United States Department of Agriculture

Forest Service

Bear Lodge Project

Draft Environmental Impact Statement

Bearlodge Ranger District, Black Hills National Forest, Crook and Weston Counties, Wyoming

January 2016

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Bear Lodge Project

Draft Environmental Impact Statement

Crook and Weston Counties, Wyoming

Lead Agency	USDA Forest Service	
Cooperating Agencies	US Army Corps of Engineers, USDOI National Park Service, State of Wyoming, Crook County and Crook County Natural Resource District, Weston County	
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Abstract

The environmental impact statement analyzes the no action alternative (Alternative A) and six action alternatives (Alternatives C, D, E, F, G, and H). Action alternatives include an amendment to the Black Hills Forest Plan, environmental protection measures, design features to minimize impacts, reclamation, mitigation, monitoring, and financial assurances.

Under Alternative A, the plan of operations would not be approved and the mine and connected actions would not be developed. Alternative B was the original Plan of Operations submitted in 2014. Alternative B was not analyzed in detail due to the modifications that resulted in Alternative C.

Alternative C is the modified proposed action, which reflects the Plan of Operations submitted in 2014 and modification to the exploration and reduced power line size. On National Forest lands, this alternative includes a 232-acre open pit mine, internal haul roads, pre-concentration processing plant, and access to the site via the Miller Creek Road and a power line. A waste rock storage facility would be located on private lands. When mining is complete and dewatering ceases, a pit lake would form.

Alternatives D through H are similar to Alternative C with an open pit mine, but consider alternative access and power line routes, alternative pre-concentration processing plant locations, use of generators, and configurations of the waste rock facility. The alternatives also consider pit reclamation alternatives, including partial or complete backfilling and high wall reductions.

Comments on the draft EIS will be accepted for 45 calendar days from the date the Environmental Protection Agency's notice of availability of the Bear Lodge Project Draft EIS appears in the Federal Register. Approval of the Bear Lodge Project Plan of Operations is subject to objection pursuant to 36 CFR 218, Subparts A and B. The proposed Forest Plan Amendment is subject to objection pursuant to 36 CFR 219 Subpart B. Objections will only be accepted from those who have previously submitted specific written comments regarding the proposed project or the proposed Forest Plan Amendment during scoping or other designated opportunity for public comment in accordance with §218.5(a) or §219.53. Issues raised in objections must be based on previously submitted, timely, specific written comments unless based on new information arising after the designated comment opportunities.

Executive Summary

Introduction

A Plan of Operations has been submitted by Rare Element Resources, Inc. (RER), for the purpose of exploration, construction, operation, reclamation, and closure of a rare earth elements mine in the Black Hills National Forest, Bearlodge District in Wyoming. The proposed project is called the Bear Lodge Project. On National Forest System (NFS) lands, the Plan of Operations proposes construction and operation of the Bull Hill Mine and associated facilities, the Miller Creek access road, a power line, and ongoing mineral exploration. The mine would be approximately six air miles north of Sundance, in Crook County.

The Black Hills National Forest determined that the environmental review of the proposed action, required under the National Environmental Policy Act of 1969 (NEPA), will take the form of an Environmental Impact Statement (EIS) (this document) to analyze the effects from the project.

Purpose and Need

The Forest Service's purpose and need for action is to respond to RER's Plan of Operations to mine rare earth elements for which they own private mineral rights and have a possessory interest in unpatented mining claims. The General Mining Law of 1872, as amended, establishes a right to develop a mine on federally administered lands. Forest Service surface management regulations (36 CFR 228 Subpart A) require that such mining operations "*be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources*" and be consistent with the 1997 Revised Land and Resource Management Plan for the Black Hills National Forest, as amended by the Phase II Amendment (Forest Plan).

The proposed mine development is needed to provide a supply of rare earth elements to support today's evolving technologies. Rare earth elements are the technology metals used in cell phones, televisions, lasers, wind turbines, and other modern conveniences.

The proposed exploration activities are needed to continue evaluating the geological resources.

The underlying purpose and need for the project, as determined for the USACE permitting process, is to mine and physically process rare earth elements contained within economically viable deposits in northeast Wyoming to meet a portion of the public demand.

Decisions to Be Made

The Black Hills National Forest Supervisor will decide:

- Whether the proposed project components (PUG, administration building, maintenance shops, sediment ponds, WRF, stockpiles, Mineable Pit, haul routes, production well, pipelines, access route, power line, and reclamation activities) on NFS lands should proceed as proposed or as modified by an alternative;
- Which recommended mitigation measures and monitoring requirements will be applied;
- Whether additional special use authorizations are required; and
- Whether any project-specific Forest Plan amendments will be approved.

The USACE regulates the placement of dredged or fill material into jurisdictional waters of the US under Section 404 of the Clean Water Act (CWA; 33 USC 1344). The proponent will submit an application for a Section 404 permit and the USACE must review any application and impacts before deciding to issue a permit. The USACE can only issue a permit for the least environmentally damaging practicable alternative. The USACE Wyoming State Program Manager will decide whether to:

- Issue a CWA Section 404 standard permit for the discharge of dredged and/or fill material into waters of the US for the Plan of Operations;

- Issue a CWA Section 404 standard permit with modifications, mitigations, or special conditions; or
- Deny the Section 404 standard permit.

The Black Hills National Forest and the USACE will issue separate Records of Decision.

No Action (Alternative A)

Federal regulation (40 CFR 1502.14(d)) requires consideration of a No Action alternative which serves as the baseline for estimating the effects. Because the proponent has a statutory right to mine and selection of the No Action alternative would not allow the proponent their legal right, this alternative cannot be selected. The No Action alternative does not need to meet the Purpose and Need to be considered.

The No Action alternative would be for the Forest Service to not approve the Plan of Operations. Under the No Action alternative, the Mineable Pit, PUG Plant, WRF, access road, and power line would not be constructed or operated. There would be no need for the connected actions (WRF, sediment ponds, stockpiles on private lands and Hydromet Plant) so they would also not be constructed. Exploration as proposed in the Plan of Operations would not occur. Previously approved exploration and environmental studies on NFS lands would be reclaimed by the proponent in accordance with current approvals and regulations, per the *Sundance Exploration Project Decision Notice and Finding of No Significant Impact*.

Proposed Action (Alternative C)

The Mine Area would include 1,065 acres of NFS lands and 635 acres of private lands (1,696 acres total). Portions of the access and power lines and a Hydromet Plant near Upton, Wyoming would be on private land and are considered connected actions.

- Mineable Pit - Conventional truck and excavator open pit mining methods would be used. The mineralized material to be removed lies within the oxide layer. The pit would have a disturbance footprint of approximately 232.4 acres. The bottom of the pit would be at about 5,630 feet above mean sea level (amsl), indicating that the pit would be around 500 to 550 feet deep, depending on the elevation of the top of the pit, which varies. After six to seven years, the pit depth would reach groundwater level and would require dewatering. At closure, the pit dewatering would cease and a pit lake would form as groundwater infiltrates the pit. The Plan of Operations indicates it would take approximately 100 years for the pit lake to reach a steady water level.
- PUG Plant - A Physical Upgrade (PUG) Plant, 176 acres in the Mine Area, is designed to maximize concentration of the rare earth minerals and produce a pre-concentrate using a crushing, screening, and gravity separation process. This process would reduce the physical mass of material to be transported to the Hydromet Plant. The PUG Plant area would also include a topsoil stockpile, guard station, buildings for personnel and vehicle maintenance, and storage tanks for gas and diesel. A six-foot, chain-link security fence with a “V” top would be constructed around the PUG Plant area in the Mine Area wire fence. Final reclamation of the PUG Plant area would include regrading of disturbed and compacted areas for drainage, scarification, and revegetation. Fill slopes would be graded to a maximum of 3H:1V (three horizontal run for every one vertical rise) and contoured as necessary.
- WRF - The WRF is a connected action located on private lands. The total design height of the WRF would be approximately 250 feet and material would be placed in 50-foot lifts. When completed, the WRF would reach a maximum elevation of approximately 6,200 feet amsl and the footprint would be approximately 405 acres. The final capacity of the WRF would be about 124 million tons of waste rock. The WRF would include a low grade ore stockpile. A topsoil stockpile would be located just to the east of the WRF on NFS lands. An underdrain water collection system would be constructed to control seepage and collect naturally occurring flows from seeps and springs. The collection system would be drained into four sediment ponds.

- Main Access - Miller Creek Road (County Roads 208, 266, and 8 and NFS Roads 854.1 and 847) would be the main access to the Mine Area. This 13-mile access route (2 miles on NFS lands, 11 miles other ownership) is proposed to be upgraded to accommodate two-way traffic in two 12-foot driving lanes with two 4-foot shoulders. The posted speed limit would be 30 miles per hour, unless final construction shows a slower speed is needed. The total road easement width for the access route is 80 feet. For safety, the route would be designed with grades under six percent. During operations, the mining traffic is estimated at between 13 to 17 round trips each day for semi-trucks carrying pre-concentrate ore material in addition to worker traffic and delivery supply vehicles.
- Power Line - A 25-kilovolt (kV) transmission line would be constructed above ground to provide power. The transmission line requires a right-of-way of 30 feet to manage vegetation. Approximately 1.5 miles of the power line would cross NFS lands, while the remainder would be on private and state of Wyoming lands. For maintenance purposes, PRECorp requested full vehicle access along the route. Diesel generators (2000-kilowatt, one at a time) would provide power for the first four years while the power line is constructed. It is estimated that generators would be used for the first 3 to 4 years. The generators would also serve as backup during power failures for critical systems.
- Exploration - The proponent would continue exploration activities (drilling, trenching, geologic mapping, ground geophysics and geochemical soil analysis) over the first 10 years of operations. The proponent estimates the exploration activities would consist of a total of 488 drill holes (122 rotary holes to an average depth of 660 feet and 366 core holes with an average depth of 750 feet) and approximately 21,000 feet of trenching. Prior to each exploration season, a work plan would be submitted to the Forest Service with the current years' anticipated locations for the Forest Service to approve. Access for exploration would be via existing roads, new temporary roads, and overland travel. Drill holes would be abandoned according to Wyoming Land Quality Rules and Regulations, WS 35-11-404, for plugging and abandoning drill holes. Drill pads and sumps would be reclaimed concurrently with abandonment. Roads would be reclaimed concurrently unless needed for future access for exploration or mining. They would be reclaimed after exploration activities are completed in a given area.
- A Forest Plan Amendment establishing a new management area for the mine area is proposed.
- The proponent has included Environmental Protection Measures, including reclamation and monitoring

Alternative D

Alternative D was developed to address the impacts on water and cultural resources. Major differences between Alternative C and Alternative D are:

- Reduction of the Mineable Pit highwalls and backfilling of the pit with waste rock to eliminate the pit lake at closure, creating a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms;
- The PUG Plant moved south and west to avoid riparian areas and known cultural resources;
- The dewatering pond for the Mineable Pit moved to an unnamed tributary south of the PUG Plant to avoid riparian areas. Water would be discharged into Whitelaw Creek.
- Reconfiguration of the WRF to avoid impacts on Beaver Creek. WRF located on approximately 384 acres of private lands and approximately 61 acres of NFS lands;
- Main access road access using Warren Peak Road to avoid conflicts with users on Miller Creek Road;
- Power line route located on the east side of the Bearlodge Mountains off Government Valley Road (County Road 123), generally following the Ogden Ridge Road (NFS Road 899.1A), and connecting to the existing transmission line at Warren Peak Fire Tower on the Warren Peak Road (NFS Road 838) then NFS Road 838 to the PUG Plant. The power line would be 9.4 miles.

- Smaller fenced Mine Area than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features identified by the Forest Service to reduce impacts.

Alternative E

Alternative E was designed to reduce impacts on cultural resources and current NFS land uses by reducing the NFS acres within the Mine Area fence. The major differences between Alternative C and Alternative E are:

- Reduction of Mineable Pit highwalls to a 3:1 slope or less where overburden would be placed in the pit at closure. Pit walls would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. A shallow pit lake (5 to 15 feet deep) would likely form.
- Main Access Route would use NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838).
- The PUG Plant would be moved to Tract 42 (private lands) so as to minimize the NFS lands within the Mine Area fence.
- Water supply for the PUG Plant would be the same supply well as Alternative C; however a pipeline would be constructed across NFS lands to the PUG Plant.
- Reconfiguration of the WRF to avoid impacts on Beaver Creek by at least 100 feet.
- Elimination of the power line. Instead, power would be supplied for the life of the mine by one 2,000kW generator for years 1 through 9 and two 2,000kW generators for years 10 through 45.
- Fenced Mine Area is smaller than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features have been identified by the Forest Service.

Alternative F

Alternative F was developed to reduce the long-term potential impacts on current NFS land uses, by reducing the NFS acres within the Mine Area fence and reducing risks to public safety. The major differences between Alternative C and Alternative F are:

- The PUG Plant would be moved to private lands in Tract 42 (same as Alternative E) to reduce the size of the fenced Mine Area.
- Reconfiguration of the WRF to avoid potential impacts on Beaver Creek by at least 300 feet. The WRF would be engineered to more closely follow natural landforms.
- Reduction of Minable Pit highwalls would be similar to Alternative D, however, the mineral withdrawal area to the south would not be included in the reclamation area and additional waste rock would not be used for backfill. A pit lake up to 70 feet deep would form. Pit walls on the north, east, and west would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. Pit highwall on the south and southwest would remain as constructed to avoid affecting the mineral withdrawal area.
- Main access route would use NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838).
- Power line route from Government Valley Road (County Road 123) and along NFS Road 858.
- Smaller fenced Mine Area than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.

- Design Features have been identified by the Forest Service.

Alternative G

This alternative is designed to reduce even more than Alternative D the potential risks to water resources. The major differences between the Alternative C and Alternative G are:

- PUG Plant would be the same as Alternative D.
- The dewatering pond for the Mineable Pit would be located on an unnamed tributary south of the PUG Plant. Water would be discharged into Whitelaw Creek.
- WRF would avoid Beaver Creek by at least 300 feet and incorporate an impermeable cap and liner system to isolate waste rock from rain, snowmelt, or springs. The majority of the waste rock would be returned to the pit at closure.
- Mineable Pit reclamation would require a complete backfill with waste rock to approximate the pre-mining topography and installation of an impermeable cap to prevent rain and snowmelt from coming in contact with waste rock in the pit.
- The fenced Mine Area would be smaller than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features have been identified by the Forest Service.

Alternative H

This alternative is designed to consider all of the main issues into one alternative. The major differences between the Alternative C and Alternative G are:

- PUG Plant would be the same as Alternative D.
- The dewatering pond for the Mineable Pit would be located on an unnamed tributary south of the PUG Plant. Water would be discharged into Whitelaw Creek.
- WRF would avoid Beaver Creek by at least 100 feet and resemble the design of Alternative E.
- Mineable Pit reclamation would be the same as Alternative F and avoid the mineral withdrawal area to the south. A pit lake up to 70 feet deep would form. Pit walls on the north, east, and west would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. Pit highwall on the south and southwest would remain as constructed to avoid affecting the mineral withdrawal area.
- The fenced Mine Area would be smaller than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features have been identified by the Forest Service.

Forest Plan Amendment

The Black Hills National Forest proposes to amend its Forest Plan to allow activities integral to the Bear Lodge Project on NFS lands. The amendment would apply to all action alternatives. The proposed Forest Plan amendment consists of a new management area that specifically addresses mining activities within the Mine Area, which varies by alternative.

The proposed new management area is referred to as Management Area 8.4 – Mining. It includes standards and guidelines specifically developed to allow mining to comply with an amended Forest Plan. All ground-disturbance from mining activities on NFS lands would be located within the boundaries of the proposed management area, with the exception of the utility route and access road construction. The final boundaries of

this management area for the Bear Lodge Project would be the Mine Area fence which may be modified, depending on which alternative is ultimately selected for implementation. Any revisions will be described in the FEIS and ROD.

The activities that would be approved in this management area are restricted in geographic extent (0.08 percent of the NFS land in the Black Hills National Forest and 0.20 percent of the total Management Area 5.1 acres) and would not have wide-ranging effects across the Black Hills National Forest.

Proponent Committed Environmental Protection Measures

The Plan of Operations and its 15 appendices provide Environmental Protection Measures and details on plans for specific resources. The Forest Service interdisciplinary team and the Cooperating Agencies developed additional measures. The proponent would be responsible for completing all protection measures, including developing plans, monitoring, and maintenance through reclamation.

Proponent Committed Environmental Protection Measures

These measures would apply to the other action alternatives, unless specifically stated or if the alternative design precludes the measure. For example, reclamation of the WRF in Alternative G precludes the concurrent reclamation. For the period this EIS is available for public review, the Plan of Operations and its appendices are available online[1] at http://tinyurl.com/BearlodgeMineProject.

Design Features

The interdisciplinary team reviewed the Plan of Operations and appendices for the proposed activities and environmental protection measures to be applied on NFS lands and compared them with the Forest Plan standards, the National Core Best Management Practices (BMPs), Wyoming state agencies regulations, and USACE regulations. Additionally, the public comments received during scoping and measures requested by cooperating agencies have been considered and included where appropriate.

Black Hills National Forest Land and Management Plan Standards; Watershed Conservation Practices (WCP); Black Hills Weed Management Plan (US Forest Service, 2003); Black Hills Fire Management Plan and annual agreements with Crook County; and Wyoming state BMPs would be followed during implementation, unless otherwise noted.

Agency Preferred Alternative

The Forest Supervisor has indicated Alternative H as the preferred alternative.

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[1] http://www.fs.usda.gov/wps/portal/fsinternet/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gDfxMDT8MwRydLA1cj72BTUwMTAwgAykeaxRtBeY4WBv4eHmF-YT4GMHkidBvgAI6EdIeDXIvfdrAJuM3388jPTdUvyA2NMMgyUQQAyrgQmg!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfS000MjZOMDcxT1RVODBJN0o2MTJQRDMwODQ!/?project=37875.

Summary Comparison of Alternatives

Comparison of Activities

Table S-1 summarizes the major components of the alternatives compares the differences between them.

Table S-1.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
Mine Area Fence	5-wire fence.	3- or 4-wire fence.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
	1,696 acres (1,062 NFS acres)	1,494 acres (860 NFS acres)	1,240 acres (606 NFS acres)	1,488 acres (854 NFS acres)	1,495 acres (861 NFS acres)	1,377 acres (743 NFS)
Mineable Pit	232 acres	232 acres	232 acres	232 acres	232 acres	232 acres
Mineable Pit at Closure	Pit highwalls reduced to stable slope; with pit lake that is permanently closed to the public and wildlife. 232 acres permanently closed.	Post closure pit would have access for administration, public use, safety, and wildlife. Highwalls above groundwater level reduced to a maximum 3:1 slope.	Post closure pit would have access for administration, public use, safety, and wildlife. Highwalls from bottom of pit reduced to a maximum 3:1 slope	Same as Alternative D, except highwalls remain on south and southwest to avoid the mineral withdrawal.	Pit backfilled to pre-mining topography. Post-mining access for public and wildlife.	Same as Alternative F
	No impermeable cap	Same as Alternative C	Same as Alternative C	Same as Alternative C	Impermeable cap to prevent infiltration of surface water.	Same as Alternative C.
	Pit lake after 50-100 years.	No pit lake. Partial backfill of pit with waste rock to natural groundwater level	Shallow lake (5 to 15 feet deep).	Shallow lake up to 70 feet deep depending on volume of reclamation material generated.	No pit lake. Complete backfill with waste rock and return to natural topography	Same as Alternative F.

Table S-1.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
	No additional acres disturbed at reclamation	Additional 95 acres disturbed then reclaimed to a 3:1 slope.	Additional 104 acres disturbed then reclaimed to a 3:1 slope.	Additional 42 acres disturbed then reclaimed to a 3:1 slope except on south and southwest to avoid mineral withdrawal.	No additional acres disturbed at reclamation.	Same as Alternative F.
PUG Plant	Located on NF lands; 176 acres	PUG Plant, located on NFS, moved to avoid riparian areas and known cultural sites. Size reduced to 110 acres.	PUG Plant (including facilities) would be in Section 16 on private land. Beaver Creek and unnamed tributaries avoided by 100 feet.	Same as Alternative E.	Same as Alternative D.	Same as Alternative D.
PUG Plant at Closure	Disturbed and compacted areas would be regraded for drainage, scarified, and revegetated. Fill slopes would be graded to a maximum of 3H:1V and contoured as necessary.	Removal of all facilities and re-contouring to pre-mining conditions to the extent possible.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
WRF	Located entirely on private lands in Sec 16.	WRF would stay north of Beaver Creek by at least 100 feet and extend north of Section 16 on to NFS lands in Section 15.	WRF would stay north of Beaver Creek by at least 100 feet, and remain mostly in Section 16.	Would stay north of Beaver Creek at least 300 feet and extend north and east of Section 16 on to NFS lands in Section 15 and 9.	Would stay north of Beaver Creek by at least 300 feet. WRF would extend north of Section 16 on to NFS lands in Section 15. Cap and liner system.	Same as Alternative E.

Table S-1.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
	Footprint would be 405 acres and highest elevation would be 6,200 feet amsl.	Footprint would be 445 acres (44 acres on NFS) and highest elevation would be 6,215 feet amsl.	Footprint would be 378 acres and highest elevation would be 6,320 amsl.	Footprint would be 621 acres and highest elevation would be 6,155 amsl.	Footprint would be 445 and highest elevation would be 6,215 amsl.	Same as Alternative E.
	4,000 feet of Beaver Creek diverted.	Beaver Creek not diverted and avoided by 100 feet.	Same as Alternative D.	Beaver Creek not diverted and avoided by 300 feet.	Same as Alternative F.	Same as Alternative E.
WRF at Closure	Regrading, contouring, revegetation, and topsoil placement will occur progressively.	Final reclamation would follow natural landforms utilizing a 3:1 slope. Footprint reduced to 329 acres due to backfilling.	Same as Alternative C.	Final reclamation engineered to follow natural landforms with a more natural appearance, utilizing a 3:1 slope. 621-acre footprint.	Reduced WRF size due to back filling.	Same as Alternative E.
	124 million tons of waste rock in WRF.	123 million tons of waste rock in WRF.	124 million tons of waste rock in WRF.	124 million tons of waste rock in WRF.	33 million tons of waste rock in WRF.	Same as Alternative E.
Access Route	Lytle/Miller Ck Roads (FSR 847/854.1 to County Road 8, 208, 266) – with 80 foot ROW.	Warren Peak Road (County Road 100 and FSR 838) – includes 1.4 mile reconstruction – with 66 foot ROW.	FSR 879.1 to Warren Peak (FSR 838) – aligns with road when appropriate - with 66 foot ROW	Same as Alternative E.	Same as Alternative C, except a 66-foot ROW.	Same as Alternative G.
	No change in surfacing.	Change surfacing on Warren Peak Road from paved to aggregate.	Change surfacing on Warren Peak Road from paved to aggregate.	Same as Alternative E.	Same as Alternative C.	Same as Alternative C.
Power	5.0 miles of new power line.	9.4 miles of new power line.	No power line.	5.9 miles of new power line.	Same as Alternative C.	Same as Alternative C.
	25kV Miller Creek; follows the access road corridor; Above ground.	25 kV; Ogden Ridge Warren Peak Route.	Power produced onsite using 2 2000 kW diesel generators.	25kV; Peterson Fire Trail/Government Valley Route.	Same as Alternative C.	Same as Alternative C.

Table S-1.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
Exploration	2000 acres; 488 drill holes and 21,000 feet trenching.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.

Disturbance

Table S-2 compares the acres of disturbance on NFS lands and the total acres of disturbance for all land ownership by alternative.

Table S-2.
Acres of Estimated Surface Disturbance by Alternative

	Alternative C		Alternative D		Alternative E		Alternative F		Alternative G		Alternative H	
New Disturbance	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**
Mine Pit	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4
Additional Pit Reclamation	0	0	94.8	94.8	104.4	104.4	38.6	38.6	0	0	38.6	38.6
PUG	2.6	2.6	2.1	2.1	0.0	2.1	0.0	2.1	2.1	2.1	2.1	2.1
PUG Facilities (including guardhouse)	14.4	14.4	14.5	14.5	0.0	14.0	0.0	14.0	14.5	14.5	14.5	14.5
PUG Haul Road	6.1	6.1	10.6	10.6	2.3	9.4	1.2	8.0	10.6	10.6	10.6	10.6
WRF (including ore stockpiles)	0.2	405.2	61.0	444.5	3.1	378.4	232.6	620.9	61.0	444.5	3.1	378.4
WRF Haul Road2 and Secondary Haul Road	19.4	21.0	10.9	14.9	0.7	0.9	-	-	10.9	14.9	3.0	3.2
Access Road New Construction	16.7	79.2	50.0	72.0	35.1	61.2	35.1	61.2	15.5	63.5	15.5	63.5
Pit Dewatering Pond	5.1	5.1	7.9	7.9	5.5	5.5	5.5	5.5	7.9	7.9	7.9	7.9
Sediment Pond	4.5	12.1	6.9	9.4	3.6	10.3	6.4	7.2	7.0	9.4	6.9	9.4
Drainage Channel	2.1	5.8	3.0	5.2	2.6	4.9	2.4	2.8	3.0	5.2	2.6	4.9
Water Pipeline	0.4	0.4	0.3	0.3	2.7	5.2	2.5	4.9	0.3	0.3	0.3	0.3
Beaver Creek Diversion	0	7.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Topsoil Stockpile	27.0	27.0	4.1	20.8	0.3	17.0	0.3	16.9	3.8	24.1	4.1	20.8
Topsoil Stockpile Access	0.2	0.4	NA	NA	0.0	0.1	0.0	0.1	NA	NA	NA	NA
Fence Construction	4.8	4.8	4.4	4.4	3.5	3.5	3.8	3.9	4.4	4.4	4.3	4.3
Fence Maintenance Road	7.3	7.3	5.9	6.6	7.2	7.9	8.1	8.3	5.9	6.6	7.7	8.4
Power Line Substation	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
25kV ROW	5.9	10.3	22.6	29.9	NA	NA	11.5	19.8	6.2	11.6	6.2	11.6
Total New Disturbance	**349.1**	**841.3**	**531.4**	**970.4**	**403.6**	**857.5**	**579.5**	**1,043.9**	**385.5**	**852.1**	**359.9**	**811.0**

Source: Table 4.5-1 (RER, 2014a) and GIS
Totals may not add up exactly due to rounding.

