Walsworth	5
CH-08-0760	2008	Bruno Creek Impoundment	Claudia Taylor Walsworth	22
CH-09-0766	2009	Road 322 Exploratory Drilling	John Rose	2
ID4C08031	2009	Thompson Creek Land Exchange Project	Rusty Smith	274
CH-11-00820	2010	Thompson Creek Mine Rock and Soil Borrow Areas	Linda Goetz and Doug Tingwall	48

Table 3.15-2. Cultural resource sites, MMPO and selected land areas

Site Number	Site Type	Site Evaluation	In MMPO Area/ Selected Land	In Permitted Mine Area[1]
10CR324	Lithic scatter	Not Eligible	X	
10CR325[2]	Open camp	Eligible		
10CR326	Historic cabin	Not Eligible		X
10CR327	Lithic scatter	Not Eligible		X
10CR328	Lithic scatter	Not Eligible	X	
10CR329	Lithic scatter	Not Eligible	X	
10CR330	Historic mine cabin remains	Not Eligible		X
10CR735	Lithic scatter/ rock pile/rock alignment	Not Eligible		X
10CR736	Quarry/lithic scatter	Not Eligible		X
10CR737	Lithic scatter	Not Eligible		X
10CR738	Lithic scatter	Not Eligible		X
10CR739	Rock shelter/ lithic scatter	Not Eligible		X
10CR740	Lithic scatter	Not Eligible	X	X
10CR741	Lithic scatter	Not Eligible	X	
10CR744	Lithic scatter	Not Eligible		X
10CR747	Lithic scatter	Not Eligible	X	
10CR748	Lithic scatter	Not Eligible	X	
10CR749	Lithic scatter	Not Eligible	X	
10CR750	Lithic scatter	Not Eligible	X	
10CR751[3]	Twin Apex Mine	Eligible		
10CR758	Cinnabar/Bruno Creek Mine/ lithic scatter	Not Eligible		X
10CR1992	Quarry/ stacked rock/ lithic scatter	Not Eligible		X
10CR1993	Lithic scatter	Not Eligible	X	
37-17116	Sawmill	Not Eligible	X	

[1] The mine site includes some area permitted for mining that would not be used under any of the MMPO alternatives (Section 2.2.1).

[2] This site is adjacent to but just outside the selected land.

[3] This site is located on a privately owned in-holding that Thompson Creek Mine has no intention of purchasing.

3.15.2. Offered Lands – Broken Wing Ranch

Forty-three cultural resource inventories have been conducted in the analysis area (Table 3.15-3). A project-specific cultural resource inventory was not conducted on the entirety of the Broken Wing Ranch parcels. However, a historic structure inventory was conducted on the homestead properties on the ranch to evaluate the historic structures and associated homestead sites for potential eligibility for the NRHP (Goetz et al. 2011).

Table 3.15-3. Previous cultural resource inventories, Broken Wing Ranch analysis area.