Summary Comparison of Impacts

Table S-3 summarizes the impacts on resources by alternative.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Issues and Indicators and Section where detailed analysis appears						
Water Quality (Section 3.10)						
• Effects on stream channels	Beaver Creek bypass would be 4,000 feet of engineered channel could result in a loss of functional habitat, could lead to additional sediment and erosion in the bypass.	No diversion channel would be constructed for Beaver Creek.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
	Partial removal of Whitetail Creek and Beaver Creek headwaters by the Mineable Pit	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
	11.8 acres of Water Influence Zones disturbed during construction.	27.3 acres of Water Influence Zones disturbed during construction.	18.5 acres of Water Influence Zones disturbed during construction.	29.0 acres of Water Influence Zones disturbed during construction.	11.0 acres of Water Influence Zones disturbed during construction.	8.2 acres of Water Influence Zones disturbed during construction.
	18,371 linear feet of stream channel disturbed during construction.	8,310 linear feet of stream channel disturbed during construction.	8,740 linear feet of stream channel disturbed during construction.	13,897 linear feet of stream channel disturbed during construction.	8,297 linear feet of stream channel disturbed during construction.	7,762 linear feet of stream channel disturbed during construction.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• In-stream flow	Increased instream flow in Whitetail Creek and lower portion of Whitelaw from pit dewatering (years 7-45). Increased flow increases erosion and sediment in Whitetail Creek during dewatering.	Increased instream flow in Whitelaw Creek (avoids Whitetail Creek) and lower portion of Whitelaw from pit dewatering (years 7-45). Increased flow increases erosion and sediment in Whitetail Creek during dewatering.	Similar to Alternative C.	Similar to Alternative C.	Similar to Alternative D.	Similar to Alternative C.
	Less than 1% decrease in flow after augmentation from pit dewatering ceases from pit lake evaporation.	No pit lake evaporation.	Same as Alternative C.	Same as Alternative C.	No pit lake evaporation	Same as Alternative C.
• Surface Water Quality	WDEQ will establish discharge limits and the proponent will be required to meet them. Therefore, all permitted discharge will meet water quality discharge standards even if treatment is required to meet the standard.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.
	Post-mine pit lake water quality may degrade surface water, indirectly through seepage into Whitetail and Whitelaw creeks.	No pit lake effects.	Same as Alternative C.	Same as Alternative C.	No pit lake effects.	Same as Alternative C.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Groundwater Quality	Post-mine Pit lake water quality will meet standards to be established by WDEQ. Because of flow-through characteristics, pit lake water could enter groundwater and degrade groundwater quality, causing exceedance of current groundwater standards for some constituents.	No pit lake, no groundwater effects from pit lake. Groundwater flowing through the backfill could degrade groundwater quality, causing exceedance of current groundwater standards for some constituents.	Similar to Alternative D.	Pit lake water would have similar effects as Alternative C. Evaporation of pit lake water would reduce the water that come in contact with partial pit fill which would then enter groundwater and reduce groundwater effects compared to Alternatives D and G.	Similar but slightly better for groundwater, although cover would reduce rain and snowmelt water from filtering into the backfill.	Similar to Alternative F.
• Groundwater designated uses	Designated uses protected.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Effects of blasting on springs and wells	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Cultural Resources (Section 3.7)						
• Historic Properties directly affected	4 historic properties potentially affected by the PUG and access route; 3 may result in no direct impacts	Same as Alternative C.	No historic properties potentially affected	Same as Alternative E	Same as Alternative C	Same as Alternative C

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Health and Safety (Section 3.18)						
• Public exposure to nonradioactive constituents and radioactive materials through dust and material falling from trucks.	Higher potential just outside the Mine Area fence. Residential exposure along haul route to gamma radiation exposure would be too low to measure.	Additional dust and particulates generated from 18 years of pit reclamation, but contaminant concentrations should be lower than those estimated for operations.	Similar to Alternative D.	Similar to Alternative D, except additional dust would occur for 15 years.	32 years of additional dust from hauling backfill. At closure, exposure potential eliminated.	Same as Alternative D.
• Exposure to radioactive or hazardous elements from ingesting meat from beef, sheep or wild game	Meat not likely to contain significant concentrations of radioactive or hazardous elements, not a significant exposure pathway.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Exposure to contaminants in water	Radium – Exceeds drinking water standard in pit lake.	No pit lake.	Similar to Alternative C.	Similar to Alternative C.	No pit lake.	Similar to Alternative C.
• Impacts on human health from rare elements	Element-specific air concentration estimates indicate potential inhalation hazards from dust during operations.	Same as Alternative C, extended for 18 years due to reclamation.	Same as Alternative D.	Same as Alternative C, extended for 15 years due to reclamation.	Same as Alternative C extended for 32 years due to reclamation.	Same as Alternative C, extended for 15 years due to reclamation.
• Road use	Access road open to public use. Mixed use of mine traffic, recreational, and residential use on Miller Creek.	Access road open to public use. Mixed use of mine traffic, recreational, and residential use on Warren Peak Road, currently the main access route for visitors to NFS lands.	Access road open to public use. Mixed use of mine traffic, recreational, and residential use Warren Peak Road, currently the main access route for visitors to NFS lands.	Same as Alternative E.	Same as Alternative C.	Same as Alternative C

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Social and Economic (Section 3.17)						
• Spent during Construction	$71 million	$65 million	$66 million	$65 million	$106 million (including $37 million for WRF liner)	$65 million
• Employment during Construction	180-240 workers $19 million employee compensation	160-220 workers $18 million employee compensation	160-220 workers $17 million employee compensation	160-220 workers $17 million employee compensation	270-333 workers $21 million employee compensation	160-220 workers $17 million employee compensation
• Operations • Annual spent first 9 years	$14 million	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Annual spent Following Years of Operations	$12 million	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Employment during Operations Year 1-9	145 in Crook County 55 in Weston County	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Employment during Operations Year 10-15	115 in Crook County 50 in Weston County	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Property taxes	$20-25K in Crook County	About the same as Alternative C.	About the same as Alternative C.	About the same as Alternative C.	$30K in Crook County	About the same as Alternative C.
• Sales tax	$1.4 million	About the same as Alternative C.	About the same as Alternative C.	About the same as Alternative C.	$2.1 million	About the same as Alternative C.
• Cost of Closure and Reclamation of Mine Area	$20 million $10 million/year for Mine Area for 2 years.	$165 million $9.2 million/year for 18 years.	$177 million $9.9 million/year for 18 years.	$106 million $9.0 million/year for 12 years.	$426 million $13.3 million/year for 32 years.	$106 million $9.0 million/year for 12 years
• Employment during closure	70 jobs per year for 2 years.	50-55 jobs for 18 years.	55-60 jobs for 18 years.	50-55 jobs for 15 years.	40-45 jobs for 32 years.	50-55 jobs for 15 years.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Revenue loss from reduction in hunting or recreational opportunities	It is expected that some revenue losses resulting from recreational activities may occur as individuals choose to no longer participate in activities in the area; however, the exact value cannot be determined due to personal choice. Loss revenues could result from commodities offered from communities or licenses issued by WGFD.					
Access and Transportation (Section 3.4)						
• Traffic increase from process concentrate hauling	13-17 round trips per day on Miller Creek Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, increase in supply trucks particularly for fueling the power generators and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	Same as Alternative C	Same as Alternative C.
• Residences along the access route	5 houses within ¼ mile buffer, 10 driveways total along road	52	52	52	5 houses within ¼ mile buffer, 10 driveways total along road	Same as Alternative G.
• Miles from PUG Plant to Upton	40.2	38.8	38.1	38.1	40.2	Same as Alternative G.
• Miles of Currently Open NFS Roads on NFS lands in Mine Area	5.0	1.6	1.4	2.7	2.6	2.4
Air and Climate (Section 3.6)						
• Percent of Annual NAAQS limit (**Table 26**)	3.6-87.8	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Greenhouse Gas Emissions	55,929 tons per year of total CO_2e (total, direct and indirect)	Same as Alternative C.	Addition of generators for the life of the project would emit about 7,084 additional tons of CO_2 per year, totaling up to 32,361 tons per year of CO_2.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
Aesthetics and Visual Quality (Section 3.5)						
• Meets SIO	Mine pit meets SIO of low, but not the small portion that is moderate. Miller Creek Access and power line are largely in moderate SIO.	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Warren Peak Access and power line are largely in low SIO	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Access is largely in low SIO and would meet	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Access and power line are would meet low SIO but not high SIO.	Mine pit meets SIO of low, but not the small portion that is moderate. Miller Creek Access and power line are largely in moderate SIO	Same as Alternative C.
• Warren Peak Viewpoint	Permanent visual intrusion from pit walls and pit lake in the foreground and WRF in the middle ground, where eventually the color and form contrast would reduce. The pit lake would create contrast in landform, color, texture.	41% more disturbance at reclamation for backfilling, grading, and revegetation of pit. WRF visible in the middle ground. Eventually the color and form contrast would reduce. The pit lake would not form to create contrast in landform, color, texture.	45% more disturbance at reclamation for backfilling, grading, and revegetation. WRF visible in the middle ground. Eventually the color and form contrast would reduce. The pit lake may create contrast in landform, color, texture.	17% more disturbance at reclamation for backfilling, grading, and revegetation. WRF visible in the middle ground. Eventually the color and form contrast would reduce. The pit lake would create contrast in landform, color, texture.	Mineable Pit would be eliminated and essentially disappear as a meadow is formed. Once reclaimed, the WRF would likely not be as noticeable in the middle-ground views.	Same as Alternative F.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• NFS Road 831 Viewpoint	Permanent but partially obscured view of WRF and angular, engineered appearance	At reclamation, in the long term, the WRF would eventually become less noticeable as the slopes become revegetated. Visual impacts would be permanent.	Same as Alternative D.	Same as Alternative D.	Mineable Pit would be eliminated and essentially disappear as a meadow is formed. Once reclaimed, the WRF would not be as noticeable in the foreground and middle-ground views. There would not be permanent visual effects.	Same as Alternative D.
• Devils Tower NM, Inyan Kara Mountain, Wyoming Welcome Center Viewpoint, and Crow Peak Viewpoints	WRF visible towards the end of mining and during night activities from lighting, some may notice the engineered and somewhat angular appearance. Eventually, the contrast would be reduced enough that it may not attract the attention of viewers from these viewpoints, especially once trees become established.	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation	WRF may be visible during construction, particularly at night when lighted – but after reclamation, WRF may be naturally appearing in the background only from the top of the Devils Tower	WRF may be visible during construction, particularly at night when lighted – but not after reclamation	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Night skies	At night, lighting from mining operations and headlights would change the nighttime landscape character by increasing sky glow. Night sky observation would be adverse in the foreground and middle ground (Warren Peak Fire Tower and NFS Road 831). Nighttime lighting of the WRF during operations may be visible from Devils Tower National Monument as the WRF elevation increases in the second half of the mine life at a distance of 13 miles.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C with additional time where WRF operations would be lit and visible at night as the waste rock is hauled back to the pit, possibly another 20 years.	Same as Alternative C.
Soils (Section 3.8)						
• Cubic yards of stockpiled soil from NFS lands	672,474	834,900	572,330	1,035,760	763,913	697,176
• Cubic yards of stockpiled soil from NFS lands due to pit reclamation total	0	191,136	207,381	84,095	0	84,095

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Cubic yards of stockpiled soil from NFS lands due to access road on NFS	27,667	66,240	61,017	66,240	17,550	17,550
• Cubic yards of stockpiled soil from NFS lands WRF	284	122,246	6,327	458,940	122,246	6,327
• Cubic yards of stockpiled soil from WRF total	634,042	874,277	742,708	1,218,436	874,277	742,708
Geology, Minerals, Stability (Section 3.9)						
• Material removed from the Mineable Pit	Approximately 151 million tons	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Mineral Resources Recovery Impaired by Reclamation	None	978 million pounds of rare earth elements worth $10.93 billion	Same as Alternative D.	Same as Alternative D.	1,160 million pounds of rare earth elements worth $12.94 billion	Same as Alternative D.
Fish and Wildlife (Section 3.11, Table 47)						
• ESA Listed Species	May affect, likely to adversely affect.					
• R2 Sensitive Species	Species known to occur in the project area may be adversely affected, but not likely to affect population viability or contribute to federal listing.					
• MIS	Species known to occur in the project area may be affected by habitat removal. Some species may benefit from altered habitats.					
• Species of Local Concern	The proposed project would not conserve or enhance habitat for these species of local concern. Individuals would likely be affected by loss of habitat.					
• Big Game Species	Loss and alteration of habitat and increase in human presence would likely affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Mortalities may occur due to vehicle collisions and fence entrapments. Not likely to cause a loss of species viability range-wide.					
• Migratory Birds	Loss and alteration of habitat and increase in human presence would affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Not likely to cause a loss of species viability range- wide, as individuals would be able to move away from activity.					

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Wild turkey	Likely to adversely impact individuals and local population viability in the analysis area. Not likely to cause a loss of species viability range-wide, as populations are known to use other areas of suitable habitat in the vicinity.					
Vegetation (Section 3.11)						
• Acres of Vegetation Type Disturbed on NFS lands						
Already Disturbed	6.9 acres	7.6 acres	8.8 acres	10.9 acres	7.2 acres	7.0 acres
Riparian	13.7 acres	15.5 acres	13.0 acres	19.8 acres	15.0 acres	11.5 acres
Aspen	22.0 acres	37.5 acres	37.6 acres	35.2 acres	25.6 acres	22.9 acres
Grass	47.3 acres	79.8 acres	72.1 acres	65.1 acres	47.2 acres	46.8 acres
Ponderosa Pine	260.4 acres	381.1 acres	270.1 acres	441.8 acres	288.0 acres	229.0 acres
Wetland	1.4 acres	2.5 acres	1.1 acres	6.7 acres	2.5 acres	0.7 acres
Cropland	1.9 acres	0.0 acres	0.0 acres	0.0 acres	0.6 acres	0.6 acres
Total	**353.6** acres	**526.6** acres	**402.7** acres	**579.5** acres	**386.2** acres	**318.6 acres**
Wetlands and Riparian (Section 3.12)						
• Total Wetland Affected	2.8 acres	2.8 acres	1.4 acres	7.2 acres	2.8 acres	0.9 acres
• NFS Wetland Permanently Removed by Mineable Pit	0.5 acres	0.5 acres	0.5 acres	0.5 acres	0.5 acres	0.5 acres
• NFS Wetland removed due to the PUG Plant	0.1 acres	0.0 acres	0.0 acres	0.0 acres	0.0 acres	0.0 acres
• Wetland Permanently lost from WRF and Roads	0.9 acres	1.4 acres	0.0 acres	5.9 acres	1.4 acres	0.1 acres

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Timber (Section 3.13)						
• NFS Timber affected by construction	257 acres	316 acres	208 acres	419 acres	287 acres	206 acres
• Timber Volume Harvested from NFS lands	1,016 MBF 2,122 CCF	1,387 MBF 2,927 CCF	1,063 MBF 1,497 CCF	1,834 MBF 3,865 CCF	1,317 MBF 2,772 CCF	943 MBF 1,985 CCF
• Timber Affected by Pit Reclamation	0 acres	55 acres	62 acres	42 acres	0 acres	Same as Alternative F
• NFS Ponderosa Pine Timber Volume Harvested due to Pit Reclamation	0	228 MBF 492CCF	253 MBF 549 CCF	189 MBF 411 CCF	0	Same as Alternative F
Livestock Grazing (Section 3.15)						
• Acres in Mine Area	NFS Acres / Total Acres	NFS Acres / Total Acres	NFS Acres / Total Acres	NFS Acres / Total Acres	NFS Acres / Total Acres	NFS Acres / Total Acres
Divide Allotment	401 / 415	336 / 350	112 / 126	172 / 186	336 / 350	250 / 264
Ogden Allotment	3 / 4	2 / 3	2 / 3	3 / 3	2 / 3	2 / 3
Warren Peak Allotment	662 / 1,281	527 / 1,146	495 / 1,114	682 / 1,302	527 / 1,146	491 / 1,110
Total Acres	1,066 / 1,700	865 / 1,499	609 / 1,243	857 / 1,491	865 / 1,499	743 / 1,377
Recreation and Land Use (Section 3.16)						
• Recreation	Recreational experience modified by noise, dust, and lights for the life of mine through reclamation. Concurrent reclamation plus 2 years after closure. Mineable Pit permanently closed,	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 18 years closure plus 2 years reclamation. Partial pit backfill to restore area to multiple land uses.	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 18 years closure plus 2 years reclamation. Post closure access for potential public use.	Similar to Alternative C. Concurrent reclamation plus 12 years closure plus 2 years reclamation. Post closure access for public use.	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 32 years closure plus 2 year reclamation. Post closure access for public use.	Similar to Alternative C. Concurrent reclamation plus 12 years closure plus 2 years reclamation. Post closure access for public use.

Table S-3.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Loss of public hunting on NFS lands by percent of Hunt Area						
Hunt Area 1	0.6 percent	0.5 percent	0.4 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Hunt Area 2	1.2 percent	1.0 percent	0.7 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Hunt Area 116	1.2 percent	1.0 percent	0.7 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
• Miles of Snowmobile Trails on NFS lands in the Mine Area	3.1	1.6	0.2	0.4	2.2	2.2
• Special Uses affected	1 hunting outfitter within Mine Area. 1 winter recreation event affected by loss of trails.	1 hunting outfitter within Mine Area. 1 winter recreation event and 2 summer recreation events affected by project activities	1 hunting outfitter within Mine Area. 1 winter recreation event and 1 summer recreation events affected by project activities	Same as Alternative D.	Same as Alternative C.	Same as Alternative C.
Land Uses (also see Table 15)						
• Mineral Withdrawal	Mine fence crosses withdrawn lands	Mine fence, access road, and power line corridor crosses withdrawn lands. Reclamation of mine pit encroaches into withdrawn land by a maximum distance of 1,165 feet and 55 acres.	Mine fence crosses withdrawn lands. Reclamation of mine pit encroaches into withdrawn land by a maximum distance of 1,200 feet and 57 acres.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.

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Appendices

Appendix A Proponent Committed Environmental Protection Measures
Appendix B Emergency Response Plan Applicable to All Action Alternatives

Acronyms

AMP	Allotment Management Plan
amsl	above mean sea level
APE	Area of Potential Effects (Cultural)
AQD	Air Quality Division (Wyoming)
ARI	Aquatic Resources Inventory
ASQ	Allowable Sale Quantity
ATF	US Bureau of Alcohol, Tobacco, and Firearms
AUM	Animal Unit Month
bgs	below ground surface
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
CCF	100 Cubic Feet
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cfs	cubic feet per second
COC	Chemicals of Concern
CWA	Clean Water Act
DBH	Diameter at Breast Height
DOD	U.S. Department of Defense
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
FLPMA	Federal Land Planning and Management Act
Forest Plan	1997 Land and Resource Management Plan for the Black Hills National Forest, as Amended by the Phase II Amendment
FSH	Forest Service Handbook
FSM	Forest Service Manual
GHG	Greenhouse Gas
GIS	Geographic Information System
gpm	gallons per minute
HAP	hazardous air pollutant
HSU	Hydrostratigraphic Units
HUC	Hydrologic Unit Code
Hydromet	Hydrometallurgical

LQD	Land Quality Division, Wyoming DEQ
MBF	One Thousand Board Feet
MIS	Management Indicator Species
mph	miles per hour
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHPA	National Historic Preservation Act
NAIP	National Agricultural Imagery Project
NOI	Notice of Intent
NPS	US National Park Service
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
OSHA	Occupational Safety and Health Administration
PM (10 and 2.5)	Particulate Matter less than 10 microns in diameter or less than 2.5 microns in diameter
PRECorp	Powder River Energy Corporation
PUG Plant	Physical upgrade plant
RER	Rare Element Resources, Inc.
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
ROW	Right of Way
RV	Recreational Vehicle
SGS	Stream Gage Station
SEO	State Engineer’s Office
SHPO	State Historic Preservation Office
SIO	Scenic Integrity Objective
SPCC	Spill Prevention, Control, and Countermeasures Plan
SWPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids

TSS	Total Suspended Solids
THPO	Tribal Historic Preservation Officers
US	United States
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USDA	United States Department of Agriculture
USDOI	United States Department of Interior
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
USC	United States Code
VFD	Volunteer Fire Department
VOC	Volatile Organic Compound
VQO	Visual Quality Objection
WAAQS	Wyoming Ambient Air Quality Standards
WCP	Watershed Conservation Practices
WCRM	Western Cultural Resource Management
WDEQ	Wyoming Department of Environmental Quality
WDOT	Wyoming Department of Transportation
WGFD	Wyoming Game and Fish Department
WQD	Water Quality Division
WRF	Waste Rock Facility
WY	Wyoming
WYCRO	Wyoming State Historic Preservation Office Cultural Records Office
WYPDES	Wyoming Pollution Discharge Elimination System

Chapter 1
Purpose and Need

1.1 Introduction

A Plan of Operations has been submitted by Rare Element Resources, Inc. (RER), for the purpose of exploration, construction, operation, reclamation, and closure of a rare earth elements mine in the Black Hills National Forest, Bearlodge District in Wyoming. The proposed project is called the Bear Lodge Project. On National Forest System (NFS) lands, the Plan of Operations proposes construction and operation of the Bull Hill Mine and associated facilities, the Miller Creek access road, a power line, and ongoing mineral exploration. The mine would be approximately six air miles north of Sundance, in Crook County.

The Bear Lodge Project includes actions not on NFS lands, which are considered connected actions. Connected actions in the Proposed Action include a waste rock facility (WRF), a hydrometallurgical (Hydromet) processing plant, tailings storage facility, and portions of access roads and power line routes. The WRF is on Township 52 North, Range 63 West, Section 16, near the mine location, and the Hydromet Plant and tailings storage facility are located 45 miles away from the mine site outside of Upton, Wyoming in Weston County.

The Black Hills National Forest determined that the environmental review of the proposed action required under the National Environmental Policy Act of 1969 (NEPA) will take the form of an Environmental Impact Statement (EIS) (this document) to analyze the effects from the project. The EIS is an explanation and summary of the process used and analysis conducted, along with conclusions documented in the project file. Because this EIS will address any future mine owner, RER, or their possible successors, will be referred to as the proponent.

This analysis is being conducted under Forest Service predecisional objection regulations at 36 Code of Federal Regulations (CFR) 218, Subparts A and B. This proposal would implement a land management plan and is not conducted under the Healthy Forests Restoration Act of 2003 (Public Law108-148).

The document is organized into four chapters:

- Chapter 1. Purpose and Need: Chapter 1 includes information on the history of the proposed project, the purpose of and need for the proposed project, and the regulatory framework including permits required.
- Chapter 2. Alternatives: This chapter provides a detailed description of the alternatives considered and compares them. It also includes measures to minimize impacts.
- Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the affected environment and environmental impacts (direct, indirect, and cumulative) of implementing the exploration, construction, operations, and reclamation common to the action alternatives and alternatives individually, where differenced occur.
- Chapter 4. Consultation and Coordination: Chapter 4 provides a list of preparers and agencies consulted during the development of the EIS.

Appendices provide more detailed information to support the analyses:

- Appendix A—Proponent Committed Environmental Protection Measures
- Appendix B—Emergency Response Plan Applicable to All Alternatives

1.2 Background

The Bear Lodge Mountains were initially prospected for gold during the late nineteenth and early twentieth centuries. Thorium and rare earth mineralization were first discovered in 1949 as a result of uranium

exploration. The U.S. Bureau of Mines completed a limited radiometric survey and a ten-hole drilling program in the early 1950s (RER, 2014a).

In 2009, the Black Hills National Forest approved a phased mineral exploration plan over approximately four years with up to 200 acres of surface disturbance (US Forest Service, 2009b). This began an extensive exploration program to further delineate the rare earth minerals and prepare for development of a mine.

RER submitted a Plan of Operations in May 2012 for mining the Bear Lodge property claims which was reviewed by the Black Hills National Forest. In February 2014, RER revised and resubmitted their Plan of Operations (RER, 2014a). The February 2014 revised Plan of Operations was further modified in August 2014 after additional information about the site was acquired.

1.3 Cooperating Agencies

In addition to the Black Hills National Forest, several federal, state, and county agencies have decision-making authority related to the proposed Bear Lodge Project. Other federal, state, and county agencies have an interest in the outcome and provide specialized expertise. These cooperating agencies have been participating in the NEPA process with meetings and review of documents in accordance with 40 CFR 1501.6. Permits and authorizations required are listed in Section 1.9. Cooperating agencies are:

- US Army Corps of Engineers (USACE);
- USDOI National Park Service, specifically Devils Tower National Monument;
- Wyoming state Agencies including the Department of Environmental Quality (WDEQ) (Land Quality Division (LQD), Water Quality Division (WQD), Air Quality Division (AQD), and Industrial Siting Division (ISD); Wyoming Game and Fish Department (WGFD), State Engineer's Office (SEO), Wyoming Department of Agriculture, Wyoming State Historic Preservation Office (SHPO) and state of Wyoming Governor's Office;
- Crook County and Crook County Natural Resource District, and
- Weston County.

1.4 Location

The Bear Lodge Project would be located on NFS lands, state of Wyoming, and private lands. The Mine Area and associated facilities would be located in all of Section 16 and 17 and on portions of Sections 7, 8, 9, 10, 15, 18, 19, 20, and 21 of T52N R63W. Proposed access roads and power line corridors would continue outside these sections. **Figure 1** shows the project location.

1.4.1 Mine Area

The Mine Area would be a fenced area where mining and other activities would occur including the Mineable Pit, Physical Upgrade Plant (PUG Plant) and WRF. Public access to the Mine Area would be restricted for public safety. Administrative access would be allowed through coordinating with the proponent to ensure safety. There would be no grazing, recreation or travel on NFS roads within the Mine Area. The Mine Area footprint would be different for each alternative analyzed in this EIS.

1.4.2 WDEQ Permit Boundary

The proponent has identified a permit boundary approved by the WDEQ LQD. The WDEQ Permit boundary identifies where monitoring and approved project activities may occur. The WDEQ Permit boundary includes the Mine Area, other mine facilities, and most exploration. Public access, except for within the fenced Mine Area, would be allowed within the WDEQ Permit boundary except during blasting. Management activities on NFS lands in the WDEQ Permit boundary, outside of the Mine Area, would continue in accordance with the Forest Plan and addressed though other NEPA projects. These activities include dispersed recreation

opportunities, livestock grazing, motorized travel on currently open NFS roads, timber management, wildlife habitat and vegetation treatments, among others. The WDEQ Permit boundary would be the same under any action alternative and is a requirement for the WDEQ-LQD Permit to Mine.

1.5 Purpose and Need

The Forest Service's purpose and need for action is to respond to RER's Plan of Operations to mine rare earth elements for which they own private mineral rights and have a possessory interest in unpatented mining claims. The General Mining Law of 1872, as amended, establishes a right to develop a mine on federally administered lands. Forest Service surface management regulations (36 CFR 228 Subpart A) require that such mining operations "*be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources*" and be consistent with the 1997 Revised Land and Resource Management Plan for the Black Hills National Forest, as amended by the Phase II Amendment (Forest Plan) (US Forest Service, 2006).

The proposed mine development is needed to provide a supply of rare earth elements to support today's evolving technologies. Rare earth elements are the technology metals used in cell phones, televisions, lasers, wind turbines, and other modern conveniences.

The proposed exploration activities are needed to continue evaluating the geological resources.

The underlying purpose and need for the project, as determined for the USACE permitting process, is to mine and physically process rare earth elements contained within economically viable deposits in northeast Wyoming to meet a portion of the public demand.

1.6 Forest Service Management Direction

NFS lands are managed following the forest-wide and management area goals, objectives, standards, and guidelines found in the Forest Plan (US Forest Service, 2006). NFS lands affected by the Proposed Action are allocated to Management Areas 5.1 and 5.4 (**Figure 2**).

- 5.1 – Resource Production Emphasis focuses on production of timber and forage, water yield, diversity of wildlife, and a variety of other goods and services.
- 5.4 – Big Game Winter Range Emphasis is managed for big game winter range, multiple use resources.

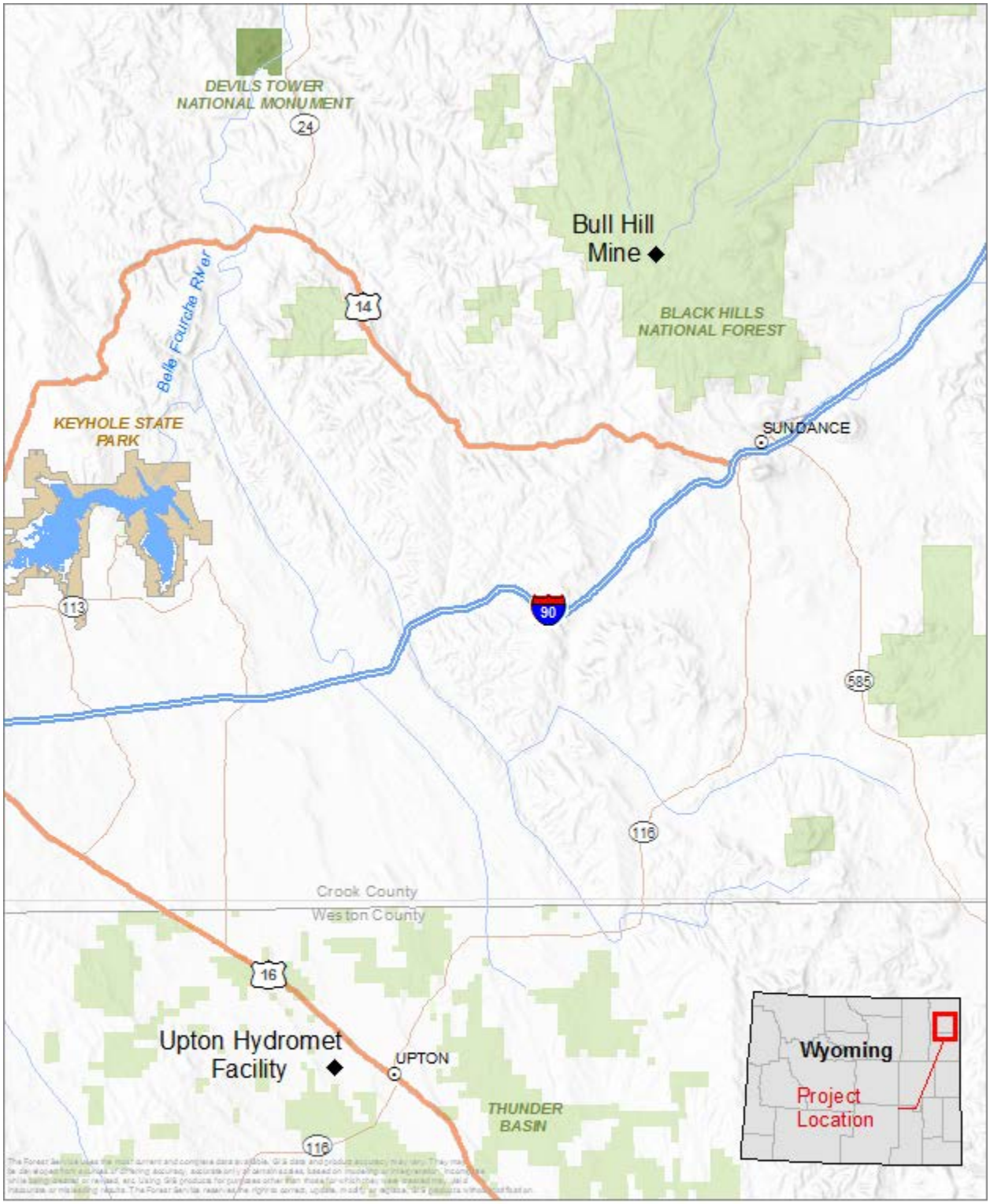
Table 1 shows the acres of NFS lands in the Mine Area (as it occurs in the Proposed Action) and the WDEQ-Permit boundary. Both these areas include private lands where Forest Plan management areas do not apply. There are 698 acres of private land in the Mine Area. Additionally, there are NFS lands outside of the WDEQ Permit boundary where the access road and power line cross in the same Management Areas. Mineral exploration, mining, and access to such activities are acceptable practices in each of these management areas, except where land has been withdrawn for specific reasons. A mineral withdrawal for the Department of Defense (DOD) Warren Peak PM-1 site[2] occurs in Management Area 5.1 (**Figure 2**).

Table 1. Proposed Action NFS Acres by Forest Plan Management Area

Management Area	Fenced Mine Area	WDEQ Permit Boundary
5.1	1,066	2,151
5.4	0	123

Source: GIS

[2] The PM-1 site in Section 20 is a former radar facility used by the Air Force in the 1960s. The facility was powered by a small nuclear reactor which has been dismantled and the nuclear material encased in concrete which remains at the site.