Project Number	Year	Project Name	Author	Inventoried (acres)
NA	1977	Archaeological Inventory of the Challis Planning Unit, BLM.	Epperson, Terrence	0
NA	1982	Cultural Resource Reports for 1982.	Vaughan, Nancy	0
NA	1983	Annual Report of Archeological Investigations. IDT Boise.	Gaston, Jenna	0
NA	1984	Annual Report of Archaeological Investigations. IDT Boise.	Gaston, Jenna	0
F-FR-6393(3)	1986	ARR, Cu-75s, SU-75 Jct. US-93 to E. Fork Salmon River.	Gaston, Jenna	2
F-FR-6393(3)	1986	ARR, S.H. 75 – US 93 Junction, Salmon River Bridges.	Gaston, Jenna	425
ID4C88027	1988	CRRN, Mining Notice - Leonard Owens, SMN-040-08-02.	Anderson, Nancy	2
ID4C88015	1988	CRRN, Sink Creek Community Pit.	Anderson, Nancy	5
ID4C92036	1992	Challis Area Fish Screens. BLM, Salmon District.	Wright, Steven	1
NA	1991	Archaeological Investigations Along SH-75, Custer County, Idaho.	Petersen, Nick and Jenna Gaston	0
ID4C92009	1992	Broken Wing Telephone Cable Burial.	Wright, Steven	2 1[1]
ID4C92010	1992	East Fork Dump Site.	Wright, Steven	4 3[1]
ID4C93022	1993	Cramer Haystack Storage LUP/ Agricultural Trespass.	McLaughlin, Jim	1
ID4C93042	1993	Alkali Drift Fence.	McLaughlin, Jim	1
ID4C93049	1993	River Terrace Drift Fence and Water Trough.	McLaughlin, Jim	2
ID4C94031	1994	Alkali Spring Habitat Improvement Project.	Clark, Linda	32
ID4C93043	1993	Split Hoof Highway Fence.	McLaughlin, Jim	11
ID4C96021	1996	Three Rivers Quarry Road.	Hill, Larry	18
ID4C96040	1996	Herrick Point of Diversion and Irrigation Pipeline ROW.	Clark, Linda	4
ID4C96052	1996	Idaho Department of Transportation Material Site ROW.	Clark, Linda	1
ID4C96053	1996	Crystal Townsite Interpretive Wayside.	Clark, Linda	9
ID4C98020	1998	East Fork Road Maintenance.	Clark, Linda	2
ID4C97004	1997	Bradshaw Basin Retention Dam Maintenance.	Clark, Linda	15
ID4C99039	1999	Salmon River Fish Screen.	Clark, Linda	7

Project Number	Year	Project Name	Author	Inventoried (acres)
NA	2000	A Cultural Resource Survey of the Proposed Telecommunications Fiber Optic and Copper Cable Route, East Fork Salmon River Area, Custer County, Idaho.	Walsworth, Claudia	Unknown
ID4C00044	2000	Herrick Land Use Permit.	Clark, Linda	12
IDI-16925	2000	East Fork Salmon River Area Fiber Optic and Copper Cable Route.	Walsworth, Claudia	18
NA	2001	Proposed Digital Line Carrier Sites Associated with Challis to Stanley Telecomm Line.	Taylor Walsworth, Claudia	13
NA	2002	Proposed Challis to Stanley Telecomm Project Phase I.	Taylor Walsworth, Claudia	166
ID4C0210	2002	L&W Stone Interim Clearance for Pit 1 Waste Rock Disposal.	Hearne, Carol	3
ID4C0313	2003	East Fork Campsite Toilet and Waterline Replacement.	Hearne, Carol	2
ID4C0314	2003	JB Stone Quarry Development (Application for Extension).	Hearne, Carol	10
ID4C0323	2003	L&W Stone Corporation Rock Storage Project.	Hearne, Carol	7
NA	2004	Upper Salmon River Anadromous Fish Passage Project-Sink Creek River Diversion Site Improvement.	Walsworth, Claudia	1
ID4C04-43	2004	L&W Stone Corp. Interim Gate Authorization.	Hearne, Carol	1
BR-6390(105)	2005	SH-75 East Fork Salmon River Bridge.	Leary, S.	60
ID4C04-03	2005	L&W Stone Corp. Amended Plan of Operations.	Hearne, Carol	180
ID4C06018	2007	Salmon River Osprey Platform.	Hearne, Carol	12
BR-6390(105)	2007	Results of Archaeological Excavations East Fork Salmon River Bridge Sites Data Recovery (10CR413 and 10CR1860) and Testing (10CR113 and 10CR1862).	Leary, S., Nelson, I., Olson, D., Mitchell, K.	5
NA	2007	D6 2007 Maintenance Scaling.	Munch, M.	9 72[1]
BRF-6398(105)	2007	East Fork Salmon River Bridge.	Munch, M.	2
ID4C07028	2007	L&W Stone EIS - Amended Plan of Operations.	Hearne, Carol	60
CH-11-00814	2011	Broken Wing Ranch Survey	Goetz, L., D. Tingwall, and T. Rust	36[1]

[1] acres of reconnaissance level survey, as opposed to intensive level survey

General Land Office (GLO) maps and land patent entries for T. 12 N., R. 18 E. and T. 11 N., R 18 E., B.M. indicate historic activities in the analysis area as early as 1911. Historic structures exist on the ranch and have been documented under the historic structure inventory (CH-11-00814; Goetz et al. 2011). This study resulted in the recording of three historic homestead sites (CH-1519, CH-1520, CH-1521; Table 3.15-4). In addition, SHPO records indicate nine additional cultural sites in the ranch comprising three lithic scatters, one talus pit site, one historic cribbing across Sink Creek, a historic highway route, one historic debris scatter, one historic rock foundation, and a historic bridge. These recorded sites indicate prehistoric and historic use of the analysis area. Of the twelve sites on the ranch, seven are NRHP-eligible or unevaluated (Table 3.15-4); the associated parcel is presented in the last column of the table.