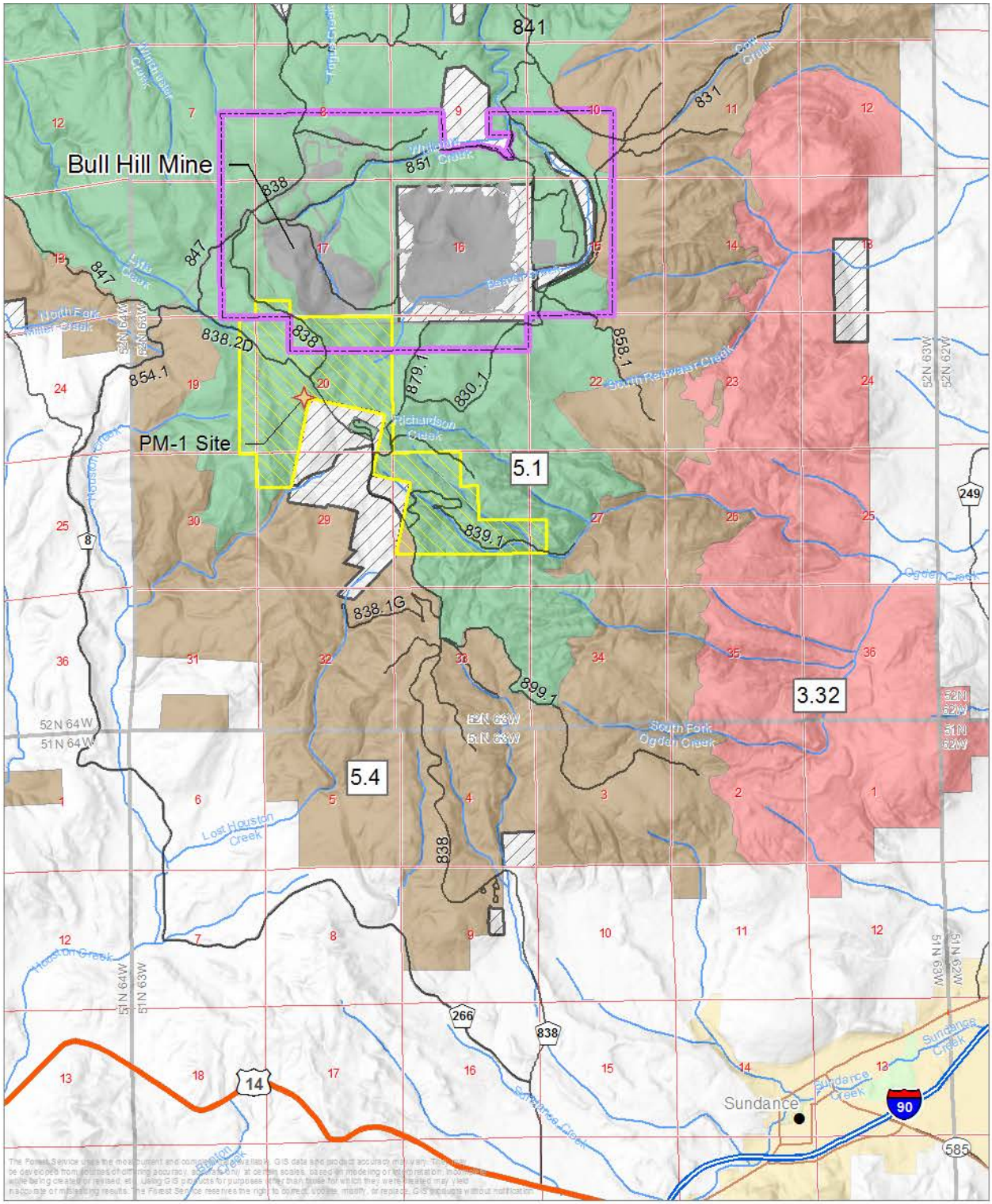
0 5
Miles

NAD83 UTM Zone 13N

◆ Project Components

Project Location Wyoming

Source: Copyright © 2014 Esri, USDA Forest Service



0 1
Miles

NAD83 UTM Zone 13N

Management Areas

- 3.32- Backcountry Non-motorized Recreation
- 5.1- Resource Production
- 5.4- Big Game Winter Range
- PVT- Private or Other Ownership
- Mineral Withdrawal Area
- WDEQ Permit Boundary
- Stream
- Road

Forest Plan Management Areas Wyoming

Source: Copyright:© 2014 Esri

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A Presidential Memorandum was issued November 3, 2015 for mitigating impacts on natural resources from development and encouraging related private investment on Federal properties (Whitehouse, 2015). The memorandum directs Federal agencies to consider mitigations to avoid, minimize, rectify, reduce over time, or compensate for impacts on natural resources to the extent permitted by an agency's legal authorities. This Draft EIS incorporates alternatives and design features to avoid, reduce, and minimize impacts to the natural resources. Additional agency specific direction is expected to be drafted over the next 180 days (from November 3, 2015). This further direction will be incorporated into the Final EIS and Draft Record of Decision, as appropriate.

A project-specific Forest Plan amendment (Forest Service Handbook 1909.12 Chapter 21.31) is proposed (see Section 2.5.1) because some of the forest-wide and management area standards would not be met by the action alternatives where critical project components are proposed (such as the Mineable Pit).

1.7 Proposed Action

The Proposed Action is Alternative C as described in detail in Section 2.4.2. The Proposed Action includes the use of NFS lands to construct and operate a rare earth elements open pit mine and a PUG Plant that would include administration and maintenance buildings, and continued mineral exploration by drilling and trenching methods. Portions of the Miller Creek access road, a power line, and WRF are also proposed to be constructed on NFS lands.

Because of minor project updates, the Proposed Action is a Modified Plan of Operations. Modifications include a reduced exploration plan (Appendix N of the Plan of Operations submitted in August 2014), a reduced power line (from 69kV to 25kV) and a change in the initial mine production, which affects the stockpiling of ore and the overall mine life (from 43 to 45 years).

1.7.1 Connected Actions

Some components of the Bear Lodge Project on non-NFS lands are considered connected actions (40 CFR 1508.25), because they "*are interdependent parts of a larger action and depend on the larger action for their justification*." These include portions of the power line, portions of the access route, and portions of the WRF and all of the Upton Hydromet Plant. There is no Forest Service decision or authorization to be made regarding these activities. Because the following entities will be conducting further analysis on portions of the project located on non-NFS lands, impacts are not disclosed in detail in this EIS.

- The Nuclear Regulatory Commission (NRC) has determined that its licensing authority would extend from the PUG Plant continuing along the access route to the Upton Hydromet Plant up to a final disposal of source material to ensure protection of the health and safety of the workers and public, and of the environment from the possession of uranium and/or thorium at 0.05 weight percent or greater (see the "source material" definition in 10 CFR Part 40). NRC's analysis will be available for public review.
- State of Wyoming will be reviewing, analyzing, and evaluating the impacts on natural resources in conjunction with issuing a variety of permits, including at the Upton Hydromet Plant.
- Powder River Energy Corporation (PRECorp) will be conducting wildlife and cultural property surveys along the entire preferred power line route. They will consult with the US Fish and Wildlife Service, Wyoming SHPO, USACE, and the WGFD to ensure minimal impacts to natural resources.
- The USACE is analyzing effects related to Section 404 of the Clean Water Act. The USACE is a cooperating agency and the NEPA analysis is incorporated in this EIS.

1.8 Decisions to Be Made based on the Analysis in this EIS

The Black Hills National Forest Supervisor will decide:

- Whether the proposed project components (PUG, administration building, maintenance shops, sediment ponds, WRF, stockpiles, Mineable Pit, haul routes, production well, pipelines, access route, power line, and reclamation activities) on NFS lands should proceed as proposed or as modified by an alternative;
- Which recommended mitigation measures and monitoring requirements will be applied;
- Whether additional special use authorizations are required; and
- Whether any project-specific Forest Plan amendments will be approved.

The USACE regulates the placement of dredged or fill material into jurisdictional waters of the US under Section 404 of the Clean Water Act (CWA; 33 USC 1344). The proponent will submit an application for a Section 404 permit and the USACE must review any application and impacts before deciding to issue a permit. The USACE can only issue a permit for the least environmentally damaging practicable alternative. The USACE Wyoming State Program Manager will decide whether to:

- Issue a CWA Section 404 standard permit for the discharge of dredged and/or fill material into waters of the US for the Plan of Operations;
- Issue a CWA Section 404 standard permit with modifications, mitigation, or special conditions; or
- Deny the Section 404 standard permit.

The Black Hills National Forest and the USACE will issue separate Records of Decision.

1.9 Permits or Licenses Required

The proponent would secure permits for all mining and reclamation activities as required by law. Several permits would be obtained pending the completion of the analysis and decision. Prior to implementation, local, state and Federal agencies may need to issue permits or licenses in accordance with state and Federal regulations and laws. **Table 2** lists permits or licenses expected to be needed, depending on the alternative selected.

Table 2.
Permits and Approvals Likely Required

Permitting Agency	Permit Required	Authority
Black Hills National Forest	Approval of a Plan of Operation to occupy NFS lands for purposes of developing and operating a mine, including related access based on an environmental decision. No permit is issued. Special use authorization for the operation and maintenance of a power line would be issued to PRECorp.	36 CFR Part 228A 36 CFR 251
USACE	Standard 404 Permit • Authorization for discharge of dredged or fill materials into jurisdictional waters of the U.S. • Diversion of Beaver Creek, stream crossings, facility and mining disturbances, and on-going water and erosion control practices, and compensatory mitigation affecting jurisdictional waters of the U.S.	33 CFR Parts 320, 323, and 325; 40 CFR Part 230
NRC	Specific license for the possession of source material (i.e., uranium and/or thorium at 0.05 weight percent or greater) at the PUG Plant, along the transportation route to the Upton Hydromet Plant.	10 CFR Part 40
WDEQ-LQD	Permit-to-Mine	W.S. Section 35-11-410

Table 2. Permits and Approvals Likely Required		
	• Public notification, signage, and timing of blasting. • Annual report on activities, including reclamation and monitoring. In accordance with WDEQ LQD regulations, the approved reclamation plan (b)(i) backfilling, grading and contouring will: • (A) Reestablish the contour of the land in a manner consistent with the proposed future use of the land; • (B) Reestablish adequate through drainage if such a provision is necessary to prevent pollution or diminution of the quantity and quality of the surface water and groundwater; • (C) Contour affected land to blend in with the topography of the surrounding terrain unless so doing creates an erosion problem or a hazard to man or beast. Drilling Notification Permit • For exploration activities, this permit addresses drill hole abandonment and reclamation.	Chapter 3, Section 2 General Environmental Protection Performance Standards WS Section 35-11-404
WDEQ WQD	Wyoming Pollutant Discharge Elimination System (WYPDES) Permit • Required to address the water discharge.	WS Section 35-11-302
WDEQ AQD	Construction Permit • Required prior to the time of construction to account for short and long term emissions, dust control, and overall impacts to air quality Operating Permit (after initial construction is completed) • Required to address the emissions associated with the operation of the mine.	Wyoming Air Quality Standards and Regulations (W AQSR), Chapter 6, Section 2 Title V of the Clean Air Act, 1990 W.S. Section 35-11-203
Wyoming State Engineer's Office (SEO)	All Water appropriations: • Water supply and water yield analysis requirements for industrial projects that utilize more than 800 acre-feet of water per year. Reservoirs built to utilize water allocated to Wyoming in excess of 1,000 acre-feet capacity.	Wyoming Constitution Article 8 Title 41 Wyoming Water Statute WS 35-12-108 Belle Fourche River Compact of 1943, Article IX
	Groundwater Permits • Required for the groundwater supply well for the mine facility • Pit de-watering well permit – time-limited permits authorizing miscellaneous use. • Abandonment notice – post-mining – must be filed upon abandonment of well	SEO UW-5 application

Table 2. Permits and Approvals Likely Required		
	Surface Water Permits • Sediment or collection ponds permit authorizes ponds at the mine and at the Upton facilities • Pit dewatering pond authorizes holding water from the mine pit • Surface water diversion channels authorizes channels to divert surface water away from facilities	SEO SW-3 application SEO SW-1 application
Wyoming Industrial Siting Council	Industrial Siting Permit, including county road use permits. Required for the construction and operation of an industrial facility to assess socio-economic and environmental impacts	WS 35-12-106
Crook County	County Road Use Permit Required to regulate the maintenance on County roads. County Commission approval is required to alter any county roads. Any roads added to the County system shall need the consideration and approval from the Crook County Commission	WS 18-5-509 WS 24-3-101 et seq
Weston County	County Road Use Permit Required to regulate the maintenance on County roads.	WS 18-5-509

1.10 Consultation

The Black Hills National Forest has been participating in and facilitating consultation under Section 106 of the National Historic Preservation Act (NHPA) of 1966 (Title 16 USC Chapter 54), as amended through December 19, 2014; and Section 7 of the Endangered Species Act of 1973 (Title 16 USC Chapter 35), as amended through 2004.

1.10.1 Tribal Consultation

Initial scoping letters and project description were sent to tribal members and Tribal Historic Preservation Officers (THPO) on the Forest Service mailing list on March 20, 2014.

The Black Hills National Forest consults with tribes including; the Cheyenne/Arapaho Tribes of Oklahoma, Flandreau Santee Sioux Tribe, Northern Cheyenne Tribe, Northern Arapaho Tribe, Sisseton-Wahpeton Sioux Tribe; Mandan, Hidatsa & Arikara Nation, Yankton Sioux Tribe, Oglala Sioux Tribe, Rosebud Sioux Tribe, Cheyenne River Sioux Tribe, Crow Creek Sioux Tribe, Standing Rock Sioux Tribe, and Eastern Shoshone Tribe.

Written correspondence to the tribes regarding Bear Lodge Project occurred on October 23, 2012; December 14, 2012; June 26, 2013; March, 12, 2014; March 3, 2015; March, 5, 2015; and numerous other correspondences with individual Tribal representatives.

Face-to-Face Tribal Consultation where Bear Lodge Project was on the agenda

- June 22, 2011 - Wakpa Sica Reconciliation Center, Ft. Pierre, SD
- June 11, 2012 - AmericInn Hotel & Teton Island Conference Center, Ft. Pierre, SD
- September 5, 2012 - AmericInn Hotel & Teton Island Conference Center, Ft. Pierre, SD

- June 25, 2013 - Black Hills National Forest Supervisor's Office, Custer, SD
- September 22, 2014 - Crazy Horse Memorial, Crazy Horse, SD
- USFS presentations to Tribal Councils that included summaries of Bear Lodge Project occurred on June 8, 2011; June 26, 2012; March 25, 2014; June 3, 2014; June 10, 2015; and August 31, 2015.

Field trips to mine area that focused on Tribal concerns occurred on October 14, 2011 and June 26, 2013.

1.10.2 Section 106 of the National Historic Preservation Act

The Black Hills National Forest will complete consultation with the Wyoming SHPO and tribal representatives before the Record of Decision is signed.

1.10.3 Section 7 of the Endangered Species Act

A biological assessment will be prepared and a draft submitted to the US Fish and Wildlife Service (USFWS) regarding the Ute's ladies-tresses and northern long-eared bat.

1.11 Cooperating Agencies

Starting in February 2014, the Forest Service met weekly, via conference call, with cooperating agencies to discuss the development of alternatives, design features, and analysis issues. A meeting on June 15, 2014 was designed to review the public scoping comments and begin developing alternative ideas to consider for the proposed Bear Lodge Project. Another meeting on November 18, 2014 was held to finalize the key issues for consideration and alternatives. A meeting on August 11, 2015 was designed to review preliminary analysis data and address additional mitigations to be considered in the EIS. Documentation of meetings is in the project file.

1.12 Scoping

Public scoping includes the outreach efforts to identify issues and suggested alternatives to the Proposed Action to be considered in the EIS. Scoping of the cooperating agencies and lead agency personnel also identified additional issues, mitigation measures, and possible alternatives. Approximately 154 letters or emails were received. Comments were used to shape the analysis and alternatives analyzed. All comments received were compiled in a Public Scoping Summary Report and have been included in the project file.

The scoping comment period occurred from March 20 to April 30, 2014.

1.12.1 Scoping Announcements

Initiation of the EIS process and the public scoping meetings were announced through an email, a mailing, a notice in the Federal Register, press releases, and the Black Hills National Forest Service project web site.

- Quarterly Schedule of Proposed Actions – the Black Hills National Forest first listed the Bear Lodge Project on their list of upcoming and ongoing proposed actions for NEPA on October 1, 2012.
- Mailings - A short announcement was emailed to people on the Bearlodge District NEPA mailing list and permittees, outfitters, landowners, and agencies. The email included attachments with the scoping letter and project description. Printed copies of the scoping letter and project description were mailed to the Bearlodge District NEPA and Tribal/Tribal Historic Preservation Officer (THPO) mailing lists. Both of these mailings were sent out on March 20, 2014.
- Federal Register – A Notice of Intent (NOI) to prepare an EIS was published on Friday, March 28, 2014 (79 FR 17497, Pages 17497-17500 Document Number 2014-06916). The NOI is on the Black Hills National Forest Service project web site project web site.

- Web Site - Black Hills National Forest Service prepared news releases to introduce the project, announce the scoping period, and publicize the scoping meetings and locations. The news releases were posted on the Black Hills National Forest Service project web site (http://www.fs.usda.gov/projects/blackhills/landmanagement/projects).
- Twitter notices – The Black Hills National Forest announced on April 8 and April 10, 2014 the dates for the public scoping meetings.
- Media Releases and Public Service Announcements - Announcements regarding the public scoping meetings and scoping process were issued as news releases on March 20, 2014, to local and regional newspapers, radio stations, and television stations in Wyoming and South Dakota.

1.12.2 Public Scoping Meetings

Forest Service hosted two public meetings in April 2014 to provide planning and NEPA information for the public and agencies and allow them to identify issues and concerns. Public scoping meetings were advertised on the Black Hills National Forest Service project web site, and through the local media. Attendance at the meetings is summarized in **Table 3**. The public was invited to sign in at the meetings but there were people at both meetings who did not sign in. At the public meetings the project description and a copy of the NOI were provided.

Table 3. Public Scoping Meeting Sign-in

Date	Meeting Location	Signed In
April 14, 2014	Sundance, WY	142
April 15, 2014	Upton, WY	139
Total		281

The Prairie Hills Audubon Society held a public meeting on April 23, 2014. The Forest Service attended, answered questions, and provided a comment form.

Chapter 2
Alternatives

2.1 Introduction

This chapter describes the alternatives evaluated in this EIS and explains how they were developed. Rationale is provided for alternatives that were considered but not studied in detail. This chapter also includes a comparison of activities, issues, and effects of the alternatives.

The Proposed Action reflects the detailed information in the Plan of Operations (RER, 2014a) submitted in February 2014 and modifications made after further refinement in August 2014.

2.2 Alternative Development Process

The Forest Service NEPA handbook (FSH 1909.15, Chapter 10) and the CEQ regulations implementing NEPA (40 CFR 1501.2(c)) direct alternatives to be developed "*which involve unresolved conflicts concerning alternative uses of available resources…" The range of alternatives should not "prematurely foreclose options that might protect, restore, and enhance the environment.*"

Regulations define what the Forest Service should consider a reasonable alternative. "*An alternative should meet the purpose and need and address one or more significant issues related to the proposed action. Since an alternative may be developed to address more than one significant issue, no specific number of alternatives is required or prescribed"* (36 CFR 220.5(e)).

2.2.1 Refinement of the Proposed Action

The proponent submitted a revised Plan of Operations in February 2014 after refinement of engineering and design features. The Black Hills National Forest used the content of the February 2014 Plan of Operations as the basis for the NOI to prepare an EIS (see Section 1.12) to initiate public scoping in April 2014.

As the proponent continued to refine their mining design plans, several modifications were made to the Plan of Operations through letters to the District Ranger and the submittal of a revised appendix. Some modifications were accepted for a modified proposed action, while other modifications were accepted as alternatives for analysis. Modifications and updates are explained in more detail in Section 2.4.2.

2.3 Issues

The Black Hills National Forest accepted public comment and met with Forest Service specialists and cooperating agencies to gather additional information on potential concerns. After scoping, the internal and external concerns and suggestions were used to help define issues and possible alternatives to the Proposed Action. The scoping process and outcome is described in more detail in Section 1.12.

The Black Hills National Forest Supervisor provided direction regarding the issues to be used for developing alternatives in a letter to the NEPA interdisciplinary team (Forest Service and contractors) (US Forest Service, 2015a). The letter identified the following issues:

1. Water resources as measured by effects on stream channels, in-stream flows, water quality standards, and beneficial uses;
2. Cultural resources as measured by the number of historic properties determined to be "at risk" for potential adverse effects;
3. Public safety as measured by exposure to radioactive or hazardous elements from dust or ingesting meat, contaminants in water, dangers from road use; and

4. Current and future land uses and related socioeconomic consequences as measured by acres of NFS lands affected, spending, employment and income, taxes, and costs.

2.3.1 Water Resources – Surface and Groundwater

This issue includes water quality for surface and groundwater, wetlands, and riparian areas.

Alteration of surface and subsurface hydrology from the construction and operation may result in loss of riparian habitat and fragmentation of riparian habitat and corridors.

The construction and operation may affect five springs. The Mine Area fence would eliminate access to two springs, while construction of the PUG Plant may permanently affect another. The remaining two springs are located on private land where the WRF would be located. Construction and operation may affect downstream water quality in Whitelaw and Beaver Creeks and therefore exceed Wyoming Water Quality Standards.

Post-mining reclamation would result in a permanent pit lake, which may concentrate dissolved metals and toxins or lower pH levels which may exceed Wyoming Water Quality Standards.

Exploration activities could affect water resources. Drilling or trenching activities may result in sedimentation into creeks and disruption of natural flows. Ground water resources could be affected by drilling activities.

The facility as proposed would divert 4,000 linear feet of Beaver Creek, identified by USACE as a waters of the US, into a constructed channel that would serve as a permanent relocation of the creek. The WDEQ and USACE would provide the regulatory oversight of the proposed WRF on private lands.

2.3.2 Cultural Resources

The proposed project could adversely affect historic properties defined in 36 CFR 800.16(1)(1). Religious-use areas may be affected by the mine activities and there may be a need to restrict access to certain areas during the mining period.

The proposed project may indirectly affect the setting and integrity of early-settler grave sites from flooding, traffic and hauling, and power line construction.

2.3.3 Public Safety

The Plan of Operations specifies using the Miller Creek Road for access to the mine and for the transportation of ore and pre-concentrate to the Hydromet Plant in Upton. Use of this road would create additional traffic, dust, and noise that may adversely affect other road users and adjacent property owners.

The proposed above ground power line may create public safety concerns, particularly during storm events, as power lines and poles could break. Downed power lines could cause fires in the summer and impact recreation users in the winter.

The post-mining reclamation of the Mineable Pit proposes leaving the pit walls as developed (including terracing and stabilization[3]), fencing, and closing the pit permanently from public access. Unlawful entry into a closed area may affect public safety.

2.3.4 Current and Future Land Uses and Related Socioeconomic Considerations

The post-mining proposal for the Mineable Pit is to permanently close it to the public by fencing and allow the pit to fill naturally with water which would result in a pit lake. The area would not be available for grazing, terrestrial wildlife habitat, or other recreational activities after mining.

…….

[3] Slope stability analysis indicated a backslope (horizontal run to vertical rise) of between1.5:1 and 1.1:1 (Sierra Geotechnical, 2013) would be stable.

The power line could affect management activities on NFS lands. Above-ground lines could affect vegetation management, while below-ground lines could affect soil and water resources if the lines require continual maintenance and replacement.

The mine operation may have both negative and positive socioeconomic impacts that may change over time. The mine facilities and operation may result in changes to local employment, property values, tourism revenue, and demand and cost for road maintenance and emergency services. There may be costs to the alternative components and mitigation measures. The mine operations may not conform to the quality of life expectations as expressed by the Black Hills Forest Plan and Federal, State, and local regulations.

2.4 Alternatives Considered in Detail

This section describes the alternatives evaluated in the environmental consequences section in Chapter 3. The action alternatives studied (Alternative C through Alternative G) are described in detail and include measures to protect the environment (Section 2.6 and Appendix A), monitoring (Section 2.9), and emergency response (Appendix B). Alternative B, the original February 2014 Plan of Operations was not analyzed in detail and is described in Section 2.11.1, Alternatives Considered but Not Studied in Detail. All permit requirements and authorizations would need to be met under each alternative (**Table 2**).

2.4.1 Alternative A - No Action Alternative

Federal regulation (40 CFR 1502.14(d)) requires consideration of a No Action alternative which serves as the baseline for estimating the effects. Since the proponent has a statutory right to mine and selection of the No Action alternative would not allow the proponent their legal right, this alternative cannot be selected. The No Action alternative does not need to meet the Purpose and Need (Section 1.5) to be considered.

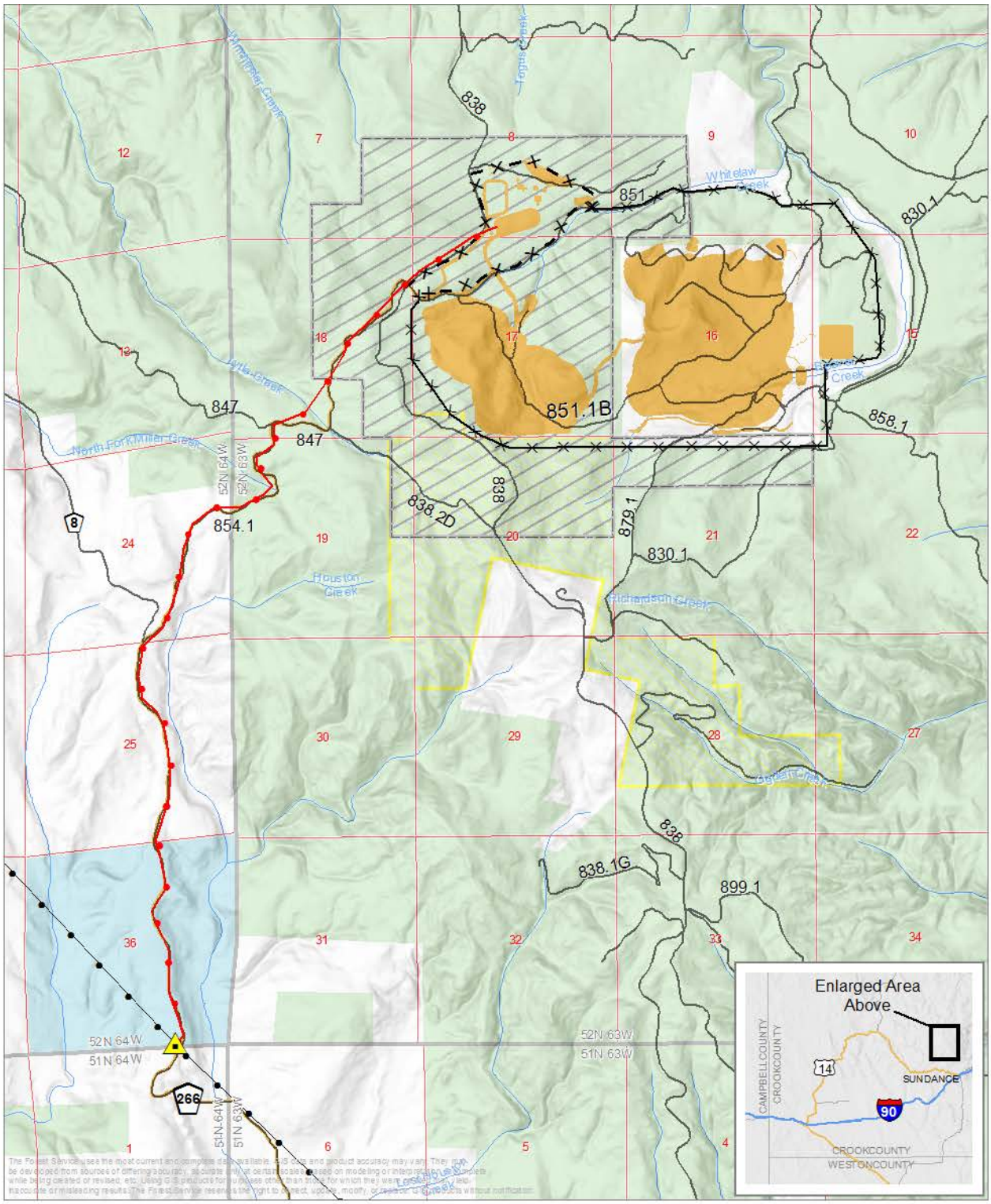
The No Action alternative would be for the Forest Service to not approve the Plan of Operations. The Mineable Pit, PUG Plant, WRF, access road, and power line would not be constructed or operated. There would be no need for the connected actions (WRF, sediment ponds, stockpiles on private lands and Hydromet Plant) so they would also not be constructed. Exploration as proposed in the Plan of Operations would not occur. Previously approved exploration and environmental studies on NFS lands would be reclaimed by the proponent in accordance with current approvals and regulations, per the *Sundance Exploration Project Decision Notice and Finding of No Significant Impact* (US Forest Service, 2009b).

2.4.2 Alternative C - Modified Plan of Operations (Proposed Action)

The Bear Lodge Project includes components that would be developed in several phases. Components are shown on **Figure 3** with a closer view on **Figure 4**. This description is summarized from the Plan of Operations (RER, 2014a). The Mine Area (see Section 1.4.1) would include 1,062 acres of NFS lands and 634 acres of private lands (1,696 acres total). Portions of the access and power lines and a Hydromet Plant near Upton, Wyoming would be on private land and are considered connected actions (see Section 1.7.1).

Scoping (see Section 1.12) information included a description of the proposed action based on the Plan of Operations submitted in February 2014. As with many proposed actions, refinements have been made since scoping, minor modifications made (RER, 2014c) (RER, 2014d), and more detail added as studies have progressed. Modifications are described in detail in each component description and summarized below.

- The exploration area has been reduced and the time limited to the first 10 years at the request of the proponent. The exploration area would be reduced to 2,000 acres from the 8,700 acres.
- The power needs for the PUG Plant have been refined. Therefore, a smaller power line (25kV instead of 69kV) is proposed (**Figure 3**). Three 2000-kilowatt diesel generators (one at a time) would provide power for the first four years while the power line is constructed.