Table 3.15-4. Cultural resource sites, Broken Wing Ranch.

Site Number	Site Type	Site Evaluation	Broken Wing Ranch Parcel
10CR987	Lithic scatter	Not Eligible	N/A
10CR988	Lithic scatter	Eligible	BWR-5
10CR989	Historic debris scatter	Not Eligible	N/A
10CR990	Talus pits	Unevaluated	BWR-5
10CR998	Lithic scatter	Not Eligible	N/A
10CR1589	Rock foundation	Not Eligible	N/A
10CR1862	SH 75	Not Eligible	N/A
37-4918	Broken Wing Ranch bridge	Unevaluated	BWR-3
37-17040	Sink Creek cribbing	Eligible	BWR-6
CH-1519	Maraffio Homestead	Eligible	BWR-4
CH-1520	Gini Homestead	Eligible	BWR-3
CH-1521	Graham Homestead	Eligible	BWR-1

3.15.3. Offered Lands – Garden Creek Property

SHPO records show no cultural resource inventories on the Garden Creek Property, but one cultural resource inventory (reconnaissance as opposed to intensive level) was conducted in the vicinity: Mink Creek Timber Sale, Caribou National Forest (5,410 acres, CB-87-177) (Birch 1987). The 1901 GLO map of T. 9 S., R. 35 E., B.M. does not show any historic features in the analysis area. However, land patent records note three entries for Section 15 between 1919 and 1923, including one for the property showing US title to the property was transferred to May Parkinson on June 20, 1919 (Doc. #017719, Serial #688179). SHPO records show no recorded cultural sites at the property. One unevaluated lithic scatter (10BK109), not associated with the previous inventory, occurs west of the property. A project-specific inventory was not conducted.

3.16. Transportation, Access, and Public Safety

The analysis areas for transportation, access, and public safety for the MMPO and land disposal alternatives is the area of the mine, the selected land, the offered lands, and the public access routes to these areas. However, roads in the MMPO area are not analyzed in detail.

3.16.1. MMPO Area and Selected Land

The primary access to the mine is from SH 75 at mile post (MP) 219.6 by crossing the TCM Access Bridge (owned by TCMC, near the mouth of S. Creek) over the Salmon River, traveling 1.0 mile north on a private road (owned by TCMC) to S. Creek Road (public road), and traveling 3.1 miles north on S. Creek Road to a remote-controlled gate at the start of Bruno Creek Road, which leads 5.0 miles west to the main (upper) mine site. TCMC currently allows the public to use the bridge and private road. However, the company has an exclusive easement (no public access) from the BLM to use Bruno Creek Road (and to use other roads to mine facilities along drainages to Thompson Creek). The company maintains the bridge, private road, S. Creek Road from the private road to Bruno Creek Road, and Bruno Creek Road.

The highway is paved, has two lanes, and is posted 65 mph in the vicinity of the mine access bridge. The bridge is one lane (20 feet wide) and posted 3 mph for trucks. The private road and the section of S. Creek Road between the private road and Bruno Creek Road are posted 45 mph and maintained to a width of approximately 40 feet, with a gravel and magnesium chloride surface. It is unknown for how long such public access would continue on the private bridge and road. However, 0.2 mile west of the mine access bridge is the S. Creek Bridge (MP 219.4) with public access over the Salmon River. The S. Creek Bridge is the start of 1.1 miles of the lower section of S. Creek Road (public access). In addition to mine access, S. Creek Road provides access to several residences, ranches, and BLM and NFS lands in the S. Creek drainage. S. Creek Road has many branches and extends for many miles up the S. Creek drainage.

TCMC has an easement from the BLM for exclusive (non-public) access on Bruno Creek Road (main mine access road, posted 35 mph), which is a gravel road with a magnesium chloride surface. Bruno Creek Road also provides exclusive (non-public) access to the Twin Apex private property (Figure 1.2-1., rectangular area south of the TSF with "Twin Apex Mine" in southeast corner) and the Cinnabar unpatented mining claims north of the TSF. TCMC allows the owners of the Twin Apex property to use the Bruno Creek Road to access their claims. Otherwise, the BLM would grant an exclusive easement to the owners to use the road to access their property. TCMC also allows the owners of the Cinnabar claims to use the Bruno Creek Road and the TSF access roads to access their claims. However, TCMC currently leases (with an option to purchase) the claims from the owners.

The primary access to the lower mine site is at MP 215.6 on SH 75 via the Thompson Creek Bridge (two lanes, non-public access) and Thompson Creek Road (non-public access with gate on lower section through private property), which leads 3.0 miles, 4.1 miles and 6.8 miles to the bases of the Cherry Creek, Pat Hughes and Buckskin drainages, respectively. TCMC has easements from the BLM for exclusive (non-public) use of the roads up these three drainages. TCMC maintains Thompson Creek Road (gravel surface, one lane) to the Buckskin drainage, and maintains locked gates at the starts of the Cherry Creek, Pat Hughes, and Buckskin roads. Thompson Creek Road also provides access to BLM and NFS lands in the Thompson Creek drainage, and is the primary access for the Custer Lookout Tower. Thompson Creek Road extends with several branches more than 6 miles up the Thompson Creek drainage. Thompson Creek Road can be accessed by the public from SH 75 at the Slate Creek Bridge (MP 213.4) by traveling 2.6 miles east on the North Slate Creek Road (Forest Service #40040). The North Slate Creek Road has a gravel surface, is a narrow one lane, and is not maintained for winter use. A section of the road passes through property owned by TCMC, but the Forest Service has an easement from TCMC for non-exclusive (administrative and public) access on this section of the road.

Although the public does not have vehicle access on the selected land to the mine facilities (i.e., Bruno, Cherry Creek, Pat Hughes and Buckskin roads), the selected land is otherwise open to the public. The BLM is not aware of public-mine safety issues to date on the selected land. However, should there be such issues (e.g., people entering the toe area of the Pat Hughes WRSF), the BLM could issue a public closure order for portions of the selected land necessary to protect public safety under 43 CFR 8364.

From the S. Creek Bridge, SH 75 leads 25 miles northeast to US Highway (US) 93 (MP 244.3), or 30 miles west to SH 21 (MP 189.3) at Stanley. From Stanley SH 75 continues 116 miles south to Shoshone where US 93 leads 21 miles south to Interstate 84. From the junction of US 93 and SH 75, US 93 leads 2.2 miles north to Challis (MP 246.6), and a further 58 miles north to Salmon (MP 304.7). The average annual daily traffic on SH 75 (MP 227.0, Station #82) at the junction of East Fork Road 4 miles east of Clayton is 700 vehicles. The least traffic occurs during December through February, and the greatest traffic occurs during July and August.

The mine road network (133 miles in length) provides access to and throughout the mine. There are 34.4 miles of private roads, 57.6 miles of road on BLM land, and 41.0 miles of NFS roads in the currently permitted mine area. The widths of these roads vary from 10 to 70 feet. Some of those roads would remain in place for the life of the mine, whereas others are relocated or removed in accordance with operational requirements, e.g., some mineral exploration roads are developed and reclaimed within 1 year.

All of the mine roads including the Bruno Creek Road are bounded by berms with heights of at least mid-axle height of the largest self-propelled mobile equipment which usually travels the roadway, i.e., approximately 5 feet high in the pit and WRSFs used by the larger haul trucks, and approximately 3 feet high elsewhere. Thompson Creek Road does not have berms, but the MSHA may require TCMC to install such berms (~ 3 feet high) in the future. TCMC maintains these roads, the lower 3.1 miles of S. Creek Road, and the 1.0 mile of private road between S. Creek Road and the mine access bridge for all-weather travel by surface smoothing and dust control during the non-freezing season, and snow plowing and spot sanding during winter. TCMC plows the lower 6.8 miles of Thompson Creek Road and performs minor summer maintenance. The Forest Service performs all other required maintenance on the road, which typically comprises removing rock fall and minor rip rapping during high flow months.