0 4,000
Feet

NAD83 UTM Zone 13N

Substation
Proposed Powerline
Proposed Facility Footprint
Exploration Boundary
Mineral Withdrawal Area
National Forest
Private
State Land
Existing Powerline
Stream
Road

Fence Type
Barbed-Wire
Chain-Link

Proposed Action
Bull Hill Mine and Powerline
Wyoming

Source: Copyright:© 2014 Esri

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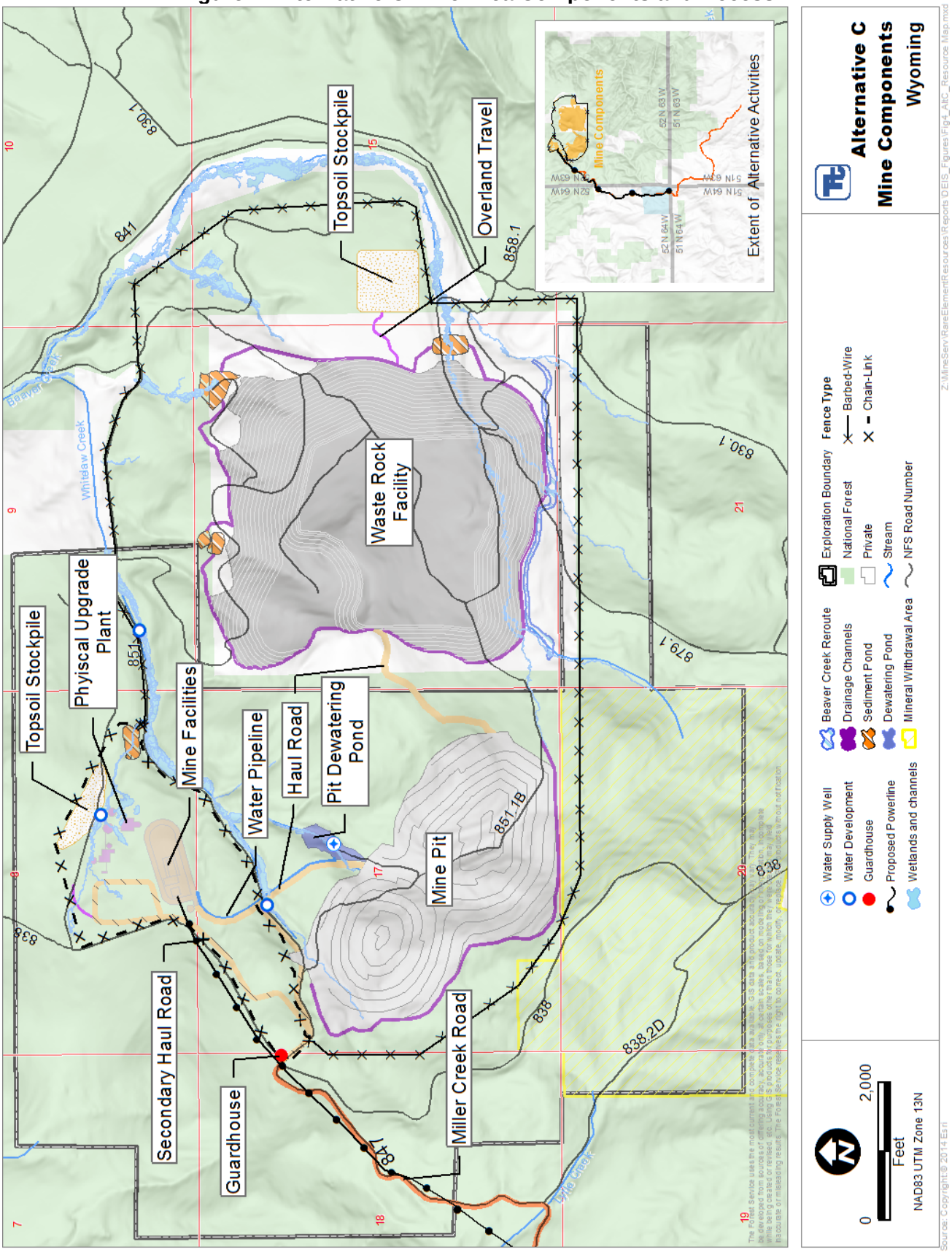
Figure 4. Alternative C Mine Area Components and Access



Mining would occur for 38 years followed by 7 years of low grade ore processing resulting in a 45-year mine life (instead of the original 43 years) followed by final reclamation (see Section 2.7). Since the February 2014 Plan of Operations was submitted, the high grade zone has been found to be more extensive and would allow preferential mining for the first nine years of operation. This change would extend the anticipated mine life by two years. As a result of the revised mining plan, the amount of waste rock and the size of low-grade ore stockpile would be reduced for the first nine years.

Table 4 shows the disturbance acres by landowner under Alternative C.

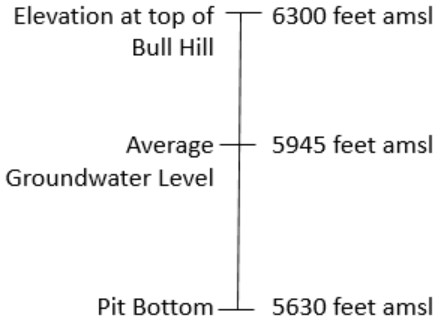
Table 4.
Alternative C Estimated Disturbance Acres

New Disturbance	NFS	Private	State	Total
Mine Pit	232.4			232.4
Additional Pit Reclamation	0			0
PUG	2.6			2.6
PUG Facilities (and guardhouse)	14.4			14.4
PUG Haul Road[1]	6.1			6.1
WRF (including ore stockpiles)	0.2	405.0		405.2
WRF Haul Road[1] and Secondary Haul Road	19.4	1.6		21.0
Miller Creek- New Construction[2]	16.7	47.9	14.6	79.2
Pit Dewatering Pond	5.1			5.1
Sediment Ponds	4.5	7.5		12.1
Drainage Channel	2.1	3.6		5.8
Water Pipeline[3]	0.4			0.4
Beaver Creek Diversion		7.1		7.1
Topsoil Stockpile[4]	27.0			27.0
Topsoil Stockpile Access	0.2	0.3		0.4
Fence Construction	4.8	0.0		4.8
Fence Maintenance Road	7.3	0.0		7.3
Power Line Substation			0.1	0.1
25kV ROW[5]	5.9	3.8	0.6	10.3
Total New Disturbance	**349.1**	**476.8**	**15.3**	**841.3**

Source: Table 4.5-1 (RER, 2014a), updated with Forest Service GIS.
Totals may not add up exactly due to rounding.
1 WRF or pit reclamation would eventually remove parts or all of the haul road. To avoid double counting the acres, they are shown in as part of the WRF. Assumes 100-foot disturbance width and does not account for existing road disturbance.
2 Assumes 80-foot disturbance width and does not account for existing road disturbance.
3 Assumes 25-foot disturbance width for pipeline construction.
4 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.
5 Power line corridor proposes a 30-foot right-of-way.

2.4.2.1 Mineable Pit in Alternative C

Conventional truck and excavator open pit mining methods would be used. The mineralized material to be removed lies within the oxide layer. The pit would have a disturbance footprint of approximately 232.4 acres (see **Table 4**). The bottom of the pit would be at about 5,630 feet above mean sea level (amsl), indicating that the pit would be around 500 to 550 feet deep, depending on the elevation of the top of the pit, which varies. Two 100-foot wide haul roads[4] would be constructed from the pit to the PUG Plant and WRF.



After six to seven years, the pit depth would reach groundwater level and would require dewatering. Pumps would be installed in the bottom of the pit to maintain the groundwater level below active mine operations. An estimated average of 500 gallons per minute (RER, 2014a) is expected to be dewatered from the Mineable Pit. The water would be pumped through a separate pipeline to a dewatering pond located in the PUG Plant area, then pumped to the

[4] Mine haul roads are within the Mine Area and used to haul ore from the Mineable Pit to the WRF or PUG Plant. Public access would not be allowed. Access roads are open to the public that would be used to transport concentrate in regular gravel trucks with pup trailers from the PUG Plant to the Hydromet.

PUG Plant for use in the processing of the ore or discharged to the lower reach of Whitetail Creek. Discharging to Whitelaw Creek would proceed under a WYPDES permit.

At closure, the pit dewatering would cease and a pit lake would form as groundwater infiltrates the pit. The Plan of Operations indicates it would take approximately 100 years for the pit lake to reach a steady water level. The lake would be approximately 300 feet deep, with a storage capacity of approximately 60,000 acre-feet. The Plan of Operation proposes to leave the Mineable Pit as constructed and fence the pit completely to prevent access by the public and wildlife. No seeding, planting, or introduction of soil to restore vegetation is planned. Natural revegetation may occur over time along bench areas.

The Belle Fourche River Compact of 1943, Article IX states that "*No reservoir hereafter built solely to utilize the water allocated to Wyoming shall have a capacity in excess of 1,000 acre-feet*." Consultation is planned between the State of Wyoming and State of South Dakota to insure requirements of 1943 Compact are met as a result of the post-mining pit lake.

2.4.2.2 PUG Plant in Alternative C

A PUG Plant, located on 176 acres in the Mine Area, is designed to maximize concentration of the rare earth minerals and produce a pre-concentrate using a crushing, screening, and gravity separation process. This would reduce the physical mass of material to be transported to the Hydromet Plant. The crusher and generators would be housed in insulated buildings that would dampen sound to below levels that would not need additional abatement (less than 10 decibels above ambient noise levels). The PUG Plant area would also include a topsoil stockpile, guard station, buildings for personnel and vehicle maintenance, and storage tanks for gas and diesel. A six-foot, chain-link security fence with a "V" top would be constructed around the PUG Plant area within the Mine Area wire fence.

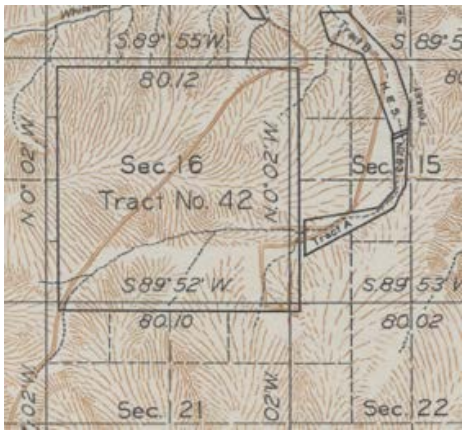
A production well (MW-16; labelled water supply well in **Figure 4**) would provide water for the PUG Plant processing and dust control. The well is located on NFS lands. The well would supply water to a storage tank via a half mile of pipeline. It is estimated that up to 74 gallons per minute of water would be required to support mine activities, including the operation of the PUG Plant and mine, dust control on roads and soil stockpiles, truck wash, and provide potable water to mine workers.

A septic system would include an onsite portable wastewater treatment facility sized to meet daily domestic needs. This system would include a designed inlet screen, equalization and aeration tank, and membrane filtration with final ultraviolet disinfection. The final effluent would meet WDEQ standards for recycled water. The water could be used for dust suppression within the WDEQ Permit boundary. Periodic removal of solids from the facility could be required, and would performed by a commercial company. Portable toilets may be used in the Mine Area as needed and would be maintained and serviced by commercial providers.

The PUG includes collecting and recycling water and using water from the dewatering pond to offset the needs from the production well. There would be no process water discharged from the PUG Plant. Stormwater runoff would be stored in a sediment pond above the confluence of an unnamed tributary to Whitelaw Creek. Stormwater would be stored for about two days while sediment settles, and then discharged downstream. Discharge would be regulated under a WYPDES permit.

Final reclamation of the PUG Plant area would include regrading of disturbed and compacted areas for drainage, scarification, and revegetation. Fill slopes would be graded to a maximum of 3H:1V (three horizontal for every one vertical rise) and contoured.

Illustration 1 Tract 42



Tract 42 is the private land which is most of Section 16, and portions of Sections 15, 21, and 22. The NFS lands surrounding Tract 42 include lots 1, 2, 3, 4, 5, 6, and 7 in Section 16 along the north and west section lines.
Source: Sheet 1 of (General Land Office, 1934)

2.4.2.3 WRF in Alternative C

The WRF is a connected action located on private lands on Tract 42 (see **Illustration 1**), T52N R63W, east of the Mineable Pit. The USACE and WDEQ would review these activities under their regulatory authority. A small portion of the drainage channels, sediment ponds, and the WRF would be located on NFS lands (see **Table 4** and **Figure 4**).

The total design height of the WRF would be approximately 250 feet and material would be placed in 50-foot lifts. When completed, the WRF would reach a maximum elevation of approximately 6,200 feet amsl and the footprint would be approximately 405 acres. The final capacity of the WRF would be about 124 million tons of waste rock. The WRF would include a low grade ore stockpile. A topsoil stockpile would be located just to the east of the WRF on NFS lands (**Figure 4)**. Regrading, contouring, revegetation, and topsoil placement will occur progressively.

An underdrain water collection system would be constructed to control seepage and collect naturally occurring flows from seeps and springs. The collection system would be drained into four sediment ponds.

Stormwater runoff would be collected in four sediment ponds and released in accordance with WYPDES permit effluent limitations. Water would be stored for about two days while sediment settles and then discharged downstream to Whitelaw and Beaver creeks. State of Wyoming standards would be met in designing the sediment ponds for a 10-year frequency, 24-hour storm event. A diversion channel would also be constructed for approximately 4,000 feet of Beaver Creek. **Photo 1** shows Beaver Creek as it appeared in June 2015.

Photo 1. Beaver Creek

2.4.2.4 Mine Area Fence in Alternative C

The Mine Area, 1,062 acres of NFS lands and 634 acres of private lands (1,696 acres total) (**Figure 4)** would be closed to the public. A 5-strand barbed wire fence that would conform to Natural Resources Conservation Service (NRCS) guidelines would be constructed around the Mine Area. With permission from the mine operator, the DOD would be allowed to access their monitoring well if it is enclosed in the Mine Area.

2.4.2.5 Main Access in Alternative C

Miller Creek Road (County Roads 208, 266, and 8 and NFS Roads 854.1 and 847) would be the main access to the Mine Area. This 13-mile access route (2 miles on NFS lands, 11 miles other ownership) is proposed to be upgraded to accommodate two-way traffic in two 12-foot driving lanes with two 4-foot shoulders. The posted speed limit would be 30 miles per hour, unless final construction shows a slower speed is needed. The total road easement width for the access route is 80 feet. For safety, the route would be designed with grades under six percent. The upgrade to county roads requires the approval from the Crook County Commission in accordance to WS 24-3-101 et seq.

During operations, the mining traffic is estimated at between 13 to 17 round trips each day for semi-trucks carrying pre-concentrate ore material in addition to worker traffic and delivery supply vehicles.

2.4.2.6 Power Line in Alternative C

A 25-kilovolt (kV) transmission line would be constructed above ground to provide power. The transmission line requires a right-of-way of 30 feet to manage vegetation. Approximately 1.5 miles of the power line would

cross NFS lands, while the remainder would be on private and state of Wyoming lands. For maintenance purposes, PRECorp requested full vehicle access along the route.

Three 2000-kilowatt diesel generators (one at a time) would provide power for the first four years while the power line is constructed. It is estimated that generators would be used for the first 3 to 4 years. The generators would also serve as backup during power failures for critical systems.

2.4.2.7 Exploration

The proponent would continue exploration activities (drilling, trenching, geologic mapping, ground geophysics and geochemical soil analysis) over the first 10 years of operations (RER, 2014b). The proponent estimates the exploration activities would consist of a total of 488 drill holes (122 rotary holes to an average depth of 660 feet and 366 core holes with an average depth of 750 feet) and approximately 21,000 feet of trenching. Prior to each exploration season, a work plan would be submitted to the Forest Service with the current years' anticipated locations for the Forest Service to approve. Exploration disturbance acres are shown in **Table 5.**

Table 5. Exploration Surface Disturbance Acres

Activity	Acres of Disturbance
New Temporary Road Construction	16.4
Overland Travel	0.4
Drill Sites (including sediment traps)	25.6
Trenching and Bulk Sampling	12.1
Existing Roads	2.0
Total	**56.5**

Source: Table 1, Appendix N (RER, 2014b)

1 Assumes 47,700 feet of road with a 15 foot disturbance width.

2 Based on 4,500 feet of overland travel.

3 Based on 366 core holes at 0.05 acre per site and 122 rotary holes at 0.06 acre per site.

4 Based on 21,000 feet of trenching (4 feet in width). Footprint is 25 feet in width including spoils piles.

5 Based on 14,720 feet of existing road.

Access for exploration would be via existing roads, new temporary roads, and overland travel. Temporary road construction would incorporate best management practices (BMPs) outlined by the WDEQ in the Wyoming Nonpoint Source Management Plan for Silviculture (WDEQ, 2004).

Drill holes would be abandoned according to Wyoming Land Quality Rules and Regulations, WS 35-11-404, for plugging and abandoning drill holes. Drill pads and sumps would be reclaimed concurrently[5] with abandonment. Roads would be reclaimed concurrently unless needed for future access for exploration or mining. They would be reclaimed after exploration activities are completed in a given area.

Appendix N of the Plan of Operations (as modified in August 2014) contains additional details, including water use, methods, environmental protection measures, and details on reclamation.

2.4.2.8 Other Activities in Alternative C

The Forest Plan Amendment (Section 2.5.1), Environmental Protection Measures (Appendix A), including reclamation, monitoring (Section 2.9), and financial assurance (Section 2.10) would be included.

2.4.2.9 Connected Actions

As stated in Section 1.7.1, in Alternative C, most of the WRF is a connected action. Portions of the power lines, access route, and all of the Hydromet Plant are considered connected actions under this alternative.

Hydrometallurgical Processing Plant

A Hydromet Plant would be constructed and operated on private land near Upton, Wyoming, approximately 45 miles from the Mine Area. The Hydromet Plant would process the pre-concentrate from the PUG Plant through acid leaching followed by additional chemical processing to remove impurities and precipitation to

…….

[5] **Concurrent reclamation -** Disturbed areas will be reclaimed as soon as economically and technically feasible once it has been determined that no further disturbance will occur.

produce the final total rare-earth oxides product. The tailings and waste produced from the process would be dewatered, neutralized, and stored in a double lined tailings storage facility adjacent to the Hydromet Plant. Water needed for the Hydromet Plant would be provided by the Upton municipal water system.

The NRC will be analyzing the potential environmental impacts of the construction and operation of the Hydromet Plant.

The final product would be shipped to customers via existing roads and railroads.

2.4.2.10 Implementation Schedule

Development of the mine from construction through reclamation and closure would include several phases:

- Exploration 1 through 10 years from plan approval;
- Construction 1 to 25 years from plan approval;
- Operations 2 through 45 years from plan approval; and
- Reclamation and Closure Through 47 years from plan approval.

2.4.3 Alternative D

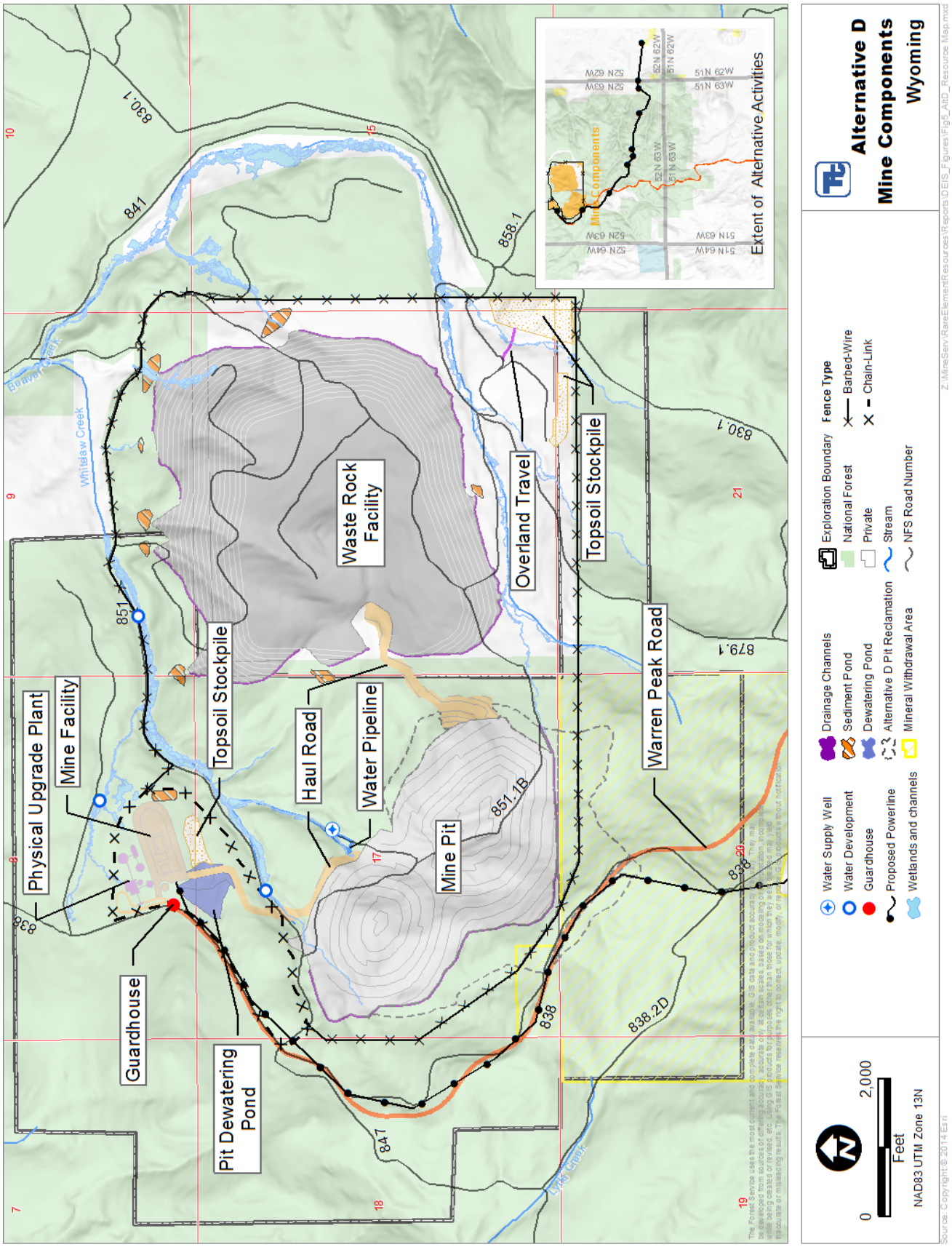
Alternative D was developed to address the impacts on water and cultural resources. Major differences between Alternative C and Alternative D are:

- Reduction of the Mineable Pit highwalls and backfilling of the pit with waste rock to eliminate the pit lake at closure, creating a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms.
- The PUG Plant moved south and west to avoid riparian areas and known cultural resources (**Figure 5**).
- The dewatering pond for the Mineable Pit moved to an unnamed tributary south of the PUG Plant to avoid riparian areas. Water would be discharged into Whitelaw Creek.
- Reconfiguration of the WRF to avoid impacts on Beaver Creek (see Section 2.3). WRF located on approximately 384 acres of private lands and approximately 61 acres of NFS lands.
- Main access road access using Warren Peak Road (see Section 2.4.3.5) to avoid conflicts with users on Miller Creek Road.
- Power line route located on the east side of the Bearlodge Mountains off Government Valley Road (County Road 123), generally following the Ogden Ridge Road (NFS Road 899.1A), and connecting to the existing transmission line at Warren Peak Fire Tower on the Warren Peak Road (NFS Road 838) then NFS Road 838 to the PUG Plant. The power line would be 9.4 miles.
- Smaller fenced Mine Area than Alternative C. A wildlife-friendly fence around the Mine Area.
- Design Features identified by the Forest Service (Section 2.5) to reduce impacts.

2.4.3.1 Mineable Pit in Alternative D

The post-mining condition of the Mineable Pit would eliminate the pit lake by reducing the steepness of remaining highwalls using variable slopes, with a nominal 3:1 maximum slope, (steeper sections, no greater than 100 feet, may remain if it represents the surrounding landscape) and partially backfilling with waste rock to the average long-term groundwater level, estimated at about 5,945 feet elevation. Reducing the pit slopes would allow safe, post-closure pit access for administrative purposes, public access, and wildlife habitat.

Figure 5. Alternative D Mine Area Components and Access



The pit reclamation landform would be developed by a trench and fill slope method with site appropriate drainage density, complex topography, and vegetation diversity. The trench and fill slope method involves cutting a series of V-shaped drainage channels or trenches at an angle to the highwall. The resulting fill material would be used to backfill and cover the highwalls remaining between drainages. The fill material would be deposited in a convex shaped bank to cover and eliminate the highwall between successive trenches.

Non-linear, meandering trenches mimicking a natural drainage channel would be developed. These channels would provide a drainage path to intercept surface runoff. The drainages would provide natural access to the pit bottom for wildlife. Drainages would be located and developed where possible to use softer or more fractured areas of rock, to minimize earthwork costs and to leave more durable rock for exposed rock features. At closure, reducing the pit wall slope to a 3:1 slope above the backfill level would increase the pit to 327 acres (**Figure 5**) and encroach into a mineral withdrawal area (about 55 acres) in Section 20 of T52N R63W for approximately 1,165 feet at the farthest point on the south side of the Mineable Pit. The final reclamation of the Mineable Pit would also require the relocation of approximately 0.4 miles of NFS Road 838. Waste rock would be hauled from the WRF back to the pit when mining is complete. It is estimated that one million tons of waste rock would be needed to completely eliminate the pit lake. The partially backfilled pit would be covered with soil and revegetated to restore multiple land uses for wildlife habitat and forage production for livestock grazing.

Table 6.
Alternative D Estimated Disturbance Acres

New Disturbance	NFS	PVT	Total
Mine Pit	232.4		232.4
Additional Pit Reclamation[1]	94.8		94.8
PUG	2.1		2.1
PUG Facilities	14.5		14.5
PUG Haul Road[2]	10.6		10.6
WRF (including ore stockpiles)	61.0	383.5	444.5
WRF Haul Road[2]	10.9	4.1	15.0
Warren Peak - New Construction[3]	50.0	21.9	72.0
Pit Dewatering Pond	7.9		7.9
Sediment Ponds	6.9	2.4	9.4
Drainage Channel	3.0	2.1	5.2
Water Pipeline[4]	0.3		0.3
Beaver Creek Diversion	NA		NA
Topsoil Stockpile[5]	4.1	16.7	20.8
Topsoil Stockpile Access	NA	0	NA
Fence Construction	4.3	0.0	4.3
Fence Maintenance Road	5.8	0.7	6.6
Power Line Substation		0.1	0.1
Power Line[6]	22.6	7.3	29.9
Total New Disturbance	**531.2**	**438.8**	**970.4**

Source: Table 4.5-1 (RER, 2014a) and GIS
Totals may not add up exactly due to rounding.

1 Pit reclamation would temporarily increase the disturbance area, but this additional disturbance would be reclaimed.
2 WRF or pit reclamation would eventually remove parts or all of the haul road. To avoid double counting the acres, they are shown in as part of the WRF or Additional Pit Reclamation Acres. Assumes 100-foot disturbance width and does not account for existing road disturbance.
3 Assumes 66-foot disturbance width and does not account for existing road disturbance.
4 Assumes 30-foot disturbance width for pipeline construction.
5 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.
6 30-foot right-of-way.

Planting of native shrubs and trees to the Black Hills National Forest would be required to support pre-mining land uses to the extent possible. In situations where soils are unsuitable, other desirable vegetation will be planted. Based on the equipment and personnel present indicated in the Plan of Operations, reclamation is expected to take 18 years to reshape and backfill and an additional 2 years to place topsoil and revegetate.

2.4.3.2 PUG Plant in Alternative D

The PUG Plant would be moved about 750 feet south and west from the location in Alternative C to avoid wetlands, riparian, and known cultural resources (see **Figure 5**). The area for all activities within the PUG Plant would be reduced to 110 acres (from 176 acres in Alternative C). The access route in the PUG Plant area would be relocated and the guard station would be moved one-half mile north on NFS Road 838. One-half mile of NFS Road 838 north of the junction with NFS Road 847/851 would be upgraded to a double-lane,

gravel road. Water for the PUG Plant would be obtained from MW-16 via a pipeline as described in Alternative C. Additional water for the PUG Plant would come from the dewatering pond as determined suitable for use by WDEQ.

The haul road from the Mineable Pit to the PUG Plant would be redesigned to avoid the developed spring along Whitelaw Creek and minimize impacts on wetlands. A chain-link fence would be constructed around the PUG Plant area, but located within 200 feet of the facilities and adjusted to avoid and protect resources.

As proposed in Alternative C, a dewatering pond would be needed to remove groundwater as the pit is constructed. The dewatering pond for this alternative would be located in the PUG Plant area on an unnamed tributary to avoid riparian areas. A pipeline would be constructed from the pit to the pond.

2.4.3.3 WRF in Alternative D

Most of the WRF, 384 acres, would be located on private lands on Tract 42. There would be 61 acres of the WRF (more than Alternative C with 0.2 acres), sediment ponds, and drainage channels would be located on NFS lands (see **Table 6** and **Figure 5**).

Beaver Creek would not be diverted as proposed in Alternative C. The WRF would stay north of Beaver Creek by at least 100 feet. The WRF would extend slightly north of Section 16 onto Section 9 and remain at least 100 feet from Whitelaw Creek. As a result of avoiding Beaver Creek, additional NFS lands adjacent to the WRF would be available as needed for the construction of the facility. The footprint would be an estimated 445 acres (see **Table 6**). The top elevation is estimated at 6,215 feet (Golder Associates, 2014a)[6]. A seepage collection channel at the toe of the fill would flow into eight sediment ponds. Final reclamation of the facilities would follow natural landforms using variable slopes with nominal 3:1 maximum slope (steeper sections, not greater than 100 feet, may remain if it blends in with the surrounding terrain) in accordance with Wyoming Non-Coal Mining Rules and Regulations, Chapter 2(B)(I-V). As in Alternative C, the WRF would include topsoil stockpiles and a low grade ore stockpile. Stormwater and the underdrain water collection system would drain into sediment ponds where water would be stored for about two days while sediment settles and then water would be discharged downstream to Whitelaw and Beaver creeks. State of Wyoming standards would be met in designing the sediment ponds for a 10-year frequency, 24-hour duration event.

Once mining is complete, waste rock would be removed from the WRF and returned to the Mineable Pit until the pit is filled to groundwater level. The final WRF would be reduced by approximately 1.02 million tons for a total remaining of approximately 123 million tons.

2.4.3.4 Mine Area Fence in Alternative D

The fenced Mine Area would be 1,494 acres (860 acres on NFS lands) (**Figure 5**).

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources. The maximum height of the fence would be 42 inches, and the lowest wire would be at least 16 inches above ground. The top two or three strands would be barbed, the bottom wire would be smooth. A 12-foot wide specified road would be constructed along the fence for maintenance and security.

2.4.3.5 Main Access Route in Alternative D

Main access would use the Warren Peak Road (County Road 100 and NFS Road 838). Some relocation and reconstruction (about 2.8 miles on NFS lands) of the Warren Peak Road would be necessary for safety. The road surface would change from asphalt pavement to gravel from Highway 14 because the current paved surface would not withstand the hauling traffic and would be easier to maintain. The road would be designed for two way traffic with four-foot shoulders. Unless needed for future land management, the old road template would be reclaimed where the road is relocated. Steeper sections may need a runaway truck ramp for safety.

…….

[6] This alternative WRF design is evaluated as Alternative 2 in the sited report.

A 66-foot easement is proposed for the entire road length. The road would be located on NFS lands for 7.0 miles and 2.7 miles on other ownership. The upgrade to county roads as well as any county road additions requires approval from the Crook County Commission in accordance to WS 24-3-101 et seq.

2.4.3.6 Power Line Route in Alternative D

A new 25kV power line would be constructed from the east side of the Bearlodge Mountains off Government Valley Road (County Road 123) and generally follow the Ogden Ridge Road (NFS Road 899.1A) and connect to the existing transmission line at Warren Peak Fire Tower on the Warren Peak Road just south of the Mineable Pit (**Figure 5**). The power line route would then follow NFS Road 838 to the PUG Plant.

As with Alternative C, diesel generators would supply power for the first four years. For maintenance purposes, a low-standard access route would be provided along the power line.

The power line route would cross through Forest Plan Management Area 3.32 – Backcountry Non-Motorized Recreation Emphasis. The maintenance road for the power line would be closed to public motorized use.