The average annual daily traffic on US 93 (MP 301.6, Station #13) 3 miles south of Salmon is 2,600 vehicles, with least traffic during December through February (~ 1,900 vehicles), and the greatest traffic during July and August (~ 3,300 vehicles). This traffic, which includes a component of local traffic, is probably similar to that between Challis and the junction of SH 75 and US 93. The average annual daily traffic on US 93 (MP 129.1, Station #55) 31 miles southeast of Challis is 530 vehicles, with the least traffic during December through February (~ 300 vehicles), and the greatest traffic during July and August (~ 800 vehicles) (ITD 2012).

For a workforce of approximately 400 employees (maximum),[19] the TCMC commuter traffic (day and night shifts) averages approximately 105 vehicles per day, and the miscellaneous traffic averages approximately 30 vehicles per day. The miscellaneous traffic is from contractors (e.g., molybdenum concentrate transport, fuel delivery, shipping delivery), vendors, mine inspectors, tours, etc., and during a few weeks each year may average as many as 60 vehicles per day (TCMC 2011). The commuter and miscellaneous vehicles make one round trip per day, 7 days per week, 52 weeks per year, with most of the vehicles traveling between the S. Creek Bridge near Clayton and Challis. The molybdenum concentrate transport is by semi-trucks with flatbed trailers making an average of three round trips each day between the mine and Challis, at which point new drivers haul the concentrate 2,100 miles to Langeloth, Pennsylvania. Therefore, the mine-related traffic comprises approximately 70 vehicle trips per day between the TCM Access Bridge and Challis, or approximately 40 percent of the total traffic on this section of SH 75 (to its junction with US 93 near Challis).

Most of the TCMC commuter traffic occurs between 5 AM and 7 AM, and between 5 PM and 7 PM during shift changes. In addition, there is more TCMC traffic during the week (e.g., 230 commuter vehicle trips and 80 miscellaneous vehicle trips) than on weekends (e.g., 150 commuter vehicle trips and 20 miscellaneous vehicle trips). However, commuter bus service during the week from Challis to the mine resumed in April 2012 (The Challis Messenger 2012). The commuter bus reduces the number of vehicle trips by as much as 140 (Doughty 2012).

S. Creek Road receives perhaps two to five (non-mine) vehicle roundtrips per day during fall, and less than one to three vehicle roundtrips during the rest of the year. The North Slate Creek Road and upper Thompson Creek Road receive perhaps one or two (non-mine) vehicle roundtrips during fall, and less than one vehicle roundtrip during spring and summer. These two roads receive perhaps two or three (non-mine) roundtrips the entire winter, e.g., mountain lion hunters on snowmobiles. No Name Road (faint two-track) branches from Thompson Creek Road at MP 5.2. No Name Road extends part way up the No Name drainage, and the road is used by probably less than two or three people each year. In general, the non-mine traffic on S. Creek Road, North Slate Creek Road, and Thompson Creek Road is recreation-focused, and concentrated on weekends.

TCMC works to prevent vehicle accidents at the mine through behavioral awareness safety training, speed controls, road design, traffic pattern analysis and adjustment, warning signs, vehicle maintenance, establishing clear employee responsibilities, monetary incentive programs, etc. (TCMC 1996). Regardless, since 1981 there have been at least two private vehicle accidents

[19] During the 1980s the workforce was 550 with a similar composition as the current traffic, and a similar amount of traffic on SH 75. Therefore, during the 1980s there was ~ 40 percent more mine-related traffic, which would have comprised ~ 55 percent of the SH 75 traffic between the S. Creek Bridge and the junction of SH 75 with US Highway 93 near Challis.

on the main access road (Bruno Creek Road), both of which were on the descent at the last sharp curve before the lower guard station (Doughty 2012).

Vehicle accidents (related to the mine or not) on S. Creek Road and Thompson Creek Road are rare. Many vehicle accidents on highways, particularly collisions with wildlife, are never reported. However, most serious vehicle accidents are reported and documented in an electronic database maintained by the ITD. These data show 38 accidents with human injuries (average of 3.8 per year) on SH 75 during 2002 to 2011 between the S. Creek Bridge and the junction of SH 75 with US 93 near Challis (ITD 2012).