2.4.3.7 Other Activities in Alternative D

This alternatives includes the Forest Plan Amendment (Section 2.5.1), exploration (Alternative C, Section 2.4.2.7), and all of the Environmental Protection Measures, and Design Features (Section 2.6), including reclamation, monitoring (Section 2.8), and financial assurance (Section 2.10).

2.4.3.8 Connected Actions

In Alternative D, most of the WRF is a connected action. Portions of the power line, access route, and all of the Upton Hydromet Plant are considered connected actions under this alternative.

2.4.4 Alternative E

Alternative E was designed to reduce impacts on cultural resources and current NFS land uses by reducing the NFS acres within the Mine Area fence. The major differences between Alternative C and Alternative E are:

- Reduction of Mineable Pit highwalls to a 3:1 slope or less where overburden would be placed in the pit at closure. Pit walls would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. A shallow pit lake (5 to 15 feet deep) would likely form.
- Main Access Route would use NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838).
- The PUG Plant would be moved to Tract 42 (private lands) so as to minimize the NFS lands within the Mine Area fence.
- Water supply for the PUG Plant would be the same supply well as Alternative C; however a pipeline would be constructed across NFS lands to the PUG Plant.
- Reconfiguration of the WRF to avoid impacts on Beaver Creek by at least 100 feet.
- Elimination of the power line. Instead, power would be supplied for the life of the mine by one 2,000kW generator for years 1 through 9 and two 2,000kW generators for years 10 through 45.
- Fenced Mine Area is smaller than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features have been identified by the Forest Service and included in Section 2.6.

2.4.4.1 Mineable Pit in Alternative E

Post-mining reclamation would reduce steepness of highwalls using variable slopes with a nominal 3:1 slope or less from the bottom of the pit to the top (steeper sections, no greater than 100 feet, may remain if it represents the surrounding landscape) in accordance with Wyoming Non-Coal Mining Rules and Regulations, Chapter 2(B)(I-V). A shallow pit lake (5 to 15 feet) will likely form.

Post-closure access to the area would be required for potential public use, administrative purposes, and wildlife habitat. The landform would be recontoured as described in Alternative D (see Section 2.4.3.1). The fill material would create accessible shoreline to a pit lake.

As in Alternative C, consultation is planned between the State of Wyoming and State of South Dakota to insure requirements of the Belle Fourche River Compact of 1943, Article IX are met as a result of the post-mining pit lake.

As in Alternative D, after grading and shaping, recontoured slopes in the pit would be covered with soil and revegetated to restore multiple land use for wildlife habitat and forage production for livestock grazing. Planting of native shrubs and trees to the Black Hills National Forest would be required to support pre-mining land uses to the extent possible. In situations where soils are unsuitable, other desirable vegetation will be planted. This reclamation is expected to take 18 years to reshape and an additional 2 years to place topsoil and revegetate. Reducing the pit wall slope to 3:1 from the bottom to the top of the pit would increase the reclaimed pit to 330 acres (**Figure 6**) and encroach into a mineral withdrawal area (about 57 acres) in Section 20 of T52N R63W for approximately 1,200 feet at the farthest point on the south side of the Mineable Pit. Final reclamation of the Mineable Pit would also require the relocation of approximately 0.4 mile of NFS Road 838.

2.4.4.2 PUG Plant in Alternative E

The PUG Plant and related facilities would be located entirely on private lands (**Figure 6**) in the southern portion of Tract 42 (south of Beaver Creek) and would therefore be a connected action. This location would include the truck and maintenance shop, diesel storage, and administration buildings. There would be a 100-foot buffer on Beaver Creek and the unnamed tributaries.

Water for use in the PUG Plant would be obtained from an existing well (MW-16) via a pipeline (0.9 miles of NFS lands and 0.8 miles on private land). Additional water to support the PUG Plant would come from the dewatering pond via a separate pipeline as determined suitable for use by WDEQ.

2.4.4.3 WRF in Alternative E

Most of the WRF in Alternative E is a connected action located on private lands on Tract 42. Some of the WRF (more than Alternative C but less than Alternative D), sediment ponds, and drainage channels would be located on NFS lands (see **Table 7** and **Figure 6**).

The WRF footprint would be 378 acres and the final height would be approximately 6,320 feet elevation (Golder Associates, 2014a). The design intent was for the entire WRF to be on private lands. The WRF would avoid Beaver Creek by 100 feet. Six sediment ponds are estimated. No diversion channel for Beaver Creek would be constructed. Final reclamation of the facilities would follow natural landforms utilizing variable slopes with a nominal 3:1 maximum slope (steeper sections, not greater than 100 feet, may be present if it blends in with the surrounding terrain). The final volume of the WRF would be 124 million tons of waste rock. Topsoil stockpiles would be located on private land in Tract 42.

Table 7. Alternative E Estimated Disturbance Acres			
New Disturbance	**NFS**	**PVT**	**Total**
Mine Pit	232.4		232.4
Additional Pit Reclamation[1]	104.4		104.4
PUG	0.0	2.1	2.1
PUG Facilities (including guard house)		14.0	14.0
PUG Haul Road[2]	2.3	7.2	9.4
WRF (including ore stockpiles)	3.1	375.3	378.4
WRF Haul Road[2]	0.7	0.2	0.9
NFS Road 879.1 New Construction[3]	35.1	26.1	61.2
Pit Dewatering Pond	5.5		5.5
Sediment Ponds	3.6	6.7	10.3
Drainage Channel	2.6	2.3	4.9
Water Pipeline[4]	2.7	2.5	5.2
Beaver Creek Diversion	NA		NA
Topsoil Stockpile[5]	0.3	16.7	17.0
Topsoil Access	0.0	0.1	0.1
Fence Construction	3.5	0.0	3.5
Fence Maintenance Road	7.2	0.7	7.9
Power Line Substation		0	0
25kV ROW	NA	NA	NA
Total New Disturbance	**403.6**	**453.9**	**857.5**

Source: Table 4.5-1 (RER, 2014a) and GIS

Totals may not add up exactly due to rounding.

1 Pit reclamation would temporarily increase the disturbance area, but this additional disturbance would be reclaimed.

2 WRF or pit reclamation would eventually remove parts or all of the haul road. To avoid double counting the acres, they are shown in as part of the WRF or Additional Pit Reclamation Acres. Assumes 100-foot disturbance width and does not account for existing road disturbance.

3 Assumes 66-foot disturbance width and does not account for existing road disturbance.

4 Assumes 25-foot disturbance width for pipeline construction.

5 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.

As in the other alternatives, the WRF would include topsoil stockpiles and a low grade ore stockpile. Stormwater and the underdrain water collection system would drain into sediment ponds where water would be stored for about two days while sediment settles and then discharged downstream to Whitelaw and Beaver creeks. State of Wyoming standards would be met in designing the sediment ponds for a 10-year frequency, 24-hour duration event.

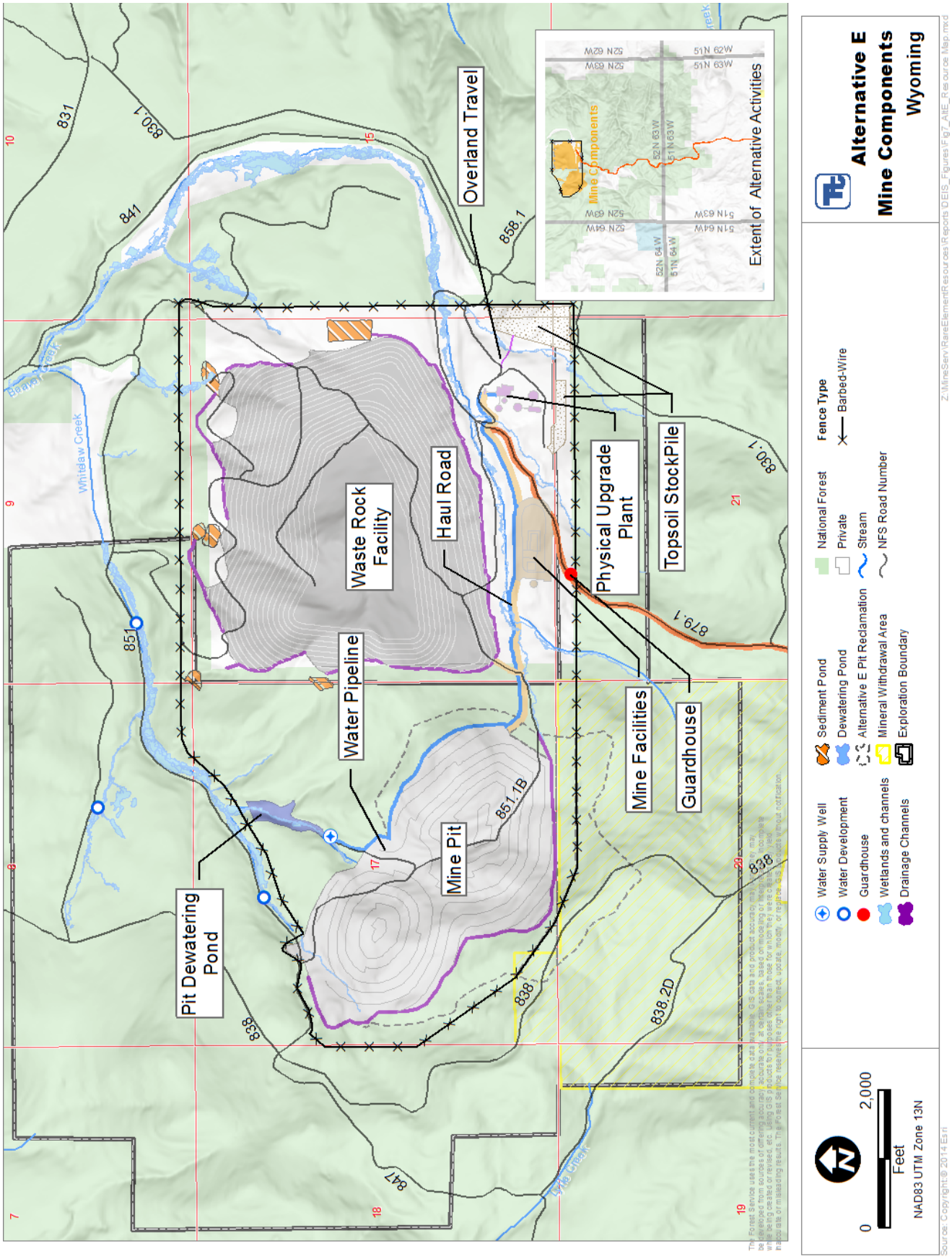
2.4.4.4 Mine Area Fence in Alternative E

The fenced Mine Area would be 1,243 acres with 608 acres on NFS lands.

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources (same as Alternative D). The maximum height of the fence would be 42 inches, and the lowest wire would be at least 16 inches above ground. The top two or three strands would be barbed, the bottom wire would be smooth. A 12-foot wide specified road would be constructed along the fence for maintenance and security.

2.4.4.5 Main Access Route in Alternative E

From the proposed PUG Plant location in Tract 42, the access route would follow existing road templates to the degree practicable and while meeting safety requirements (two 12-foot wide traffic lanes with two 4-foot shoulders). The access route would utilize NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838). The road surface would be changed from asphalt pavement to gravel from Highway 14 to the project facilities because the current paved surface would not withstand the hauling traffic. Also a gravel surface would be easier to maintain. Unless needed for future land management, the old road template would be reclaimed where the road is relocated. Steeper sections may need a runaway- truck ramp for safety. A 66-foot easement is proposed for the entire road length. The road would be located on NFS lands for 4.9 miles and 3.6 miles on other ownership. Upgrading and additions to county roads requires approval from the Crook County Commission in accordance to WS 24-3-101 et seq.


Overland Travel
Waste Rock Facility
Haul Road
Water Pipeline
Mine Pit
Pit Dewatering Pond
Physical Upgrade Plant
Topsoil StockPile
Mine Facilities
Guardhouse
Extent of Alternative Activities
Mine Components
Whitelaw Creek
Beaver Creek
Lytle Creek
831
830.1
841
858.1
851
879.1
851.1B
838
838.2D
847
Water Supply Well
Water Development
Guardhouse
Wetlands and channels
Drainage Channels
Sediment Pond
Dewatering Pond
Alternative E Pit Reclamation
Mineral Withdrawal Area
Exploration Boundary
National Forest
Private
Stream
NFS Road Number
Fence Type
Barbed-Wire
0
2,000
Feet
NAD83 UTM Zone 13N
Alternative E
Mine Components
Wyoming

2.4.4.6 Power in Alternative E

All power for the operation at the mine would be produced by two 2000-kilowatt diesel generators complete with reservoir, transfer switch, and uninterrupted power supply onsite for the life of the mine. Diesel would be stored onsite at the PUG Plant in accordance with state permitting requirements. Diesel supply delivery would continue for the life of the mine and possibly need additional storage compared to other alternatives.

2.4.4.7 Other Activities in Alternative E

This alternative includes the Forest Plan Amendment (Section 2.5.1), exploration (Alternative C, Section 2.4.2.7), all of the Environmental Protection Measures, and Design Features (Section 2.6), including reclamation, monitoring (Section 2.9) and financial assurance (Section 2.10).

2.4.4.8 Connected Actions

Most of the WRF is a connected action. In Alternative E, the PUG Plant would also be a connected action. Project activities occurring on private lands; power line, access route, and Hydromet Plant, are considered connected actions under this alternative.

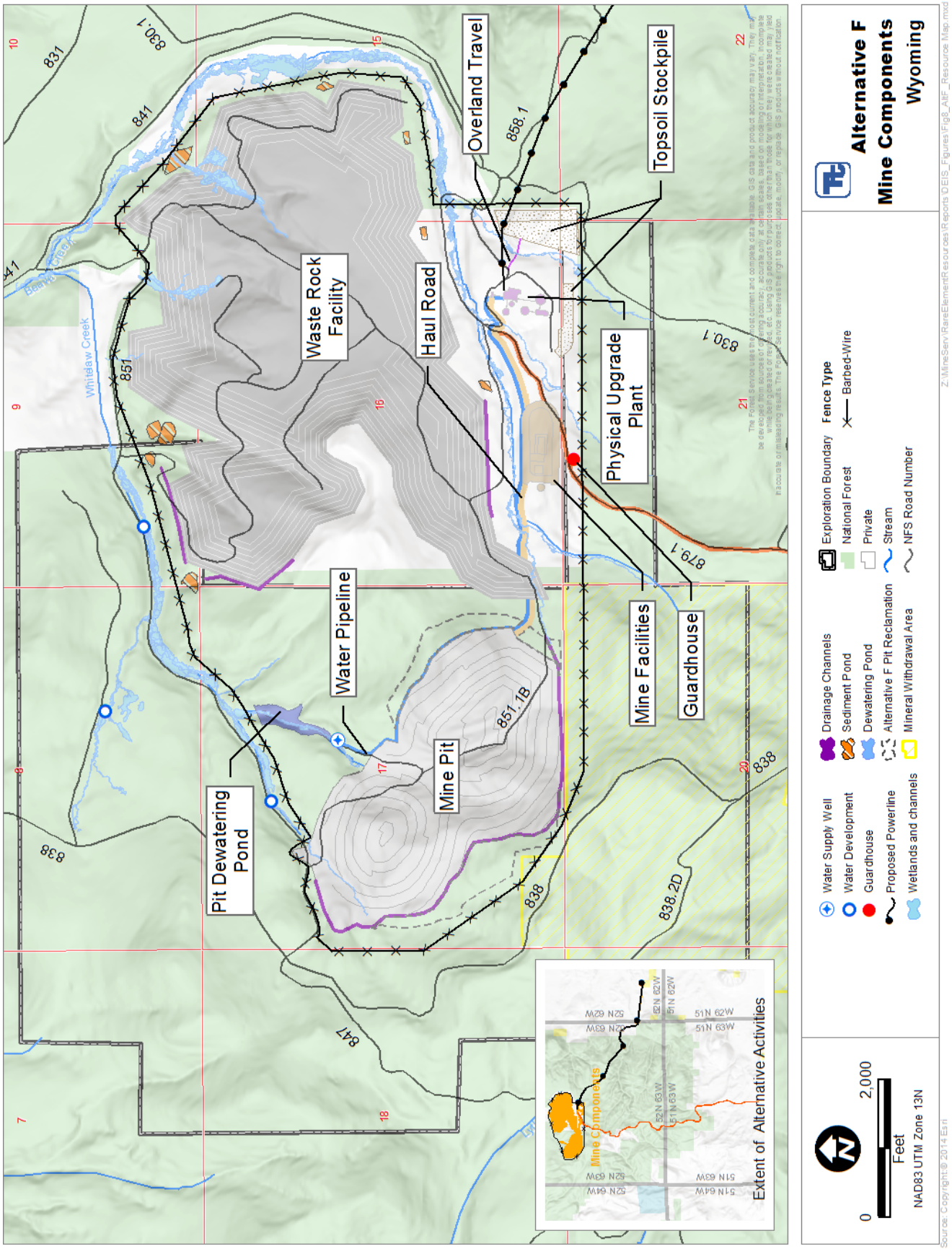
2.4.5 Alternative F

Alternative F was developed to reduce the long-term potential impacts on current NFS land uses, by reducing the NFS acres in the Mine Area and reducing risks to public safety (see **Figure 7**). The major differences between Alternative C and Alternative F are:

- The PUG Plant would be moved to private lands in Tract 42 (same as Alternative E) to reduce the size of the fenced Mine Area.
- Reconfiguration of the WRF to avoid potential impacts on Beaver Creek by at least 300 feet. The WRF would be engineered to more closely follow natural landforms.
- Reduction of Minable Pit highwalls would be similar to Alternative D, however, the mineral withdrawal area to the south would not be included in the reclamation area and additional waste rock would not be used for backfill. A pit lake would form up to 70 feet deep. Pit walls on the north, east, and west would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. Pit highwall on the south and southwest would remain as constructed to avoid affecting the mineral withdrawal area.
- Main access route would use NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838).
- Power line route from Government Valley Road (County Road 123) and along NFS Road 858.
- Smaller fenced Mine Area than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area.
- Design Features have been identified by the Forest Service and included in Section 2.6.

2.4.5.1 Mineable Pit in Alternative F

The post-mining reclamation of the Mineable Pit would reduce the steepness of highwalls using variable slope with a nominal 3:1 maximum slope (steeper sections, no greater than 100 feet, may be present if it represents the surrounding landscape may remain if it blends in with the surrounding terrain) in accordance with Wyoming Non-Coal Mining Rules and Regulations, Chapter 2(B)(I-V). The highwall reduction would not occur on the south and southwest side of the pit to avoid the mineral withdrawal area. Post closure access to the pit would be required for administrative purposes, public access, and wildlife habitat. The landform would be recontoured as described in Alternative D (see Section 2.4.3.1), however, as no backfilling with waste rock would occur, a shallow pit lake would likely form.


Alternative F
Mine Components
Wyoming
Waste Rock Facility
Haul Road
Overland Travel
Topsoil Stockpile
Physical Upgrade Plant
Mine Facilities
Guardhouse
Water Pipeline
Pit Dewatering Pond
Mine Pit
Whitetaw Creek
Bear Lodge Creek
Extent of Alternative Activities
Mine Components
Water Supply Well
Water Development
Guardhouse
Proposed Powerline
Drainage Channels
Sediment Pond
Dewatering Pond
Alternative F Pit Reclamation
Wetlands and channels
Mineral Withdrawal Area
Exploration Boundary
National Forest
Private
Stream
NFS Road Number
Fence Type
Barbed-Wire
0
2,000
Feet
NAD83 UTM Zone 13N

As in Alternative C, consultation is planned between the State of Wyoming and State of South Dakota to insure requirements of the Belle Fourche River Compact of 1943, Article IX are met as a result of the post-mining pit lake. The constructed pit walls on the south and southwest side would remain in this alternative due to the mineral withdrawal. As a result, post-mining safety actions are needed to ensure public safety along the edge of the pit. Placement of large boulder rocks, signage, or other activities may be needed to reduce or minimize safety concerns. These activities would likely be located within the mineral withdrawal area.

Reducing the pit highwalls would increase the pit to 274 acres (see **Figure 7**). No resloping of the highwalls would encroach into the mineral withdrawal area. Reclamation is expected to take 15 years to reshape and an additional 2 years to place topsoil and revegetate. After grading and shaping, exposed rock would be covered with soil and revegetated to restore multiple land use for wildlife habitat and forage production for livestock grazing. Planting of native shrubs and trees to the Black Hills National Forest would be required to support pre-mining land uses to the extent possible. In situations where soils are unsuitable, other desirable vegetation will be planted.

Table 8.
Alternative F Estimated Disturbance Acres

New Disturbance	NFS	PVT	Total
Mine Pit	232.4		232.4
Additional Pit Reclamation[1]	38.6		38.6
PUG	0.0	2.1	2.1
PUG Facilities (including guard house)	0.0	14.0	14.0
UG Haul Road[2]	1.2	6.8	8.0
WRF (including ore stockpiles)	232.6	388.3	620.9
WRF Haul Road[2]	-		0
NFS Road 879.1 New Construction[3]	35.1	26.1	61.2
Pit Dewatering Pond	5.5		5.5
Sediment Ponds	6.4	0.8	7.2
Drainage Channel	2.4	0.4	2.8
Water Pipeline[4]	2.5	2.4	4.9
Beaver Creek Diversion	NA		0
Topsoil Stockpile[5]	0.3	16.7	16.9
Topsoil Stockpile Access	0.0	0.1	0.1
Fence Construction	3.8	0.1	3.9
Fence Maintenance Road	8.1	0.2	8.3
Power Line Substation	0.0	0.1	0.1
25kV ROW[6] (Occupancy)	11.5	8.3	19.8
Total New Disturbance	**579.5**	**464.4**	**1,046.7**

Source: Table 4.5-1 (RER, 2014a) and GIS

Totals may not add up exactly due to rounding.

1 Pit reclamation would temporarily increase the disturbance area, but this additional disturbance would be reclaimed.

2 WRF or pit reclamation would eventually remove parts or the entire haul road. To avoid double counting the acres, they are shown in as part of the WRF or Additional Pit Reclamation Acres. Assumes 100-foot disturbance width and does not account for existing road disturbance.

3 Assumes 66-foot disturbance width and does not account for existing road disturbance.

4 Assumes 25-foot disturbance width for pipeline construction.

5 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.

6 Disturbance is temporary for 30-foot right-of-way. Long-term disturbance would be required for pole structures.

2.4.5.2 PUG Plant in Alternative F

The PUG Plant and related facilities would be located entirely on private lands in the southern portion of Tract 42 (south of Beaver Creek). This location would include the truck and maintenance shop, diesel storage, and administration buildings. There would be a 300-foot buffer on Beaver Creek. Water for use in the PUG Plant would be obtained from an existing well (MW-16) via a pipeline (0.9 miles on NFS land and 0.8 miles on private). Additional water to support the PUG would come from the dewatering pond via a separate pipeline as determined suitable for use by WDEQ.

2.4.5.3 WRF in Alternative F

The WRF in Alternative F would be located on private lands on Tract 42 and NFS lands. The design of the facility would use the natural landforms to the greatest extent possible, thus allowing for a more natural

appearance upon final reclamation rather than an engineered block style construction as proposed with the other alternatives. This alternative design, more than any other alternative, utilizes a greater amount of NFS lands for the construction of the facility, placement of sediment ponds, and drainage channels (see **Table 8** and **Figure 7**).

The WRF would avoid Beaver Creek and Whitelaw Creek by at least 300 feet. The WRF would extend north, east, and west of Section 16 into NFS lands in Sections 9, 10, 15, and 17. The footprint is estimated at 621 acres. Top elevation is estimated at 6,155 feet elevation. A seepage collection channel at the toe of the fill would flow into eight sediment ponds. No diversion channel for Beaver Creek would be constructed. Final reclamation of the facilities would follow natural landforms utilizing variable slopes with a nominal 3:1 maximum slope (steeper sections, not greater than 100 feet, may be present if it blends in with the surrounding terrain). The final WRF volume would be 124 million tons of waste rock.

As in the other alternatives, the WRF would include topsoil stockpiles and a low grade ore stockpile. Stormwater and the underdrain water collection system would drain into eight sediment ponds where water would be stored for about two days while sediment settles and then discharged downstream to Whitelaw and Beaver creeks. State of Wyoming standards would be met in designing the sediment ponds for a 10-year frequency, 24-hour duration event.

2.4.5.4 Mine Area Fence in Alternative F

The Mine Area would be 1,488 acres (854 acres on NFS lands).

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources (same as Alternative D). The maximum height of the fence would be 42 inches, and the lowest wire would be at least 16 inches above ground. The top two or three strands would be barbed, the bottom wire would be smooth. A 12-foot wide specified road would be constructed along the fence for maintenance and security.

2.4.5.5 Access Route in Alternative F

The access route in Alternative F would be the same as Alternative E, using NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838). A 66-foot easement is proposed for the entire road length. The road would be located on NFS lands for 4.9 miles and 3.6 miles on other ownership. The upgrade to county roads as well as any county road additions requires approval from the Crook County Commission in accordance to WS 24-3-101 et seq.

2.4.5.6 Power Line in Alternative F

A new 25kV power line would be constructed from Government Valley Road (County Road 123) along NFS Road 858. For maintenance purposes, PRECorp requested full vehicle access along the route. Diesel generators (2000-kilowatt, one at a time) would provide power for the first four years while the power line is constructed. It is estimated that generators would be used for the first 3 to 4 years. The generators would also serve as backup during power failures for critical systems.

The power line route would cross through Forest Plan Management Area 3.32 – Backcountry Non-Motorized Recreation Emphasis. The maintenance road for the power line would be closed to public motorized use.

2.4.5.7 Other Activities in Alternative F

This alternative includes the Forest Plan Amendment (Section 2.5.1), exploration boundary (Alternative C, Section 2.4.2.7), Environmental Protection Measures and Design Features (Section 2.6), including reclamation, monitoring (Section 2.9) and financial assurance (Section 2.10).

2.4.5.8 Connected Actions

In Alternative F, most of the WRF is a connected action. The PUG Plant would also be a connected action. Other activities occurring on private lands; i.e. power line, access route, and Hydromet Plant, are considered connected actions under this alternative.

2.4.6 Alternative G

This alternative is designed to reduce even more than Alternative D the potential risks to water resources (**Figure 8**). The major differences between the Alternative C and Alternative G are:

- PUG Plant would be the same as Alternative D.
- The dewatering pond for the Mineable Pit would be located on an unnamed tributary south of the PUG Plant. Water would be discharged into Whitelaw Creek.
- WRF would avoid Beaver Creek by at least 300 feet and incorporate an impermeable cap and liner system to isolate waste rock from rain, snowmelt, or springs. The majority of the waste rock would be returned to the pit at closure.
- Mineable Pit reclamation would require a complete backfill with waste rock to approximate the pre-mining topography and installation of an impermeable cap to prevent rain and snowmelt from coming in contact with waste rock in the pit.
- Smaller fenced Mine Area would be smaller than Alternative C. A wildlife-friendly fence would be constructed around the Mine Area. Design Features have been identified by the Forest Service and included in Section 2.6.

2.4.6.1 Mineable Pit in Alternative G

The post-mining pit reclamation would include complete backfill with waste rock to the original pre-mining contours, and an impermeable cap installed to limit infiltration by rainfall and snowmelt.

The impermeable cap would be covered with at least two feet of topsoil and revegetated with grass. Shrubs and trees would not be allowed to grow on the cap to prevent roots from penetrating the cap. Multiple land uses would be restored for wildlife habitat and forage production for livestock grazing. Based on the equipment available and safety, reclamation is expected to take 32 years to backfill the Mineable Pit and an additional 2 years to install caps, place topsoil, and revegetate.

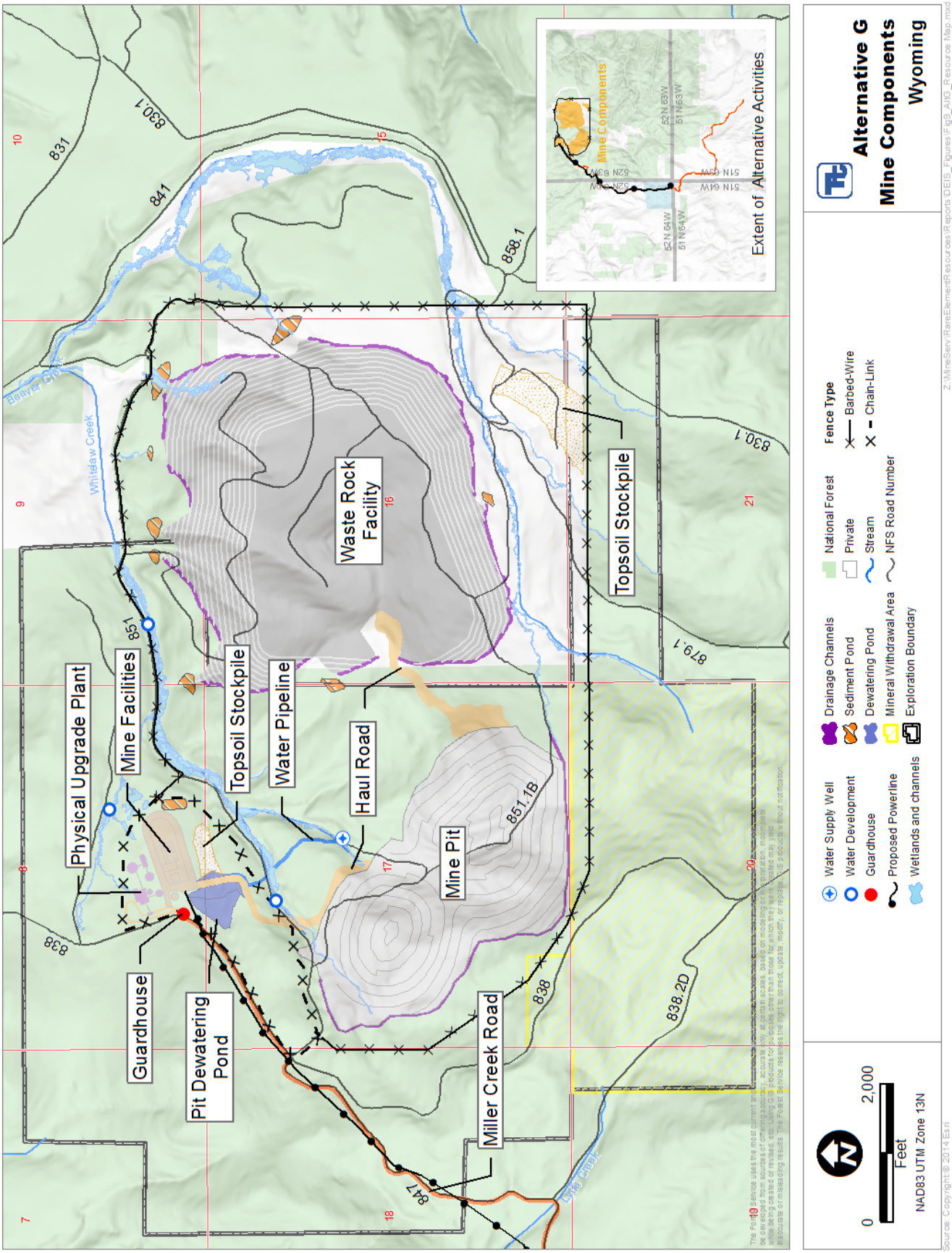
2.4.6.2 PUG Plant in Alternative G

The PUG Plant would be moved about 750 feet south and west from the location in Alternative C to avoid wetlands, riparian, and known cultural resources (same as Alternative D) (see **Figure 5**). The area for all activities within the PUG Plant would be reduced to 110 acres (from 176 acres in Alternative C). The access route in the PUG Plant area would be relocated and the guard station would be moved one-half mile north on NFS Road 838. One-half mile of NFS Road 838 north of the junction with NFS Road 847/851 would be upgraded to a double-lane, gravel road. Water for the PUG Plant would be obtained from MW-16 via a pipeline as described in Alternative C. Additional water for the PUG Plant would come from the dewatering pond as determined suitable for use by WDEQ.

The haul road from the Mineable Pit to the PUG Plant would be redesigned to avoid the developed spring along Whitelaw Creek and minimize impacts on wetlands. A chain-link fence would be constructed around the PUG Plant area, but located within 200 feet of the facilities and adjusted to avoid and protect resources.

As proposed in Alternative C, a dewatering pond would be needed to remove groundwater as the pit is constructed. The dewatering pond for this alternative would be located in the PUG Plant area on an unnamed tributary to avoid riparian areas. A pipeline would be constructed from the pit to the pond.

Figure 8. Alternative G Mine Area Components and Access



Final reclamation of the PUG Plant would include re-contouring to the pre-mining conditions to the extent possible (see **Table 9** and **Figure 8**).

Table 9.
Alternative G Estimated Disturbance Acres

New Disturbance	NFS	PVT	State	Total
Mine Pit	232.4			232.4
Additional Pit Reclamation[1]	0			0
PUG	2.1			2.1
PUG Facilities (including guard house)	14.5			14.5
PUG Haul Road[2]	10.6			10.6
WRF (including ore stockpiles)	61.0	383.6		444.5
WRF Haul Road[2]	10.9	4.1		14.9
Miller Creek - New Construction[3]	15.5	41.9	6.1	63.5
Pit Dewatering Pond	7.9			7.9
Sediment Ponds	7.0	2.4		9.4
Drainage Channel	3.0	2.1		5.2
Water Pipeline[4]	0.3	0		0.3
Beaver Creek Diversion	NA	NA	NA	NA
Topsoil Stockpile[5]	3.8	20.3		24.1
Topsoil Stockpile Access	NA	NA	NA	NA
Fence Construction	4.4	0.0		4.4
Fence Maintenance Road	5.9	0.7		6.6
Power Line Substation			0.1	0.1
25kV ROW[6]	6.2	4.3	1.0	11.6
Total New Disturbance	**385.5**	**459.4**	**7.2**	**852.1**

Source: Table 4.5-1 (RER, 2014a) and GIS
Totals may not add up exactly due to rounding.
1 Pit reclamation would temporarily increase the disturbance area, but this additional disturbance would be reclaimed.
2 Assumes 100-foot disturbance width and does not account for existing road disturbance.
3 Assumes 66-foot disturbance width and does not account for existing road disturbance.
4 Assumes 25-foot disturbance width for pipeline construction.
5 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.
6 Disturbance is temporary for 30-foot right-of-way. Long-term disturbance would be required for pole structures.

2.4.6.3 WRF in Alternative G

The WRF would be constructed to avoid Beaver Creek by 300 feet. As a result of avoiding Beaver Creek, additional NFS lands adjacent to the WRF would be available as needed for waste rock storage. The maximum footprint is estimated at 445 acres. A liner system would isolate the WRF from the groundwater and capture any drainage from the waste rock. The topsoil stockpiles would be on private lands in Tract 42.

As in the other alternatives, the WRF would include topsoil stockpiles and a low grade ore stockpile. Stormwater and the underdrain water collection system beneath the liner would drain into sediment ponds where water would be stored for about two days while sediment settles and then discharged downstream to Whitelaw and Beaver creeks. State of Wyoming standards would be met in designing the eight sediment ponds for a 10-year frequency, 24-hour duration event.

At final closure, the WRF footprint could be removed from NFS lands. An impermeable cap would be installed to prevent infiltration by rainfall and snow melt. The impermeable cap would be covered with at least two feet of topsoil and revegetated with grass. Shrubs and trees would not be allowed to grow on the cap to prevent roots from penetrating the cap. Removing waste rock from the WRF would preclude concurrent reclamation. Reclamation of the WRF would not be completed until after backfilling the pit was finished, which would take approximately 32 years (Golder Associates, 2014d). The entire WRF would not be eliminated at closure because rock removed from the pit would not be as consolidated after blasting and hauling (a 30 percent swell factor). It is estimated that approximately 33 million tons would remain in the WRF after a total pit backfill (Golder Associates, 2014d).

2.4.6.4 Mine Area Fence in Alternative G

The Mine Area would be 1,499 acres (864 acres on NFS lands).

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources (same as Alternative D). The maximum height of the fence would be 42 inches, and the lowest wire would be at least 16 inches above ground. The top two or three strands would be barbed, the bottom wire would be smooth. A 12-foot wide specified road would be constructed along the fence for maintenance and security.

2.4.6.5 Main Access Route in Alternative G

Miller Creek Road (County Roads 208, 266, and 8 and NFS Roads 854.1 and 847) would be the main access to the Mine Area. This 13-mile access route (2 miles on NFS lands, 11 miles other ownership) is proposed to be upgraded to accommodate two-way traffic in two 12-foot driving lanes with two 4-foot shoulders. The posted speed limit would be 30 miles per hour, unless final construction shows a slower speed is needed. The total road easement width for the access route is 66 feet. For safety, the route would be designed with grades under six percent. The upgrade to county roads requires the approval from the Crook County Commission in accordance to WS 24-3-101 et seq.

During operations, the mining traffic is estimated at between 13 to 17 round trips each day for semi-trucks carrying pre-concentrate ore material in addition to worker traffic and delivery supply vehicles.

2.4.6.6 Power Line in Alternative G

A 25-kilovolt (kV) transmission line would be constructed above ground to provide power (same as Alternative C). The transmission line requires a right-of-way of 30 feet to manage vegetation. Approximately 1.5 miles of the power line would cross NFS lands, while the remainder would be on private and state of Wyoming lands. For maintenance purposes, PRECorp requested full vehicle access along the route.

Three 2000-kilowatt diesel generators (one at a time) would provide power for the first four years while the power line is constructed. It is estimated that generators would be used for the first 3 to 4 years. The generators would also serve as backup during power failures for critical systems.

2.4.6.7 Other Activities in Alternative G

This alternative includes the Forest Plan Amendment (Section 2.5.1), exploration boundary (Alternative C, Section 2.4.2.7), and all of the Environmental Protection Measures, and Design Features (Section 2.6), including reclamation, monitoring (Section 2.9) and financial assurance (Section 2.10).

NFS road 851 under Alternative G would have a bypass constructed to NFS road 838.2A to provide for flow-thru traffic around the mine. NFS 838.2A would be upgraded to a Level III maintenance road. The remaining portion of NFS road 838.2A (unclassified route) would be closed to motorized travel.

2.4.6.8 Connected Actions

As stated in Section 0, in Alternative G, most of the WRF is a connected action. Other activities occurring on private lands; i.e. power line, access route, and Hydromet Plant, are connected actions.

2.4.7 Alternative H

This alternative is designed to consider all of the main issues into one alternative (**Figure 9** and **Table 10**). The major differences between the Alternative C and Alternative H are:

- The PUG Plant moved south and west to avoid riparian areas and known cultural resources (same as Alternatives D and G).
- .

Figure 9. Alternative H Mine Area Components and Access

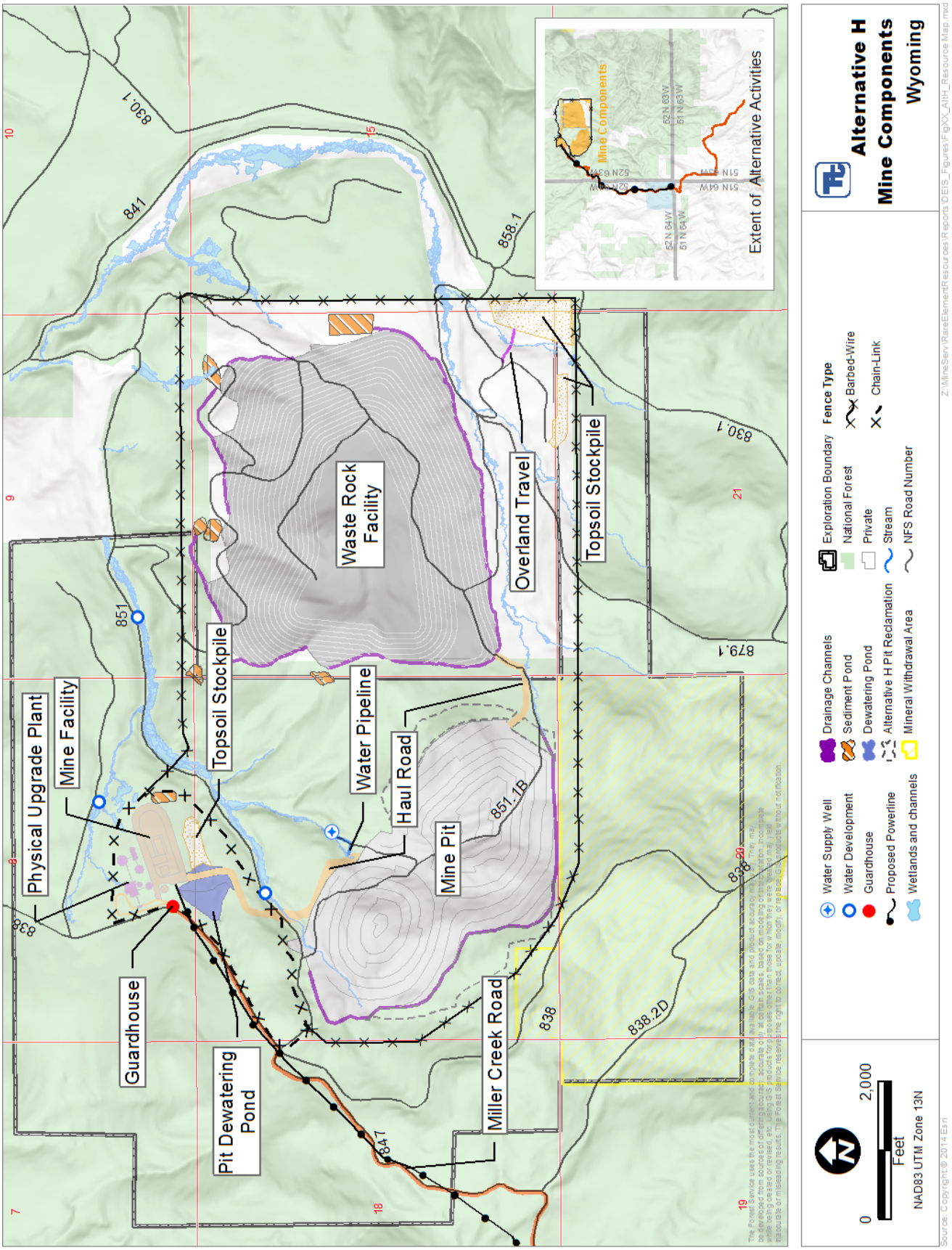


Table 10. Alternative H Estimated Disturbance Acres				
New Disturbance	**NFS**	**PVT**	**State**	**Total**
Mine Pit	232.4			232.4
Additional Pit Reclamation[1]	38.6			38.6
PUG	2.1			2.1
PUG Facilities (including guard house)	14.5			14.5
PUG Haul Road[2]	10.6			10.6
WRF (including ore stockpiles)	3.1	375.3		378.4
WRF Haul Road[2]	3.0	0.2		3.2
Miller Creek - New Construction[3]	15.5	41.9	6.1	63.5
Pit Dewatering Pond	7.9			7.9
Sediment Ponds	7.0	2.4		9.4
Drainage Channel	2.6	2.3		4.9
Water Pipeline[4]	0.3	0		0.3
Beaver Creek Diversion	NA	NA	NA	NA
Topsoil Stockpile[5]	4.1	16.7		20.8
Topsoil Stockpile Access	NA	NA	NA	NA
Fence Construction	4.3	0.0		4.3
Fence Maintenance Road	7.7	0.7		8.4
Power Line Substation			0.1	0.1
25kV ROW[6]	6.2	4.3	1.0	11.6
Total New Disturbance	**359.9**	**443.8**	**7.2**	**811.0**

Source: Table 4.5-1 (RER, 2014a) and GIS

Totals may not add up exactly due to rounding.

1 Pit reclamation would temporarily increase the disturbance area, but this additional disturbance would be reclaimed.

2 Assumes 100-foot disturbance width and does not account for existing road disturbance.

3 Assumes 80-foot disturbance width and does not account for existing road disturbance.

4 Assumes 25-foot disturbance width for pipeline construction.

5 Acreage includes Topsoil Stockpile #1 within the PUG Plant boundary.

6 Disturbance is temporary for 30-foot right-of-way. Long-term disturbance would be required for pole structures.

- The dewatering pond for the Mineable Pit would be located on an unnamed tributary south of the PUG Plant as reflected in Alternatives D and G. Water would be discharged into Whitelaw Creek.
- WRF would avoid Beaver Creek by at least 100 feet and design as in Alternative E
- Mineable Pit reclamation would be the same as Alternative F and avoid the mineral withdrawal area to the south. A pit lake up to 70 feet deep would form. Pit walls on the north, east, and west would be reshaped to provide a safe, visually appealing, sustainable, natural landform with features similar to nearby natural landforms. Pit highwall on the south and southwest would remain as constructed to avoid affecting the mineral withdrawal area.A wildlife-friendly fence would be constructed around the Mine Area as described in Alternative D. A chain-link fence is proposed installed around the PUG area, while a barbed-wire fence is proposed around the rest of the mine area. Design Features have been identified by the Forest Service and included in Section 2.6.

2.4.7.1 Mineable Pit in Alternative H

The post-mining reclamation of the Mineable Pit would be as described in Alternative F. Alternative H proposes to reduce the steepness of highwalls using variable slope with a nominal 3:1 maximum slope (steeper sections, no greater than 100 feet, may be present if it represents the surrounding landscape may remain if it blends in with the surrounding terrain) in accordance with Wyoming Non-Coal Mining Rules and Regulations, Chapter 2(B)(I-V). The highwall reduction would not occur on the south and southwest side of the pit to avoid the mineral withdrawal area. Post closure access to the pit would be required for administrative purposes, public access, and wildlife habitat. The landform would be recontoured as described in Alternative D (see Section 2.4.3.1), however, as no backfilling with waste rock would occur, a shallow pit lake, up to 70 feet deep, would likely form.

As in Alternative C, consultation is planned between the State of Wyoming and State of South Dakota to insure requirements of the Belle Fourche River Compact of 1943, Article IX are met as a result of the post-

mining pit lake. The constructed pit walls on the south and southwest side would remain in this alternative due to the mineral withdrawal. As a result, post-mining safety actions are needed to ensure public safety along the edge of the pit. Placement of large boulder rocks, signage, or other activities may be needed to reduce or minimize safety concerns. These activities would likely be located within the mineral withdrawal area.

Reducing the pit highwalls would increase the pit to 274 acres (see **Figure 9**). No resloping of the highwalls would encroach into the mineral withdrawal area. Reclamation is expected to take 15 years to reshape and an additional 2 years to place topsoil and revegetate. After grading and shaping, exposed rock would be covered with soil and revegetated to restore multiple land use for wildlife habitat and forage production for livestock grazing. Planting of native shrubs and trees to the Black Hills National Forest would be required to support pre-mining land uses to the extent possible. In situations where soils are unsuitable, other desirable vegetation will be planted.

2.4.7.2 PUG Plant in Alternative H

The PUG Plant would be moved about 750 feet south and west from the location in Alternative C to avoid wetlands, riparian, and known cultural resources (same as Alternatives D and G) (see **Figure 5**). The area for all activities within the PUG Plant would be reduced to 110 acres (from 176 acres in Alternative C). The access route in the PUG Plant area would be relocated and the guard station would be moved one-half mile north on NFS Road 838. One-half mile of NFS Road 838 north of the junction with NFS Road 847/851 would be upgraded to a double-lane, gravel road. Water for the PUG Plant would be obtained from MW-16 via a pipeline as described in Alternative C. Additional water for the PUG Plant would come from the dewatering pond as determined suitable for use by WDEQ.

The haul road from the Mineable Pit to the PUG Plant would be redesigned to avoid the developed spring along Whitelaw Creek and minimize impacts on wetlands. A chain-link fence would be constructed around the PUG Plant area, but located within 200 feet of the facilities and adjusted to avoid and protect resources.

As proposed in Alternative C, a dewatering pond would be needed to remove groundwater as the pit is constructed. The dewatering pond for this alternative would be located in the PUG Plant area on an unnamed tributary to avoid riparian areas. A pipeline would be constructed from the pit to the pond.

Final reclamation of the PUG Plant would include re-contouring to pre-mining conditions to the extent possible.

2.4.7.3 WRF in Alternative H

The WRF would be the same as Alternative E, including avoiding Beaver Creek by a minimum of 100 feet. Topsoil piles will also be located on the private land in Tract 42 on the south side of Beaver Creek. Sediment ponds, to the extent possible, would be constructed to minimize any impacts to wetlands and riparian resources and designed for a 10-year frequency, 24-hour duration event. Final reclamation of the facilities would follow natural landforms using variable slopes with nominal 3:1 maximum slope (steeper sections, not greater than 100 feet, may remain if it blends in with the surrounding terrain) in accordance with Wyoming Non-Coal Mining Rules and Regulations, Chapter 2(B)(I-V).

The WRF would be designed to maximize the use of private land while minimizing impacts to water resources and providing for a stable facility. NFS lands surrounding the facility may be authorized, as needed, for facility construction.

2.4.7.4 Mine Area Fence in Alternative H

The Mine Area would be 1,377 acres (743 acres on NFS lands).

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources (same as Alternative D). The maximum height of the fence would be 42 inches, and the lowest wire would be at least 16 inches above ground. The top two or

three strands would be barbed, the bottom wire would be smooth. A 12-foot wide specified road would be constructed along the fence for maintenance and security.

2.4.7.5 Main Access Route in Alternative H

Miller Creek Road (County Roads 208, 266, and 8 and NFS Roads 854.1 and 847) would be the main access to the Mine Area (same as Alternative G). This 13-mile access route (2 miles on NFS lands, 11 miles other ownership) is proposed to be upgraded to accommodate two-way traffic in two 12-foot driving lanes with two 4-foot shoulders. The posted speed limit would be 30 miles per hour, unless final construction shows a slower speed is needed. The total road easement width for the access route is 66 feet. For safety, the route would be designed with grades under six percent. The upgrade to county roads requires the approval from the Crook County Commission in accordance to WS 24-3-101 et seq.

During operations, the mining traffic is estimated at between 13 to 17 round trips each day for semi-trucks carrying pre-concentrate ore material in addition to worker traffic and delivery supply vehicles.

2.4.7.6 Power Line in Alternative H

A 25-kilovolt (kV) transmission line would be constructed above ground to provide power (same as Alternative C). The transmission line requires a right-of-way of 30 feet to manage vegetation. Approximately 1.5 miles of the power line would cross NFS lands, while the remainder would be on private and state of Wyoming lands. For maintenance purposes, PRECorp requested full vehicle access along the route.

Three 2000-kilowatt diesel generators (one at a time) would provide power for the first four years while the power line is constructed. It is estimated that generators would be used for the first 3 to 4 years. The generators would also serve as backup during power failures for critical systems.

2.4.7.7 Other Activities in Alternative H

This alternative includes the Forest Plan Amendment (Section 2.5.1), exploration boundary (Alternative C, Section 2.4.2.7), and all of the Environmental Protection Measures, and Design Features (Section 2.6), including reclamation, monitoring (Section 2.9) and financial assurance (Section 2.10).

2.4.7.8 Connected Actions

In Alternative H, most of the WRF is a connected action. Other activities occurring on private lands; i.e. power line, access route, and Hydromet Plant, are connected actions

2.5 Forest Plan Consistency

The Black Hills Forest Plan and ROD was first completed in 1997, and amended in 2006 by the Phase II Amendment, in accordance with the 1976 National Forest Management Act, NEPA, and other laws and associated regulations. The purpose of the Forest Plan is to provide direction for all resource management activities on the Black Hills National Forest. It establishes goals, objectives, standards, and guidelines for natural resources management.

Occasionally, individual projects cannot meet the management direction provided in the Forest Plan and if it is determined that the project warrants full consideration, then it becomes necessary to propose a modification to the plan. Forest Plans may "*be amended in any manner whatsoever after final adoption and after public notice*" (16 USC 1604 (f)(4)). Because the NOI for the Bear Lodge Project announced that a plan amendment would be part of the decision, and because the NOI was published before May 2015, the plan amendment process may take place under the provisions of the 1982 planning regulation (36 CFR 219.10(f) (1982)). Corresponding direction at Forest Service Manual (FSM) 1926.5 directs the Forest Service Responsible Official to do the following:

1. Determine whether proposed changes to the land management plan are significant or not significant;

2. Document the determination of whether the change is significant or not significant in a decision document; and
3. Provide appropriate public notification of the decision prior to implementing the changes.

A review of the consistency of the Bear Lodge Project with the Forest Plan resulted in a determination that certain aspects of the Proposed Action or the action alternatives would or may result in conditions that are not consistent with management direction in the Forest Plan. **Table 11** provides an overview of potential inconsistencies identified. A plan amendment has been proposed (Section 2.5.1) to resolve most of these inconsistencies. In other instances, modifications have been made to the alternatives to make them consistent with Forest Plan standards (see Section 2.5.2).

Table 11.
Black Hills Forest Plan Standard Consistency Overview

Management Area Direction	Standards as applied to Alternatives C through G
Forest-wide Standards	Bear Lodge Project is inconsistent with Forest Plan direction for: • Maintaining and sustaining soil productivity (Standards 1102 and 1116) • Minimizing soil damage • Maintaining and protection of riparian resources (Standards 1301, 1302, 3106, 3106a, 3106b) • Maintaining or improving long term stream health (Standards 1209, 1210, 1301) • Restoring lands to pre-mining conditions (Standards 1501, 1505, 2416b, 2416d,) • Protection of cultural resources (Standard 7103) • Maintenance and enhancement of visual resources • Maintenance and improvement of wildlife habitat (Standard 3111, 3116) • Providing for structural diversity and species diversity (Standards 2101, 2103) • Establishment of new utility corridors
Management Area 5.1 Standards	Bear Lodge Project is inconsistent with Forest Plan direction for: • Maintaining lands for timber production • Maintenance of the visual resource • Maintaining livestock grazing • Protection of cultural resources
Management Area 5.4	Bear Lodge Project may be inconsistent with Forest Plan direction for: • Maintenance of wildlife habitat
Management Area 3.32	Bear Lodge Project may be inconsistent with Forest Plan direction for: • Loss of Recreation Opportunity Spectrum class • Loss of recreation setting • Maintenance of visual resources • Establishment of new road • Maintenance of wildlife habitat • Protection of cultural resources

2.5.1 Proposed Forest Plan Amendment

The Black Hills National Forest proposes to amend its Forest Plan to allow activities integral to the Bear Lodge Project on NFS lands. The amendment would apply to all action alternatives. The proposed Forest Plan amendment consists of a new management area that specifically addresses mining activities within the Mine Area, which varies by alternative. The effects of the proposed Forest Plan amendment are described in the various sections of Chapter 3 of the EIS based on the activities that would be allowed in the approved Plan of Operations.

The proposed new management area is referred to as Management Area 8.4 – Mining. It includes standards and guidelines specifically developed to allow mining to comply with an amended Forest Plan. All ground-disturbance on NFS lands would be located within the boundaries of the proposed management area, with the exception of the utility route and access road construction. The final boundaries of this management area for the Bear Lodge Project would be the Mine Area which may be modified, depending on which alternative is ultimately selected for implementation. Any revisions will be described in the FEIS and ROD.

Disclosure of the need to amend the Black Hills Forest Plan in the EIS is intended to provide public notification. Determination of significance of the proposed amendment will be made by the Black Hills Forest Supervisor and documented in the ROD.

2.5.1.1 Management Area 8.4 – Mining

Management Setting: The area is managed for solid mineral development operations. The area is defined by an approved Plan of Operations to implement operations of privately held mineral resources on NFS lands. Additional forest uses may occur to the degree that they are safe, practical, and appropriate for an active or post-mine environment.

During active mining operations, the area is concentrated with high evidence of mining equipment, roads, structures, people, and disturbed lands. Safety hazards are numerous including highwalls, mining shafts, and other related equipment. Noise from heavy equipment and possibly blasting is highly noticeable. The area may be restricted to public access through signs, gates, or fences.

Desired Future Condition: Locatable mineral operations are emphasized to effectively and efficiently remove available commercial mineral resources, concurrent with other ongoing resource uses and activities. Operations include exploration, development and production of solid minerals, (such as hard rock, open-pit mines, stock-piled overburden and topsoil), and various ancillary facilities. Facilities and landscape modifications are visible but are reasonably designed to blend and harmonize with natural features. Depending on the stage of the mineral operations, permitted livestock grazing may be allowed.

Restrictions on public use may occur to ensure public safety and to avoid unreasonable interference with mineral operations. Visitors may experience frequent encounters with people, heavy equipment, and noise. Visitors may notice new roads and disturbances associated with mining exploration including large haul roads. These roads would be closed to public access. Drill pads and equipment may be present in localized areas.

Reclamation activities restore the area to a reasonable level of pre-mining topography to restore pre-mining uses, including removal of all structures, reestablishment of drainages for surface water and placement of growth media. New roads authorized for mining or exploration activities would be fully rehabilitated to resemble surrounding topography.

Management Area Goals:

1. Allow concentrated mineral development and infrastructure in defined areas in accordance with an approved Plan of Operations;
2. Manage for orderly development of mineral resources while avoiding, where possible, or minimizing effects on biological, physical, social, and economic resources to the extent possible consistent with applicable law; and
3. Reclaim mined lands within the capability of the affected lands for long-term management. Emphasize reclaiming mined lands to a stable topographic relief that conforms visually to natural surroundings to the extent reasonably possible. Plant selected species that will hold the soils in place, provide for vegetative diversity, and through succession, contribute to a stable ecosystem.

Management Area Objective: Restrict development of concentrated mining sites to the smallest area of NFS lands practicable while providing for worker, equipment, and facility safety and avoiding, minimizing, or mitigating impacts on natural resources.

The following management standards and guidelines **(Table 12**) provide direction for this management area. In the event of a conflict with Forest-wide direction, the following direction takes precedence.

Table 12.
Proposed Management Area 8.4 Standards and Guidelines

Management Resource	Standards and Guidelines
Water and Soil Resources	1. In active mine areas, monitor surface and ground water as required by the Plan of Operations and state standards. STANDARD 2. Surface and ground water quality should meet state water quality and sanitation standards unless current conditions already exceed standards. STANDARD 3. Riparian and wetland areas would be avoided to the extent practical. STANDARD 4. During construction activities, conserve all topsoil and growing medium on areas to be disturbed for future reclamation use. Stockpile separately in accordance with Best Management Practices. STANDARD 5. Erosion control devices will be certified weed-free to prevent the spread of noxious weeds. STANDARD 6. Post-reclamation ground cover on disturbed soils to minimize erosion potential would utilize native weed-free grass and forb species as appropriate for site conditions. Where necessary for rapid stabilization on disturbed soils, non-persistent, non-native species may be used as approved by the Forest Service. Post-reclamation should be shaped consistent with sound watershed principles and accommodate the desired long-term land use. STANDARD 7. Interim reclamation would be required during periods of shutdown operation. Activities may include erosion control, seeding to reduce soil movement, establishment of drainages. STANDARD 8. Reclamation activities should occur concurrently with the operation to the extent practical. GUIDELINE
Mineral Resources	1. Mining activities will be allowed consistent with applicable laws and regulations. Emphasis will be on gaining cooperation with the proponent through the use of operating plans to protect and restore surface resources. STANDARD 2. The operating plan will include a detailed reclamation plan that addresses concurrent and interim reclamation activities to reduce impacts on resources, and return the land to a productive state consistent with long-term management objectives. STANDARD 3. The designated mine area would be defined by an approved Plan of Operation. STANDARD
Lands	1. Permanent structures and/or occupancy are limited to only those that are necessary for approved mining operations. STANDARD
Scenery Resources	1. To the extent practicable, minimize impacts on the visual resources by using earth tones for structures and natural features to blend the facility with the environment. GUIDELINE

Table 12. Proposed Management Area 8.4 Standards and Guidelines	
Management Resource	**Standards and Guidelines**
	2. Scenic Integrity Objectives (SIO) is Partial Retention to Maximum Modification. GUIDELINE 3. Design reclamation to incorporate the existing topography and landscape characteristics. GUIDELINE
Forest Communities	1. Timber harvested to clear the site contributes to the annual sale quantity, but lands that cannot be reclaimed to timber production are then removed from the suitable base and not managed for timber production. STANDARD 2. Other forested lands not required for mining within a designated mine area, may be harvested for wood products with the objectives of perpetuating or enhancing long-term values of forest health, range, wildlife, and visual resources. STANDARD
Range Resource	1. Selection of plant species for reclamation should reflect the surrounding ecosystem and post-reclamation land use. Consideration and preference should be given to promoting natural succession, native plant species, and structural diversity. STANDARD 2. Livestock grazing may be allowed. Opportunities are evaluated based on the type of mining proposed. STANDARD
Noxious Weeds	1. An operating plan shall include a weed management plan, approved by the Forest Service, to prevent and control the spread of noxious weeds in the mine area. STANDARD 2. The mining proponent shall be responsible for weed control in areas disturbed by mining operations until reclamation success is determined and the bond released. STANDARD
Wildlife/Botany	1. To the extent practical, disturbance to wildlife and plant species and their habitat will be avoided or minimized. Consider mitigation opportunities when no other habitat areas exist for a particular species. GUIDELINE 2. Reclamation plan includes establishing a variety of native shrubs and trees species to enhance habitat diversity to benefit local species population. GUIDELINE 3. When raptor nests are found within the mine area, proponent will coordinate with state and federal agencies to determine an appropriate course of action. STANDARD
Recreation	1. Design reclamation to incorporate public safety. STANDARD 2. When associated with an approved plan of operation, the active mine area may be closed to public use until reclamation activities are completed. GUIDELINE 3. Evaluate existing trails to determine appropriate action for the proposal. GUIDELINE 4. Recreation opportunity spectrum (ROS) is semi-primitive non-motorized to urban. GUIDELINE
Transportation and Travel	1. New roads constructed in the mine area will be fully reclaimed following use. STANDARD 2. Gates, fences, and signs may be used to notify and restrict public access to the mine area. Consider a fence design that is meets FS management requirements and is wildlife-friendly. GUIDELINE

2.5.1.2 Preliminary Finding of Significance of Forest Plan Amendment

Findings regarding the consistency of projects or activities and actions with the land management plan and the determination of the significance of an amendment are an integral part of decisions. Implementation of the proposed forest plan amendment would not significantly alter the multiple-use goals and objectives of the current Forest Plan. The amendment proposes changes in the management direction to allow mining and associated activities to occur for the Bear Lodge Project. The activities that would be approved in this management area are restricted in geographic extent (0.08 percent of the NFS land in the Black Hills National Forest and 0.20 percent of the total Management Area 5.1 acres) and would not have wide-ranging effects across the Black Hills National Forest.