3.16.2. Offered Lands - Broken Wing Ranch

There are multiple access points to the portion of the ranch east of the Salmon River. The ranch is bisected by SH 75 (paved, 2 lanes, posted 65 mph) between MP 229.2 and MP 231.0. Lyon Creek Bridge (MP 231.2, non-public, wood deck) provides access to the portion of the ranch west of the Salmon River. The main ranch road (non-public through ranch, dirt and gravel, 1 lane) extends from SH 75 across Lyon Creek Bridge 0.4 mile north and west to the Lyon Creek ranch house, from where Lyon Creek Road extends 1.3 miles west to the western edge of BWR-1. From near this point, Leuzinger Spring Road extends 0.7 mile south to Leuzinger Spring (Figure 2.2-3).

The portion (particularly the south end) of the ranch west of the Salmon River is also accessed from SH 75 at MP 226.7 by Poverty Flat Road (public access, gravel, 1 lane) by traveling 1.5 miles north to Broken Wing Ranch Road (public access to the ranch property line, dirt, 1 lane), and then 0.3 mile to the southeast corner of the ranch. From this point there are several roads (private, dirt and gravel, 1 lane) on the ranch, but none that can be used to access the main ranch road (private, dirt and gravel, 1 lane) to the north end of the ranch during the growing season without damaging crops. The ranch can also be accessed from Poverty Flat Road via Sink Creek Road (public access, dirt, 1 lane) to Lower Sink Creek Road (public access, gravel, 1 lane) or to the unnamed road (public access, dirt, jeep track) 0.3 mile north of Lower Sink Creek Road (Figure 2.2-3). There is also a network (~ 10 miles in length) of narrow dirt tracks throughout the ranch. Traffic on the ranch is sparse with perhaps one or two vehicle round-trips and a few OHV vehicle trips per day, except during a few days in the spring and fall when tractors plow, seed and harvest hay at the ranch.

3.16.3. Offered Lands - Garden Creek Property

From Pocatello the property is reached by traveling 12.4 miles south on South Fork Mink Creek Road (Forest Service Road #163, open May 15 to November 15), and then 3.7 miles west on Scout Mountain Top Road (Forest Service Road #009, open June 1 to November 15, 2 lanes, gravel surface), the only road to the property. Scout Mountain Top Road touches the north edge of the property adjacent to the CTNF. There are no roads on the property, which is generally visited by less than one person per year as the property is not open to the public.

3.17. Hazardous Materials and Solid Waste

The analysis area for hazardous materials and solid waste for the MMPO alternatives is the mine site. No hazardous materials or solid waste are known at the selected land (North Wind 2008) or the offered lands (North Wind 2010a, 2010b), apart from common household/farm items at the

Broken Wing Ranch such as fluorescent light bulbs and batteries and fluids (e.g., oil and antifreeze) in vehicles and equipment.

Hazardous materials herein are any substance regulated by US Consumer Product Safety Commission under the Federal Hazardous Substances Act of 1960 as amended or the EPA under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (30 CFR 47.11). The mine uses hazardous materials (e.g., fluorescent light bulbs, mercury- and sodium-vapor light bulbs, paints, batteries, certain solvents such as acetone) in compliance with all applicable laws and regulations (e.g., 30 CFR 47, 56.16003-56.16004).

Solid waste is most generally any material (solid, semi-solid, liquid, or contained gas) that is discarded. Solid waste is classified as hazardous (e.g., potential to harm people, animals or the environment such as the hazardous materials listed above) or non-hazardous (e.g., glass, wood, plastic, paper, antifreeze, used oil, certain solvents such as linseed oil). Hazardous solid waste is further classified as acute (i.e., fatal to humans or substantially contribute to a serious, irreversible illness) or non-acute. TCMC does not generate any acutely hazardous solid waste, and only small quantities of non-acutely hazardous solid waste. Consequently, TCMC is a conditionally exempt small quantity generator of hazardous solid waste (CESQG) (≤ 220 pounds/month non-acutely hazardous solid waste, 40 CFR 261.5).