2.5.2 Modifications to Alternatives for Forest Plan Consistency

The Forest Service, after reviewing the alternatives to determine consistency with the Forest Plan (**Table 11**), made the following modifications to alternatives so they would be consistent with Forest Plan standards and guidelines.

Power line corridor in Alternatives D and F within Management Area 3.32. The proposed maintenance road to provide access to the power line corridor would be closed to motorized use by the public. New construction of the road would be designed to minimize impacts to the resources and blend with the environment, to the extent practical. The road would serve as a motorized administrative road for management of resources by the Forest Service. Authorization for maintenance of the power line would be included in a special use permit. These actions would ensure compliance with Forest Plan Management Area 3.32.

Access route in Alternatives D, E, and F. The proposed reconstruction of the access route in Alternatives D, E, and F includes three stream crossings. If the decision of this project includes the reconstruction of this access road, the design would comply with requirements of the Forest Plan.

Management Area 5.4. Both proposed access routes listed in all the alternatives and the proposed power line corridor in Alternatives D and G are within Management Area 5.4. Any reconstruction of the roads would be designed to comply with Forest Plan standards for wildlife habitat. Vegetation along the power line corridor would only be removed if deemed as a hazard to the line construction and maintenance to minimize impacts to wildlife habitat.

2.6 Environmental Protection Applicable to All Action Alternatives

The Plan of Operations and its 15 appendices provide Environmental Protection Measures and details on plans for specific resources. These measures are listed in detail in Appendix A. Forest Service interdisciplinary team and the Cooperating Agencies developed additional measures (Design Features, Section 2.6). The proponent would be responsible for completing all protection measures, including developing plans, monitoring (Section 2.9), and maintenance through reclamation (see Sections 2.7 and 2.10), unless stated otherwise.

Proponent Committed Environmental Protection Measures

Appendix A is summarized below. These measures would apply to the other action alternatives, unless specifically stated or if the alternative design precludes the measure. For example, reclamation of the WRF in Alternative G precludes the concurrent reclamation. For the period this EIS is available for public review, the Plan of Operations and its appendices are available online at http://tinyurl.com/BearlodgeMineProject.

Design Features

The interdisciplinary team reviewed the Plan of Operations and appendices for the proposed activities and environmental protection measures to be applied on NFS lands and compared them with the Forest Plan

standards, the National Core Best Management Practices (BMPs) (US Forest Service, 2012), Wyoming state agencies regulations, and USACE regulations. Additionally, the public comments received during scoping and measures requested by cooperating agencies have been considered and included where appropriate.

Black Hills National Forest Land and Management Plan Standards; Watershed Conservation Practices (WCP); Black Hills Weed Management Plan (US Forest Service, 2003); Black Hills Fire Management Plan and annual agreements with Crook County; and Wyoming state BMPs would be followed during implementation, unless otherwise noted.

2.6.1 Air

The Plan of Operations Section 5.1.4 includes measures to control dust to reduce potential air quality impacts during construction and operation of the mine activities, including:

- Fugitive dust would be controlled using standard BMPs, to the extent possible, during mining activities along roads, soil stockpiles, WRF, and PUG Plant area. Control methods include coarse gravelling at high traffic areas, using safe vehicle speeds on roads, planting a vegetation cover, or using a water suppression or chemical treatment such as magnesium chloride. Additional methods may be required by permitting agencies.
- If identified as needed through monitoring activities, additional air monitoring stations would be installed as recommended by air quality specialists or permitting agencies.

2.6.2 Roads

Appendix C of the Plan of Operations includes measures for access route upgrades to improve safety and minimize environmental impacts. Measures stated under other resources would apply to roads, so they are not repeated here. Appendix C includes specific measures for access road design including an 80-foot radius at intersections, two 12-foot driving lanes with 4-foot shoulders, side slopes of 6:1 to allow for driver correction, construction of a ditch for snow storage, guard rails where needed, drainage designed for the 25-year, 24-hour storm event, erosion control and BMPs, and dust control.

- All signs along roadways outside of the Mine Area would conform to Manual on Uniform Traffic Control Devices standards. Signage inside the Mine Area would conform to Mine Safety and Health Administration (MSHA) standards.
- The main route used to access the Mine Area would be constructed following the guidelines utilized by Wyoming Department of Transportation (WDOT) as outlined in Appendix C of the February 2014 Plan of Operations. Roads shall be crowned and outsloped to drain, and all drainage, water collection, and water discharge features associated with the roadway shall be designed and maintained to minimize the mobilization and transport of soil.
- Any NFS roads utilized as part of the mining activities would meet Forest Service road construction, reconstruction or maintenance level requirements (Forest Service Handbook 7709.59) unless superseded by the MSHA requirements.
- Bridges and culverts would be installed to minimize sedimentation and turbidity resulting from excavation for in-channel structures. Wet drainages would have temporary crossings and cross at right angles to keep roads from unduly damaging streams or disturbing channels. Culverts would be maintained annually or as necessary.
- NFS roads open to motorized travel that would end at the Mine Area fence would be signed appropriately and have turn-arounds constructed.
- A road maintenance agreement between the proponent and road managing agencies would be required to address construction, reconstruction, and maintenance requirements, snow removal including escape

routes for wildlife, signage, safety including removal of mine related road kill, and dust suppression. This agreement would be incorporated into the final Plan of Operation.

- A transportation plan would be developed by the proponent and approved by the road managing agencies and incorporated in the final Plan of Operation. The plan will address public safety and minimization of mine related traffic on the access route during the life of the mine.

2.6.3 Visual Quality

The Plan of Operations Section 5.5.2 includes measures to reduce impacts on scenic values, namely completing reclamation as quickly as possible; disposal of slash, debris, and waste and the use of directional lighting.

- To the extent allowed under the MSHA regulations, all exterior and operational lighting would be designed and operated with the intent to reduce nighttime light pollution. Proponent proposes to use 80 percent downward illumination exterior lighting where applicable.
- Facilities would be designed and located to blend with the natural environment by using non-reflective earth tone colors. Whenever possible, the power line would be located away from ridge tops and utilize non-reflective wires and earth tone poles to blend with the environment.
- When not operating, the mine lights will be turned off; the lights on conveyors will be turned off when the plant is not in operation.
- Pit lighting, top of ramp lighting, and waste dump lighting will include light abatement shielding to block light from shining up.
- Light abatement shields will be used on all outdoor lighting fixtures on the PUG and Hydromet site.
- Lights will utilize warmer color options and be mostly facing to the southeast to minimize luminesce towards Devils Tower National Monument to the northwest.

2.6.4 Cultural Resources

The Plan of Operations, Section 5.7.3 includes measures to reduce potential effects to historic properties through a number of protocol stipulations, and use of the Post Review Discoveries found at 36 CFR 800.13 in the event cultural resources are discovered during the construction or operations phases.

For Alternatives D, E, F, G, and H, the Plan of Operations measures in Section 5.7.3 would be replaced with the following.

- Class III cultural resource inventories and Forest Service consultation with the Wyoming SHPO, tribal representatives, and other interested parties on the Forest’s determinations of effect is in progress to ensure that historic properties are managed according to relevant laws, regulations, and agency directives.
- Changes in construction plans or operation plans beyond those consulted on and approved would require the proponent to submit a detailed proposal to the Bearlodge Ranger District prior to initiating any activities. The Bearlodge Ranger District Heritage staff would review the new or amended proposal and determine the need for additional effects analysis and consultation.
- Prior to initiation of either construction or operation activities, the proponent shall enlist the services of a qualified cultural resources specialist to formally instruct all supervisory construction and operation personnel on the significance and protection of cultural resources. This specialist shall be approved in advance by the Bearlodge Ranger District. It may be necessary to provide more than one training session in order to ensure that all supervisory personnel receive instruction. Cultural resources training for supervisory personnel would include:
    - A definition of cultural resources and historic properties.

  - An overview of applicable cultural resource statutes and regulations.
  - Legal mandates for the avoidance of historic properties and/or justification for mitigation procedures.
  - An overview of the specific treatment measures or mitigations that were consulted on and mandated for this particular project.
  - Statutes addressing protection and confidentiality of archaeological materials and consequences of looting.
  - Process to follow for unanticipated discoveries and/or disturbances.
- Should the proponent or their contractors encounter any previously unknown cultural resources at any time during any phase of the project, all work would immediately stop within 300 feet of the newly discovered resources and the Bearlodge District Ranger and Heritage Resource lead would be notified immediately. Black Hills National Forest personnel would determine subsequent actions based on an assessment of circumstances and pursuant to 36 CFR §800.13(b). The proponent and their contractors may resume work in the vicinity of the cultural resource discovery/disturbance location after receiving written approval from the Bearlodge District Ranger.
- Should the proponent unintentionally disturb a cultural resource at any time during any phase of the project, all work would immediately stop within 300 feet of the newly discovered resources and the Bearlodge District Ranger and Heritage Resource lead would be notified immediately. National Forest personnel would determine a subsequent action based on an assessment of circumstances and pursuant to 36 CFR §800.13(b). The proponent and their contractors may continue work in the vicinity of the cultural resource discovery location after receiving written approval from the Bearlodge District Ranger.
- National Forest personnel retain the right to monitor cultural resources on NFS lands throughout the life of the mine as needed to ensure proper management policies and adherence to federal regulations regarding historic properties are followed.
- Should any human remains, funerary objects, sacred objects, or items of cultural patrimony be encountered at any phase in this project those materials and the area in which they lie should be treated as a secured scene with no further project activities or personnel access. In the event of an inadvertent discovery or disturbance of human remains, all work within 300 feet of the discovery would cease, the area would be secured, and the proponent shall immediately notify the Bearlodge District Ranger. At that time a Black Hills National Forest official would notify the County Coroner, appropriate Tribal Historic Preservation Officers, the Wyoming State Historic Preservation Office, and the County Sheriff.
- Native American human remains, funerary objects, sacred objects, or items of cultural patrimony found on federal land would be handled according to Section 3 of NAGPRA and its implementing regulations (43 CFR §10). If non-Native American human remains are found on federal land, the administering federal agency would treat such remains in accordance with applicable state law.
- The Black Hills National Forest would notify the proponent that they may resume project activities in the area of the discovery as per stipulations in 43 CFR §10.4(d)(2).

2.6.5 Soil

The Plan of Operations, in Section 5.9.3 identified measures to reduce potential impacts on soils including stockpiling topsoil and subsoil and marking them as such and special placement of topsoil when replaced on sloped areas. Soil would also be protected using the measures identified to maintain water quality.

- During construction of the facilities, roads, Mineable Pit and WRF, the uppermost soil horizon as determined by sampling would be stockpiled for future reclamation in accordance with regulatory

agencies. Topsoil and subsoil would be salvaged and piled separately in accordance with permitting requirements. Soils with special characteristics, such as riparian or wetland areas, would be piled and labelled separately from other soils. Long-term soil storage (greater than six months) would be seeded to minimize any loss from wind and erosion. Containment berms would be constructed around topsoil stockpiles to prevent any loss.

- All disturbed soils on NFS lands would receive a native seed mixture as discussed under vegetation (Section 2.6.9) and approved by the Forest Service. If needed, a non-persistent, non-native seed source as approved by the Forest Service on a case-by-case basis may be used to rapidly stabilize soils. Soils salvaged from riparian or wetland areas would utilize a native seed mixture that represents these communities.
- Any projected ground disturbance, and placement of temporary (greater than six months) fill within delineated wetland areas would have topsoil removed and stockpiled for later use in only wetland reclamation or mitigation sites. Wetland topsoil stockpiles would be clearly marked and kept separate from all other soil stockpiles. If new wetlands are created in the project vicinity as mitigation for mining activities; mitigation sites, whenever possible, would be constructed first so that wetland topsoil can be salvaged and placed on the new sites to ensure the greatest survival of propagules and successful wetland establishment.

2.6.6 Paleontological Resources

The Plan of Operations, Section 5.11.2 includes measures to reduce potential impacts on paleontological resources requiring notification of the Forest Service if paleontological resources are found and authorization prior to further operations.

- Proponent would notify all associated with operations that any objects or sites of paleontological or scientific value discovered on NFS lands, such as vertebrate or scientifically important invertebrate fossils or plant fossils, shall not be damaged, destroyed, removed, moved, or disturbed. If in connection with authorized operations any of the above resources are encountered, all activities that might further disturb such materials would be suspended and the Forest Service would be notified.

2.6.7 Water/Wetland/Riparian Resources

The Plan of Operations Section 5.3.7 includes measures to reduce potential impacts on hydrology and water quality that would protect natural drainages. Prevention measures may include check dams and riprap, rapid stabilization practices, and erosion and sedimentation control. Maintenance measures may include placement of silt fences, cross-slope barriers constructed of certified weed-free straw bales, and the use of surface coverings such as nettings or plastic coverings. Additional measures may include containment berms around soil stockpiles, and recontouring steep slopes.

- BMPs and WCPs would be used to protect streams and other water resources, to the extent possible, from erosion. Sediment control structures, such as certified weed-free straw wattles, silt fences, certified weed-free hay bales, and vegetation, would be used to control the movement of sediments to nearby water sources and sensitive or riparian habitat areas, including wetlands.
- Maintenance of erosion prevention measures would be conducted until long-term surface stabilization is achieved. Annual maintenance may include repairing and seeding erosional features such as rills and gullies that develop on newly revegetated slopes, recontouring problem slopes, and the installation of additional channel protection in natural drainage channels located down-gradient of sediment control structures, if erosion is evident.
- The installation of appropriately designed and authorized channel protection by placement of rocks or planting vegetation would aid in dissipating the energy of the stream flow and may reduce stream bed and bank scouring related to the increased flow volume in the channels and/or changes in flow

velocities. Any construction of in-stream structures would require USACE authorization prior to construction.

- Construction activities that require ground disturbing activities would be timed accordingly to minimize erosion by restricting operations during extreme rainfall or snowmelt. Flows would be diverted around construction sites to minimize downstream sedimentation.
- Any ground disturbance and temporary fill (longer than six months) within delineated wetland areas would have topsoil removed and stockpiled for later use in only wetland reclamation or mitigation sites. Wetland topsoil stockpiles would be clearly marked and kept separate from all other soil stockpiles.
- To the extent possible, mining activities proposed within known riparian areas where populations of sensitive species are located would be minimized. Mineral operations may be modified through designs, as appropriate, to reduce the impacts to riparian areas and sensitive species and habitat.
- Any wetland and stream mitigation required in accordance with a Section 404 permit would be located, designed, implemented, and monitored according to specific mitigation plans approved by the USACE and other appropriate regulatory authorities. Wetlands and designated water influence zones would be clearly identified in the field and in operation plans and would be avoided unless authorized to disturb by appropriate regulatory authorities.
- If it is determined through project implementation that a seed mixture for riparian or wetland areas (greater than 0.5 acre) is required, the Forest Service would develop a mixture based on native species present at the site-specific location. Seed mixes for 404 wetland mitigation would be approved by the USACE.
- As described in **Table 2**, a WYPDES permit would be required for all water discharges to streams. WDEQ would set the water quality standards that must be met as part of the permit requirements. In any alternative collection and treatment of water before discharge into the environment may be required to meet the WDEQ standards. These discharge and possible treatment requirements would apply to pit dewatering, stormwater, or discharge from the sediment pond from the WRF. The need for treatment would be established through monitoring and adjusted as needed to meet the permit requirements. WDEQ-WQD would work with the permit holder to identify effective treatment methods, if any are needed. The proponent would be required to install and maintain any treatment systems as long as needed, and to dismantle, remove, and reclaim the areas once WDEQ determines that treatment is no longer needed.
    - Section 5.12.2 of the Plan of Operations includes measures to protect water supply wells with isolation packers to prevent depleting shallower groundwater that could be connected to local springs.

Section 5.16.2 of the Plan of Operations includes measures to reduce potential impacts to wetlands, namely sediment control, avoidance, timing restrictions, and protection of streambanks.

2.6.8 Wildlife/Fish/Threatened/Endangered/Botany

To reduce potential impacts on fish and wildlife, the Plan of Operations Section 5.6.3 includes measures such as garbage storage that would not attract wildlife, speed limit, prohibitions on carrying firearms on the job or in company vehicles, avoiding disturbing wildlife during critical periods and in critical areas, employee training, prohibiting harassment of wildlife, protection of bat roosts, preservation of snags when possible given safety considerations, survey for and protection of raptor nests, an Avian Protection Plan for power line design, migratory bird habitat protection (in compliance with the Migratory Bird Treaty Act and Executive Order 13186), and avoiding disturbance in wetlands and riparian areas when possible.

- Proponent is committed to minimizing impacts on wildlife species and habitat as well as sensitive plant habitat to the extent practicable. Bear-proof garbage containers, speed limits, caution signs, employee

and contractor awareness trainings, and protection of snag trees outside of the operation area are some of the commitments that would aid in minimizing impacts to wildlife and habitat.

- When possible, proponent would avoid known raptor nesting trees with the project activities. If new raptor nests are found over the life of the project, proponent would notify the Forest Service and/or regulatory agency to determine appropriate actions for protection of species. On NFS lands in areas undisturbed by mining activities, large diameter trees and snags will be retained for wildlife habitat.
- Facility designs, including the location of sediment ponds, pit dewatering pond, roads, power line, and pipelines, would avoid, to the extent practical, known areas of sensitive habitat, including riparian and wetland habitats. Where these areas cannot be avoided, the highest protection would be given to minimizing impacts to the area.
- If possible, vegetation removal activities would be timed to minimize impacts during the nesting season for migratory birds and raptors to reduce impacts on birds, eggs, young, and nests.
- Areas that are considered potential sensitive plant species habitat would be avoided to the extent possible. Where avoidance is not possible, disturbance would be limited to the smallest area required for the given activity. Relocation of populations of individual sensitive plant species to other suitable habitat areas may also be required to ensure viability of the population.
- Measures in Section 5.14 of the Plan of Operations to reduce potential impacts on Threatened and Endangered and special status plant species would be to avoid sensitive plant habitat to the extent possible and limiting disturbance of sensitive plant habitat and control of noxious weeds.
- NFS lands outside the Mine Area and inside the Mine Area but not disturbed by mining activities would continue to be managed in accordance with Forest Plan direction. Other NEPA documents would be completed to address vegetation and habitat improvements in these areas.

2.6.9 Vegetation/Timber

The Plan of Operations Section 5.13.3 states measures to reduce potential impacts on vegetation. These measures include retaining native vegetation to the extent possible, revegetation that optimizes plant establishment, careful topsoil storage and replacement, use of weed-free much, fertilization, and revegetating as soon as practicable.

- For all disturbed soils on NFS lands, a native seed weed-free mixture, appropriate for the site conditions, would be used in accordance with the Forest Plan. If needed, a non-persistent, non-native seed source as approved by the Forest Service on a case-by-case basis may be used to rapidly stabilize soils. Environmental Protection Measures where seed species are specified in the Plan of Operations would be replaced with requirements for the use of native species and rates approved by the Forest Service (**Table 13**). Seed used on NFS lands would be tested to ensure it is noxious weed free.

Table 13. Seed Mix to be Used On NFS Lands

Common Name	Scientific Name	% of Mixture
Annual Rye	Lolium multiforum	40
Slender Wheatgrass	Elymus trachycaulus	15
Sandberg bluegrass	Poa secunda	25
Green needlegrass	Nassella viridula	15
Purple prairie clover	Dalea purpurea	5

- For removal of vegetation and timber resources, proponent would flag areas proposed for mining so the Forest Service can properly mark and cruise the timber resource.
- In accordance with 36 CFR 228 regulations for NFS lands, the proponent is entitled to purchase the merchantable trees at fair market value. Proponent would be required to follow the terms of a timber sale contract for removal of trees and treatment of the slash. If the proponent elects not to purchase the

trees, the Forest Service would offer the volume through an open bid timber contract. The removal of trees from NFS lands would occur over the life of the mine based on a five year mining plan.

- Slash generated during construction activities, outside of a timber contract, would be piled for burning or cut to within 18-inches of the ground surface on NFS lands. On private lands, the Wyoming Division of Forestry guidance would be followed.
- Planting of native shrubs and trees to the Black Hills National Forest would be required to support pre-mining land uses to the extent possible. In situations where soils are unsuitable, other desirable vegetation will be planted. Planting may be completed using native stock by either bare root, transplants, or container method from an FS approved nursery. Proponent may be required to collect Black Hills native tree and shrub seeds if a FS supply is not available.

2.6.10 Invasive Plants

The Plan of Operations (Section 5.15.2 and Appendix O) has many measures to reduce potential impacts resulting from invasive non-native species. These measures include the Weed Management Plan (Appendix O), monitoring, equipment washing, seed testing for weed seed, use of weed free seed and straw, weed treatment (including use of approved herbicides if necessary), the Forest Service Weed Management Plan (US Forest Service, 2003), BMPs for soil protection, and limiting disturbance.

- Proponent is committed to treating noxious weeds within the Mine Area during the life of the project as identified in the Weed Management Plan developed for the Bear Lodge Project in the Feb 2014 Plan of Operation, Appendix O.
- Where ground disturbing activities occur in areas infested with weeds, weeds would be treated before Project implementation to reduce future spread and establishment of noxious weeds.
- In areas identified as R2 sensitive or species of local concern plant habitat, individual weeds would be treated. A treatment method that offers the least risk to the species being protected would be used.

2.6.11 Range

Section 5.19.2 of the Plan of Operations includes measures to reduce potential impacts on range management, such as retaining native vegetation to the extent possible, limiting disturbances outside the Mine Area, controlling noxious weeds and dust, repairing fences and cattle guards, revegetation that considers vegetation communities, and post reclamation livestock management.

- A fence would be constructed around the Mine Area conforming to Forest Service specifications. The fence would be designed to restrict livestock from entering the Mine Area, signed appropriately to notify the public of an active mining area, while still providing opportunities for wildlife movement. The fence would connect to a 6-foot chain-link security fence proposed for the PUG Plant area. The fences (barbed-wire and chain-link) would be maintained by the proponent until removed after reclamation. Where appropriate, fences would be located around roads so as to minimize the interference with permittee access, sensitive area to minimize impacts, existing water developments, cultural areas, and areas administered by other agencies.
- If water developments on NFS lands are located within the Mine Area fence (including the PUG fence) and the developments are determined necessary for livestock and wildlife management, relocation of the developments may be required by the Forest Service. Relocation of the developments may include construction of new stock tanks outside of the fence with water pipelines extended from source to new tanks, or construction of a new watering source. Once the new development has been completed, maintenance of the development would be the responsibility of the livestock permittee.
- The proposed project activities would avoid the Whitelaw riparian pipeline in Sections 9 of T52N R63W along Whitelaw Creek.

2.6.12 Waste Management

Wastes created on-site may include solids from sewage, truck washing wastes, laboratory wastes, and spill cleanup residues. Appendix M of the Plan of Operation includes descriptions of wastewater handling.

2.6.13 Recreation

Section 5.17.2 of the Plan of Operations includes measures to reduce potential impacts to recreation outside of the fenced Mine Area.

- Public motorized access to the Bear Lodge Mountains would be retained along the major arteries such as NFS Roads 838, 847, 849, 854.1, and 843. NFS roads that are within the Mine Area would be closed to public use, including motorized and non-motorized activities. These roads vary by alternative.
- Management activities on NFS lands, outside the Mine Area, would continue in accordance with Forest Plan direction. These include, but are not limited to; dispersed recreation opportunities, livestock grazing, timber management, and vegetation treatments. Access to NFS lands outside the Mine Area for motorized and non-motorized activities would continue in accordance with the Black Hills NF travel management plan.
- Non-motorized trails would remain open, to the extent possible, to public use for hikers, mountain bikers, and horseback riders outside of the Mine Area. Where needed, non-motorized trails may be relocated to reduce conflicts between mine traffic and non-motorized recreation.
- Minimize project related noise using all reasonable measures such as proper maintenance of equipment, blasting techniques and scheduling, and buffering continuous noise sources.
- Winter recreation opportunities, particularly snowmobile trails, outside of the Mine Area would continue to be available for the life of the mine. Where project activities impact winter recreation trails, the Black Hills National Forest may identify over the snow re-routes to provide for safe winter recreation. Winter trails adjacent to the Mine Area would be restricted to the designated trail and signed accordingly to provide for public safety.
- In accordance with state permitting regulations, placards to notify the public of an active mine area is required and would be placed on roads and general Forest areas where the public may be recreating. Information on the signs would follow WDEQ-LQD regulations.
- Interpretative signs may be developed by the proponent at viewing areas to explain the mining process.

2.6.14 Exploration

Appendix N of the Plan of Operations includes measures to be followed during exploration, which include applicable measures identified for the mining operations above. These measures included BMPs for sediment control and protection of water quality, chemical and fuel handling and storage, spill prevention, waste removal, reclamation of exploration sites, weed control, protection of cultural resources (including graves and unanticipated discoveries), and drill hole abandonment.

- Exploration activities outside the Mine Area would follow standards and guidelines of the Forest Plan. Drilling locations and trenches for exploration activities, including the construction and operation, would be restricted if natural resources are present in accordance with Forest Plan direction – such as avoiding nesting seasons for wildlife species, known cultural resource sites, water resources, known riparian and wetland locations, and minimizing disturbance to vegetation.
- Proponent would provide a site-specific exploration program annually to the Forest Service for review. The Forest Service would review the proposal, evaluate it for effects to natural and cultural resources, and notify the proponent of required modifications. Once the modifications have been made, the Forest Service would issue a letter approving the activities prior to implementation.

- Areas requiring special restrictions for exploration activities include:
  - S1/2, SW1/4, SW1/4 of Section 17 and all of Section 20, Township 52 North Range 63 West; for a mineral withdrawal area established by the DOD and identified on the BLM land status maps. The Forest Service would not approve any proposals for exploration activity that lie within the withdrawal area.
  - SE1/4 of the SE1/4 of Section 18 of Township 52 North Range 63 West for a known bat adit. Vehicles would be restricted to established roads unless approved by the District Ranger.
  - NE1/4 of Section 17 of Township 52 North Range 63 West for known historic properties. Any proposed exploration activities within 600 feet of the historic property would require approval by the District Ranger.
  - NE1/4 of the NE1/4 of Section 19 of Township 52 North Range 63 West for cultural resources. Vehicles are restricted to existing roads unless approved the District Ranger.
- From December 1 to March 31 annually, exploration would be restricted from exploration activities for winter recreation activities unless the proposed activities can demonstrate that impacts to snowmobile trails would be avoided.
- Prescribe burning areas would be coordinated with the proponent annually. Proponent contractors would not be allowed within the proposed burning units at the time of burning.
- Exploration activities within active timber sales would be coordinated with the proponent annually. Exploration activities may be postponed until active logging has ceased to avoid safety concerns between workers and avoid any delays in contractual agreements. No merchantable trees would be authorized for cutting in existing timber sale contracts unless directed by the District Ranger and timber contracting officer.
- All Forest Service-authorized improvements, such as fences, property corners, water lines and developments, utility lines, cattle guards, and gates would be protected during exploration activities. Fences that need to be crossed for access would be repaired immediately to prevent cattle movement.
- To the extent possible, access to proposed locations for exploration activities would utilize existing road systems. When new access routes are needed for exploration, overland travel would be encouraged first followed by construction of temporary roads. Temporary roads would be constructed to 12 to 18 feet wide, depending on the topography of the location and follow guidelines for road construction, including the installation of water diversions and erosion control.
- In areas where extensive exploration activities would be occurring, appropriate warning or caution signs may be required for public safety on roads. Temporary closures for public access may be necessary in areas of extensive exploration until the safety hazards have been reclaimed.
- Reclamation of disturbed exploration areas would occur concurrently with other activities. When the same exploration areas are proposed repeatedly, such as an access road, reclamation may be postponed so long as the area is stabilized to prevent erosion with Bearlodge District Ranger approval. Barriers and appropriate drainage may be necessary on temporary routes to reduce impacts on the environment. Final reclamation would require contouring to original condition and establishing drainages as necessary for access routes. Native seed mixture approved by the Forest Service would be used. Noxious weeds would be monitored and treated for three years in accordance with the Bear Lodge Project Weed Management Plan (Appendix O of the Plan of Operations).
- WDEQ - LQD requires a Drilling Notification permit for proposed exploration activities outside of the WDEQ Permit boundary in Sections 7, 18, 19, 20, T52N R63W. All drill holes would be required to adhere to the abandonment procedures identified in WS 35-11-404, drill holes would be capped, sealed or plugged. In addition to requirements for drill hole abandonment, the permit would contain

requirements for implementing BMPs for sediment control, hazardous material handling, soil management, solid waste management, and reclamation.

2.7 Mine Reclamation Plan

According to the Forest Service Manual (FSM) 2840.3, all reclamation requirements included in a Plan of Operations shall include measurable performance standards. Reclamation requirements shall be those reasonable, practicable, and necessary to attain standards. The Plan of Operations includes reclamation plans for resources and facilities, summarized in Appendix A. Additional reclamation expectations specific to individual alternatives have been addressed in Chapter 2 in each alternative description. Additional reclamation and mitigation measures may be required by the WDEQ and USACE.