All of the solid waste disposal at the mine is governed by Subtitle D of the Resource Conservation and Recovery Act of 1976 as amended (RCRA), the Idaho Solid Waste Facilities Act of 1992 as amended (39 Idaho Statutes 74), and/or the IDEQ Solid Waste Management regulations (IDAPA 58.01.06). Some of the non-hazardous solid waste (e.g., paper) is disposed of at the mine in a solid waste landfill. All of the other non-hazardous solid waste (e.g., antifreeze, solvents,[20] used oil including motor oil, brake fluid, transmission fluid) is removed from the site and disposed of by private disposal/recycling companies such as and Tri-State Recycling. Similarly, all of the hazardous solid waste is removed from the site and disposed of by private disposal companies (e.g., Veolia Environmental Services) who either dispose of the waste in permitted hazardous waste facilities or facilities that beneficially use or reuse the waste.

Molybdenum disulfide (the ore mineral and main component of the concentrate produced at the mine) is also not a hazardous material. More specifically, molybdenum disulfide is an inert, essentially insoluble, dry powder with no known toxicological chronic affects (e.g., not a known or potential carcinogen), and is essentially insoluble and chemically inert under ambient conditions, particularly after heating in the mill (which makes the sulfur inert). Molybdenum disulfide is not dangerous if spilled and can be readily cleaned up by absorption by vermiculate, dry sand, earth or similar materials (Material Safety Data Sheet, IMOA 2010), or simply swept up and re-containerized.

3.17.1. Solid Waste Management

An industrial solid waste landfill (anywhere in the Buckskin WRSF) was permitted when the mine started under a conditional use permit issued by the Idaho District Seven Health

[20] Some solvents are hazardous materials, and when used are hazardous solid waste. However, TCMC does not use any hazardous solvents.

Department. The landfill is now approximately 30 acres in the west central area of the WRSF, and is now classified as a Tier II non-municipal solid waste landfill (> 2,000 cubic yards and not likely to produce leachate) under the Solid Waste Management regulations (IDAPA 58.01.06) that became effective in 2003. The landfill may be utilized for only non-hazardous solid waste generated at the mine (e.g., packaging materials, air filters, office waste, etc). The solid waste is collected in dumpsters, picked up with a compactor truck, hauled to the landfill, and placed in a trench excavated in mine overburden. Mining waste tires greater than 54 inches in diameter are buried in either the Buckskin or Pat Hughes WRSFs (39 Idaho Statutes 6501). During reclamation, TCMC would use one or two solid additional Tier II non-municipal solid waste landfills for disposal of concrete, wood, piping material, etc. The landfill(s) would depend on the configuration of the WRSFs at reclamation, but the potential locations are the 7,250 foot bench of the Pat Hughes WRSF due to the proximity to the areas that would require demolition, and the 7,600 foot bench of the Buckskin WRSF (Section 2.1.1.8).

3.17.2. Spills and Releases

A SPCC Plan was developed and implemented at the mine in January of 1981. The SPCC plan was last updated in 2010 (ARCADIS 2010). The goal of the plan is to prevent spills of all kinds and, if a spill occurs, to minimize the risk of injury to employees, minimize the risk of damage to the environment, and make all reasonable efforts to prevent the spill from becoming a reportable event (e.g., ≥ 25 gallons of petroleum, any petroleum that causes a sheen on surface water, any release of hazardous material) (IDAPA 58.01.02).

There have been two reportable spills of petroleum products within the last 5 years at the mine. The first was a release of an unknown quantity of gasoline from a pump in 2007 and a release of approximately 300 gallons of diesel fuel from a haul truck. Both of these releases were reported to the IDEQ and immediately remediated (Doughty 2012).

Since the mine began commercial molybdenum production in 1983, there have been seven incidents of molybdenum concentrate spilled onto public roadways, one on SH 20 near the Idaho National Laboratory, two on a curve on US 93 near Mackay, and four on SH 75. These spills were cleaned up by the responsible trucking companies without environmental enforcement action, including one spill of almost an entire truckload of molybdenum concentrate (33,000 pounds) into the Salmon River (with no appreciable environmental effects). Due to increased safety measures, there have been no molybdenum spills since 2001 (Doughty 2010a, 2011, 2012; IDEQ 2001).