The reclamation plan would be updated as needed when environmental conditions change.

Prior to mine closure, the final reclamation plan will be reviewed and modified to include measurable and time specific objectives for plant community reestablishment consistent with site capabilities.

2.8 Mitigation

Mitigation measures are defined as opportunities that avoid, minimize, rectify, reduce, or compensate impacts on natural resources resulting from a given project. Forest Service regulations 36 CFR 228 directs the agency to minimize adverse environmental impacts on NFS surface resources. This section addresses the opportunities identified through public comments that are considered in the DEIS to minimize effects on NFS surface resources for the proposed project. Additional opportunities may also be identified in the alternative descriptions (Section 2.4) and design features (Section 2.6).

The proponent would be responsible to identify any off-site opportunities and present the ideas to the Forest Service and cooperating agencies for consideration. Off-site mitigations would be considered by the Forest Service to fulfill any requirements for mitigation pertaining to resource impacts on NFS lands. The Forest Service does not have the authority to complete any environmental analysis or authorize activities outside of the NFS lands (16 USC 551).

2.8.1 Wetlands

The Black Hills National Forest maintains a list of wetlands and associated restoration and enhancement opportunities that occur on the Forest. The proponent would use this list in consultation with the Black Hills National Forest to identify potential mitigation sites for USACE approval. For Alternatives C, D, E, F, G, and H, mitigations to project related impacts on wetland and stream resources in accordance with the Clean Water Act are the responsibility of the proponent including implementation costs and future maintenance for the life of the mine permit and/or discharge permits. Additional surveys and NEPA compliance work may be needed prior to implementation.

Table 17 below provides a list of the acres of wetlands by alternative that would require mitigation through 404 permitting with USACE and the Forest Service.

2.8.2 Cultural Resources

Historic properties that may be adversely affected by the proposed mine activities under Alternatives C, D, E, F, G, and H would require mitigation as determined through a Memorandum of Agreement pursuant to 36 CFR 800.6.

2.8.3 Recreation and Visual Resources

Mitigations for losses to recreational opportunities on NFS lands are considered in the alternatives. The proponent in coordination with the Forest Service and cooperating agencies would identify and implement mitigations for losses of recreational opportunities that result on NFS lands. The proponent is responsible for

mitigation costs plus future maintenance cost during the life of the mine permit. Prior to project implementation, additional surveys and NEPA compliance may be needed.

On NFS lands, mitigations considered in this document include:

- Re-routing of snowmobile Trail E by proponent under Alternatives G, and H to sustain a winter trail system
- Re-routing of snowmobile Trail A by proponent under Alternatives D, E, F, G, and H to sustain a winter trail system
- Turn-around would be constructed by proponent on NFS roads open to public motorized use that dead-end as a result of the mine area fence under Alternatives D, E, F, G, and H.
- Re-routing of NFS Road 851 by proponent to maintain motor vehicle use around the proposed mine area under Alternative G
- Variations in mine pit reclamation between Alternatives D, E, F, G, and H to restore public use of NFS lands during post-mining.
- Facilities would be designed by the proponent to blend in with the environment by using earth tones.
- To reduce night sky lighting, mine operation lights would be turned off when not in use.
- Restoration of NFS Road 838 by proponent under Alternatives D and E during post-mining pit reclamation.

For Alternatives D, G, and H consideration is given to off-site mitigations for the loss of recreational opportunities for the project activities occurring on NFS lands. Proponent would work with cooperating agencies to identify off-site opportunities that provide similar recreational opportunities for the pre-mining NFS lands affected by the proposed project.

2.8.4 Wildlife Habitat

Mitigations for losses to wildlife habitat on NFS lands are considered in the alternatives. The proponent in coordination with the Forest Service and cooperating agencies would identify and implement mitigations for losses to wildlife habitat that result on NFS lands. Mitigation opportunities would consider the functional value of the pre-mining losses. The proponent is responsible for mitigation costs plus future maintenance cost during the life of the mine permit. Prior to project implementation, additional surveys and NEPA compliance may be needed.

On NFS lands, mitigations considered in this document include:

- Designing a wildlife-friendly fence by proponent around the mine area
- Relocation of the mine area fence to exclude by proponent riparian habitat from the mine area

For Alternatives D, G, and H, consideration is given to off-site mitigations for the loss of wildlife habitat for the project activities occurring on NFS lands. Proponent would work with cooperating agencies to identify off-site opportunities that provide similar functional value of pre-mining NFS lands.

2.8.5 Range Management

On NFS lands, mitigation opportunities for livestock grazing activities are yet to be defined. Section 2.9 identifies monitoring requirements for livestock grazing activities. Mitigations being considered for livestock grazing are related to water developments located on NFS lands that may be impacted by the proposed activities under Alternatives D, E, F, G, and H. If monitoring identifies a water development on NFS lands that is lost from the proposed project as a critical need for livestock grazing, the proponent would be required to develop a new facility on NFS lands within the affected allotment. Prior to project implementation, additional surveys and NEPA compliance may be needed.

On NFS lands, mitigations considered in this document include:

- Relocation of the Mine Area fence by proponent, to the extent possible, to exclude known water developments from the mine area

2.8.6 Water Quality

On NFS lands, under Alternatives D, E, F, G, and H, monitoring of water quality will determine the need for treating water prior to release in the environment. Through permitting by Wyoming DEQ, mitigations to ensure State water quality standards are being met would be addressed and implemented by the proponent.

Permitting by Wyoming SEO may require mitigations to ensure existing water right permits are maintained. Proponent would be expected to implement any requirements established by the SEO.

2.9 Monitoring Applicable to All Action Alternatives

Monitoring would occur according to a monitoring plan prepared by the proponent to satisfy the requirements of permits granted by regulatory authorities. The plan would be reviewed periodically and modified as needed to address any concerns identified. Regulatory agencies, primarily WDEQ, Forest Service, and USACE, as part of the permits and authorizations (see Section 1.9) would review the monitoring results as monitoring progresses to determine whether monitoring is adequate for assessing the outcome and environmental protections. An annual meeting of the regulatory agencies would occur to review and discuss the monitoring results, and any changes needed to meet regulations.

Key monitoring is discussed below. Some monitoring is described under the Environmental Protection Measures, for example cultural resources (Section 2.6.4), paleontological resources (Section 2.6.6), and invasive plants (Section 2.6.10).

Should construction of additional monitoring facilities be required, the facilities would be placed within the WDEQ Permit boundary. If the facilities were to be located on private land, the landowner would need to give permission. If they were to be located on NFS lands, the Forest Service would have to authorize the use through an additional NEPA review.

2.9.1 Air Monitoring

Air monitoring and reporting of particulate matter less than 2.5 microns or 10 microns in diameter ($PM_{2.5}$ and PM_{10}) would continue as required by WDEQ air permits for compliance.

2.9.2 Water Monitoring

As part of the WYPDES permit issued by WDEQ-WQD, the proponent would be required to establish a water monitoring regime to demonstrate compliance with the discharge permit. A component of this monitoring would be the need for and effectiveness of any water treatment methods and adjustment as needed to maintain compliance with the discharge permit.

As a condition of the WDEQ-LQD mine permit, the proponent would be required to continue monitoring groundwater and surface water during operation, reclamation, and post-closure. **Figure 23** identifies the current locations for water monitoring. These locations are expected to continue and new sites may be developed as determined by permitting agencies. Seven stream gaging stations are in Beaver Creek, Whitetail Creek, Whitelaw Creek, and Lytle Creek. Surface water quality monitoring would continue at the gaging station. Groundwater monitoring wells are installed in 48 locations. Groundwater monitoring would continue to detect any changes that may occur with mine construction, operation, and reclamation. **Table 14** indicates the type of water monitoring that would continue.

In addition to the surface water stream gaging stations, several springs would be added to the WDEQ-LQD mine permit for monitoring during mine construction, operation, and reclamation within the WDEQ boundary. The springs are Willow Park, Whitelaw, Whitetail 02, Allread, Davis, Leeman, and Hutchins.

Table 14. Ongoing Water Monitoring			
Sample Type	**Sampling Method**	**Frequency**	**Type of Analysis and Analyte**
Groundwater Monitoring Wells	Grab	Quarterly	**Major Ions – Dissolved**: Alkalinity, Carbonate, Bicarbonate, Bromide, Calcium, Magnesium, Potassium, Silica, Sodium, Chloride, Fluoride, Nitrate as N, Nitrite as N, Phosphorous, Orthophosphate as P, Sulfate, Nitrogen, Ammonia as N **Metals – Dissolved:** Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Cerium, Chromium, Cobalt, Copper, Iron, Lanthanum, Lead, Lithium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Thorium, Uranium, Vanadium, Zinc **Metals - Dissolved Speciated**: Selenium IV and Selenium VI, total
Surface Water Quality Monitoring Stations	Grab	Quarterly	
Surface Water Gaging Stations	Pressure Transducer	Annual Continuous	Flow, Temperature

Source: Table 5.3-1 and Table 1 in Appendix H of the Plan of Operations (RER, 2014a).

2.9.3 Radiological Monitoring

Radiological monitoring would continue during operations, closure, and post closure as required by regulatory agency. There may be modifications to some of the monitoring locations, analytical parameters, and frequency as mining progresses.

Additional monitoring, as appropriate, in or possibly around the PUG Plant would be developed as part of NRC licensing. OSHA or MSHA may decide that monitoring results indicate that other areas need oversight.

2.9.4 Seismic Monitoring

Vibration monitoring at the PM-1 location would be performed during the initial blasting program to verify ground peak particle velocities would not cause damage based on criteria established by the US Office of Surface Mining.

2.9.5 Vegetation Monitoring

The Forest Service would coordinate with the proponent to conduct a vegetation inventory on NFS lands not required for mining in the mine area to assess the conditions of forested lands at least every 5 years.

As a requirement of the WDEQ-LQD mine permit, the proponent would develop and implement a reclamation vegetation monitoring and reporting program following WDEQ-LQD Guidelines 12 and 14, and also complies with the Forest Plan.

The Forest Service would monitor primary grazing forage within the allotments that have acres within the fenced Mine Area. Depending on the monitoring results, the Allotment Management Plan may need to be adjusted for stocking rates or the time period for grazing may be reduced.

2.9.6 Wildlife Monitoring

Annual wildlife monitoring and reporting obligations would be outlined in the WDEQ-LQD mine permit. Proponent has agreed in the September 12, 2014 letter to WGFD to continue wildlife monitoring within 2 miles of the WDEQ Permit boundary.

2.9.7 Reclamation Monitoring

Monitoring of reclamation efforts would occur according to a monitoring plan included in the WDEQ mine permit approved by the WDEQ-LQD and other regulatory authorities such as Forest Service and USACE. Monitoring stations used during normal mining operations would continue to be monitored post mine closure as directed by the WDEQ-LQD. Monitoring would continue following closure and reclamation until suitable conditions for water quality and revegetation uptake have been reached. The reclamation plan would be updated as necessary when conditions change through the life of the mine.

2.10 Financial Assurance

The proponent would post a reclamation performance bond or other instrument (financial assurance), as required by 36 CFR 228 subpart A Section 228.13, to cover the cost of stabilizing, rehabilitating, and reclaiming the area of operations to comply with 36 CFR 228.8(g) and any interim shutdowns conducted in connection with the Plan of Operations. Under the Memorandum of Understanding, the Black Hills National Forest and the state of Wyoming would establish a bond amount that addresses the needs of both.

Because the amount of the bond would be calculated when all of the requirements have been identified and may be adjusted in response to operational changes or the economy, the bond amount is not available to report in the EIS. The amount would provide adequate funding to complete reclamation on post-closure operations, maintenance, and monitoring for as long as required to return the affected areas to a stable condition. The amount would be specific to reclamation activities or standards (FSM 2840). More information on how reclamation bond amounts are calculated and managed can be found in the *Training Guide for Reclamation Bond Estimation and Administration* (US Forest Service, 2004).

Every mining operation in Wyoming must be covered by a reclamation bond in accordance with the Wyoming Environmental Quality Act (Title 35, Chapter 11, Article 1). The bond is calculated prior to issuance of the Permit to Mine and updated annually based on disturbed area.

2.11 Alternatives Considered but Not Studied In Detail

The following are alternatives that were suggested and considered through the alternative development process but after evaluation were subsequently dismissed from further consideration and analysis. Each alternative is briefly described and the reasons for dismissal are provided.

2.11.1 Alternative B – Plan of Operations submitted in February 2014

Alternative B is the plan of operations submitted in February 2014 (revised from the May 2013 Plan of Operation). It formed the basis for the public scoping in April 2014. As the Bear Lodge Project progressed into environmental analysis and further design details for the proposed mine and facilities were developed by the proponent (RER, 2014c)(see Section 2.4.2).

2.11.2 Pit Reclamation and Development Alternatives

2.11.2.1 Backfill the First Pit with Material Removed from the Second Pit

The Plan of Operations calls for beginning the mining at the south east portion of the pit followed by mining the northwest area of the pit. A suggestion was made to place the waste rock from the northwest portion in the southeast portion of the pit. This alternative was suggested to reduce the size of the post-mine pit, to reduce the number of truck trips to the WRF, and reduce the size of the WRF.

The Forest Service and the cooperating agencies do not have the regulatory authority to direct the proponent on how to mine. Their regulatory authority lies in protecting the natural and cultural resources on NFS lands.

2.11.2.2 Avoid Affecting Headwaters of Whitelaw Creek

The proposed mine pit extends to the northwest into the headwaters of Whitelaw Creek. In an effort to reduce potential impacts on water quality and quantity of Whitelaw Creek, a suggestion was made to redesign the pit to avoid direct impacts to Whitelaw Creek. By avoiding the headwaters of the creek by at least 100 feet, the Mineable Pit would be reduced by approximately 30 acres. For USACE NEPA analysis for Section 404, the proponent was asked about avoiding Whitelaw Creek headwaters. The proponent conducted a resource evaluation below the jurisdictional headwaters area of Whitelaw Creek (1,130 feet) within the pit footprint. Over 10 percent of the mineral resource would be lost within this area if not mined. Conventional surface mining is the only economic and safe method to mine the REE oxide ore due to soil instability and the highly fractured nature of the orebody.

Under the General Mining Law, the proponent has a right to develop the minerals on public lands that are open to mineral entry. By eliminating a portion of the proposed Mineable Pit, the Forest Service would be denying their right to access the mineral resource. This alternative does not meet the purpose and need (Section 1.5).

2.11.2.3 Keep the Pit Floor above the Groundwater Level

Under this alternative, mining would stop above the ground water level which is estimated to be 5,935 feet elevation. This alternative was suggested to eliminate groundwater entering the pit, and reducing potential impacts on groundwater quality, impacts on surface water from pit dewatering, and eliminate the pit lake.

The proponent indicated that a substantial portion of the mineral resource (85.5 percent) is located below the groundwater level elevation of 5,935 feet (Bergstrom email 07/07/2015). Limiting the proponent's access to the mineral resources would violate their right to mine on lands open to mineral entry under the General Mining Law. Therefore, this alternative does not meet the purpose and need (1.5).

2.11.2.4 Underground Mine (No Mineable Pit)

Mining the rare earth minerals from below the ground surface was suggested to avoid the open pit and the pit lake after closure, and as a way to reduce surface impacts, particularly impacts on current land uses. The proponent would develop a mine plan that accesses the mineral bearing ore from a portal. Waste rock and ore would be hauled out of the portal and processed as described in Alternative C.

The feasibility of underground mining was investigated (Golder Associates, 2014b). An underground mining of the oxide layers would be unsuitable due to the expected rock conditions (fractured and unconsolidated rock would not safely support underground mining in some areas, requiring excessive and costly reinforcement), increased risk to worker safety, a significant reduction in recovery of rare elements ($3.43 billion gross versus $7.64 billion gross with open pit mining) and high operating cost ($175 per ton of ore versus open pit mining cost of $42.98 per ton of ore). Therefore, this alternative was dismissed from further consideration due to the increased risk for underground mine workers and the high costs.

2.11.2.5 Grout Curtain around Mineable Pit

This alternative was to install a grout curtain around the Mineable Pit at reclamation to prevent groundwater from interacting with the waste material in the Mineable Pit. Grout curtains are relatively thin, generally vertical; walls of grout reinforced soil or rock. They are formed by injecting high pressure grout directly into the ground at closely spaced intervals (generally less than 10 feet). The technique was developed for dam construction to reduce the flow of water under the dam; however, it has also been used in mining to prevent the inflow of water through fractured rocks. Grout curtains are typically less than 50 feet deep.

A single-line grout curtain is only effective in rock having a fairly regular network of fractures with reasonably uniform fracture widths. For rock with a wide range of fracture openings, cavities, and discontinuities that are also irregularly distributed, a single-line grout curtain would not be effective.

The nature of the Bear Lodge deposit and the associated geologic structure does not lend itself to be a single-line grout curtain. In fact, a multiple-line grout curtain system may not effectively control the water. The depth of curtain is one of the most daunting obstacles; it is difficult to maintain drilling accuracy for 100 feet let alone 300 to 500 feet as would be required for the Bear Lodge Project. This is the reason grout curtains are most effective in the 40 to 50 foot range. Between the hole deviation, vertical fractures, shear zones and clay alteration, it will be very difficult if not impossible to construct an effective grout curtain at this site (Tetra Tech, 2015a). Therefore, the grout curtain has been eliminated from detailed analysis.

2.11.3 WRF Alternatives

2.11.3.1 Locate the WRF on NFS lands at Massengale Flats

This alternative was suggested as a secondary source location for the WRF in an effort to avoid diverting Beaver Creek, classified as waters of the US by the USACE, and to reduce impacts on riparian and wildlife habitat. The WRF would be located north of the mine pit on NFS lands in an area known as Massengale Flat in T52N R63W Section 3 and 8, and designed to follow natural topography.

This alternative was not considered in detail because it has been demonstrated that the estimated amount of mining waste rock can be designed to fit in the proposed location and still avoid diverting Beaver Creek, thus avoiding the need for a secondary location for waste material.

2.11.4 Mining Sequence

2.11.4.1 Plan to Mine All of the Known Rare Elements

Exploration activities over the past eight years provided preliminary information about additional rare earth resources in the general area of the mine. This alternative would expand the proposed mining plan to include mining of all the known or likely rare elements in the vicinity of Bull Hill area. This alternative was suggested to evaluate the impacts of mining all known mineral resources at entry, then reclaiming the entire area.

This alternative is not considered in detail because more mineral exploration is needed to evaluate the resource before a reasonable mine plan and Plan of Operations could be developed. Additional exploration would be able to provide a measurable mineral resource that is needed to determine an economically viable mining operation and develop a mine plan. Without a reasonable Plan of Operations, there is not enough detail to satisfy NEPA requirements and truly be considered as a reasonable action alternative.

2.11.5 PUG Plant Location Alternatives

2.11.5.1 Locate the PUG Plant at the Hydromet Plant

Instead of locating the PUG Plant on NFS lands, it would be located on private land at the Hydromet Plant in Upton. This alternative was suggested to minimize NFS lands affected, reduce the size of the WRF, and reduce light and noise at the Mine Area. All ore would be hauled to Upton and processed there. This alternative would require a larger tailings storage in Upton than is currently planned.

The purpose of the PUG Plant is to concentrate the ore and reduce the amount of material that must be hauled to the Hydromet Plant. Moving the PUG Plant to the Hydromet Plant location would double the round-trip ore haul trips from the proposed 13 to 17 trips to 26 to 34 trips between the mine and Upton, create additional safety risks to the general public along the access route, and an increase in the haul costs (RER, 2014c).

2.11.6 Power Alternatives

2.11.6.1 Warren Peak Power Line Route

An existing buried power line from the base of the Bear Lodge Mountains (Reuter Canyon) to the Warren Peak Fire Tower provides power to the lookout and other communication towers. A suggestion was made to extend this line (roughly two miles) to the PUG Plant along the Warren Peak Road (NFS Road 838).

This alternative was presented to PRECorp to determine the suitability of using the existing line. PRECorp stated that the current facilities are inadequate for serving the new load the mine would require. The power line has undersized conductors, only two phases; and the underground portion of the power line is nearing the end of its life. PRECorp was also concerned about their likely inability to maintain consistent voltage for other members connected to the same line.

In order to incorporate the existing power line, PRECorp would need to construct a new dedicated underground feeder, install a voltage regulator bank, which would be difficult to maintain and operate in the winter; and construct a new overhead power line from the existing Sundance Substation to the underground power line. Construction would require a parallel or double-circuiting to the existing distribution power line placing additional impacts on landowners along this route (PRECorp, 2015). Therefore, due to PRECorp's analysis, this alternative was eliminated from further detailed analysis because it would be too expensive to deliver power via the existing power line while maintaining the quality of service for existing members.

2.11.6.2 South Lytle Creek Road (NFS Road 847) Power Line Route

This alternative was to extend (roughly 4 miles) an existing power distribution line located north of the Lytle Creek Road (NFS Road 847) to the PUG Plant along secondary roads to the Lytle Creek Road.

This alternative was presented to PRECorp. The current line is a low voltage line to serve residences along the Lytle Creek Road. It has the same issues as the Warren Peak line. The extra power strain on the line as a result of extending it for mining purposes could cause the line to burn out resulting in no power for the residences or require reconstruction. This alternative was eliminated from further consideration based on PRECorp's recommendation (PRECorp, 2015).

2.11.6.3 Buried Power Line

The Forest Plan includes a guideline "*8303. Bury new or reconstructed electrical utility lines of 33 kilovolts (KV) or less and telephone lines, unless one or more of the following applies: a. Scenic integrity objectives of the area can be met using an overhead line; b. Burial is not feasible due to geologic hazard or unfavorable geologic conditions; c. It is not technically feasible; or d. Greater long-term site disturbance would result.*"

Burying the power lines was considered but eliminated from detailed study, largely because it would result in more disturbance from both the initial construction and maintenance or replacement over the life of the mine.

2.11.7 Access Road Alternatives

2.11.7.1 Pre-Feasibility Analysis

The proponent evaluated 11 potential access routes for transporting mineral pre-concentrate from the Bull Hill Mine to the Hydromet Plant. Route alignment designs were then revised to meet vertical, horizontal, grade, and curve radii design criteria. Road design criteria were established which considered safety, cost, environmental impacts, construction or operational complexities, areas of impact, proximity to adjacent populations, and potential for dust generation. Route evaluations are included in the Feb 2014 Plan of Operation Appendix C (HDR and Stetson Engineering, 2012).

Based on the decision matrix and evaluation of the proposed routes these routes were eliminated from further consideration because they no longer fit the final proposal for the mine project, had other unacceptable resource concerns, or were cost prohibitive (HDR and Stetson Engineering, 2012). Routes eliminated include:

- Route to Colony, WY;
- Roads to the north of the Mine Area (NFS Road 843 and NFS Road 849), and
- Combinations of secondary roads (private drive and NFS Road 899).

2.11.7.2 Peterson Fire Trail/Government Valley Road Access Route

The Peterson Fire Trail/Government Valley Road access route from the engineering report (HDR and Stetson Engineering, 2012) was incorporated early into the alternative process. The proposed route follows an existing road template (NFS Road 858), although it is unsuitable in its existing condition to function as a mine road. Engineers attempted to redesign the road template to achieve a less than 6 percent grade suitable for the mine traffic. However, 1.5 miles of the route was deemed unsuitable due to the topography of the mountain. Engineers determined it was impossible to realign the route to meet minimum safety design standards of less than 6 percent grade for mine traffic (Plummer, 2015). Therefore, it was eliminated from further consideration.

2.12 Alternatives Already Decided by Previous Decisions, Policies, or Laws

2.12.1 Convert Section 16 (Private) to National Forest

Before the Bear Lodge Project was initiated by submittal of the February 2014 Plan of Operations, the proponent entered into a land exchange with the state of Wyoming and acquired Section 16 T52N R63W. Several scoping comments suggested the land in Section 16 should be made part of the National Forest System at reclamation.

This alternative was not considered in detail because the proponent currently owns the land and has not made any suggestion that they desire the land be conveyed to the National Forest. Land exchanges occur between “willing parties”. The Forest Service has no authority to suggest or require a land conveyance of this sort.

2.13 Preferred Alternative

The Forest Supervisor has indicated Alternative H as the preferred alternative.

2.14 Comparison of Alternatives

2.14.1 Comparison of Activities by Alternative

Table 15 summarizes the major components of the alternatives compares the differences between them.

Table 15.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
Mine Area Fence	5-wire fence.	3- or 4-wire fence.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
	1,696 acres (1,062 NFS acres)	1,494 acres (860 NFS acres)	1,240 acres (606 NFS acres)	1,488 acres (854 NFS acres)	1,495 acres (861 NFS acres)	1,377 acres (743 NFS)
Mineable Pit	232 acres	232 acres	232 acres	232 acres	232 acres	232 acres
Mineable Pit at Closure	Pit highwalls reduced to stable slope; with pit lake that is permanently closed to the public and wildlife. 232 acres permanently closed.	Post closure pit would have access for administration, public use, safety, and wildlife. Highwalls above groundwater level reduced to a maximum 3:1 slope.	Post closure pit would have access for administration, public use, safety, and wildlife. Highwalls from bottom of pit reduced to a maximum 3:1 slope	Same as Alternative D, except highwalls remain on south and southwest to avoid the mineral withdrawal.	Pit backfilled to pre-mining topography. Post-mining access for public and wildlife.	Same as Alternative F
	No impermeable cap	Same as Alternative C	Same as Alternative C	Same as Alternative C	Impermeable cap to prevent infiltration of surface water.	Same as Alternative C.
	Pit lake after 50-100 years.	No pit lake. Partial backfill of pit with waste rock to natural groundwater level	Shallow lake (5 to 15 feet deep).	Shallow lake up to 70 feet deep depending on volume of reclamation material generated.	No pit lake. Complete backfill with waste rock and return to natural topography	Same as Alternative F.
	No additional acres disturbed at reclamation	Additional 95 acres disturbed then	Additional 104 acres disturbed then	Additional 42 acres disturbed then reclaimed to a 3:1 slope except on south and	No additional acres disturbed at reclamation.	Same as Alternative F.

Table 15.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
		reclaimed to a 3:1 slope.	reclaimed to a 3:1 slope.	southwest to avoid mineral withdrawal.		
PUG Plant	Located on NF lands; 176 acres	PUG Plant, located on NFS, moved to avoid riparian areas and known cultural sites. Size reduced to 110 acres.	PUG Plant (including facilities) would be in Section 16 on private land. Beaver Creek and unnamed tributaries avoided by 100 feet.	Same as Alternative E.	Same as Alternative D.	Same as Alternative D.
PUG Plant at Closure	Disturbed and compacted areas would be regraded for drainage, scarified, and revegetated. Fill slopes would be graded to a maximum of 3H:1V and contoured as necessary.	Removal of all facilities and re-contouring to pre-mining conditions to the extent possible.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
WRF	Located entirely on private lands in Sec 16.	WRF would stay north of Beaver Creek by at least 100 feet and extend north of Section 16 on to NFS lands in Section 15.	WRF would stay north of Beaver Creek by at least 100 feet, and remain mostly in Section 16.	Would stay north of Beaver Creek at least 300 feet and extend north and east of Section 16 on to NFS lands in Section 15 and 9.	Would stay north of Beaver Creek by at least 300 feet. WRF would extend north of Section 16 on to NFS lands in Section 15. Cap and liner system.	Same as Alternative E.
	Footprint would be 405 acres and highest elevation would be 6,200 feet amsl.	Footprint would be 445 acres and highest elevation would be 6,215 feet amsl.	Footprint would be 378 acres and highest elevation would be 6,320 amsl.	Footprint would be 621 acres and highest elevation would be 6,155 amsl.	Footprint would be 445 and highest elevation would be 6,215 amsl.	Same as Alternative E.

Table 15.
Activities by Action Alternative

Feature	Alternative C 2014 Plan Of Operations - Modified	Alternative D Water and Cultural Emphasis	Alternative E Minimize Footprint on NFS Lands	Alternative F Minimize Footprint and Reduce Risks To Public Safety	Alternative G Minimize Risks To Water	Alternative H Preferred Alternative
	4,000 feet of Beaver Creek diverted.	Beaver Creek not diverted and avoided by 100 feet.	Same as Alternative D.	Beaver Creek not diverted and avoided by 300 feet.	Same as Alternative F.	Same as Alternative E.
WRF at Closure	Regrading, contouring, revegetation, and topsoil placement will occur progressively.	Final reclamation would follow natural landforms utilizing a 3:1 slope. Footprint reduced to 329 acres due to backfilling.	Same as Alternative C.	Final reclamation engineered to follow natural landforms with a more natural appearance, using a 3:1 slope. 621-acre footprint.	Reduced WRF size due to back filling.	Same as Alternative E.
	124 million tons of waste rock in WRF.	123 million tons of waste rock in WRF.	124 million tons of waste rock in WRF.	124 million tons of waste rock in WRF.	33 million tons of waste rock in WRF.	Same as Alternative E.
Access Route	Lytle/Miller Ck Roads (FSR 847/854.1 to County Road 8, 208, 266) – with 80 foot ROW.	Warren Peak Road (County Road 100 and FSR 838) – includes 1.4 mile reconstruction – with 66 foot ROW.	FSR 879.1 to Warren Peak (FSR 838) – aligns with road when appropriate - with 66 foot ROW	Same as Alternative E.	Same as Alternative C, except a 66-foot ROW.	Same as Alternative G.
	No change in surfacing.	Change surfacing on Warren Peak Road from paved to aggregate.	Change surfacing on Warren Peak Road from paved to aggregate.	Same as Alternative E.	Same as Alternative C.	Same as Alternative C.
Power	5.0 miles of new power line.	9.4 miles of new power line.	No power line.	5.9 miles of new power line.	Same as Alternative C.	Same as Alternative C.
	25kV Miller Creek; follows the access road corridor; Above ground.	25 kV; Ogden Ridge Warren Peak Route.	Power produced onsite using 2 2000 kW diesel generators.	25kV; Peterson Fire Trail/Government Valley Route.	Same as Alternative C.	Same as Alternative C.
Exploration	2000 acres; 488 drill holes and 21,000 feet trenching.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.

2.14.2 Disturbance and Occupancy Comparison

Table 16 compares the acres of disturbance on NFS lands and the total acres of disturbance for all land ownership by alternative.

Table 16.
Acres of Estimated Surface Disturbance by Alternative

	Alternative C		Alternative D		Alternative E		Alternative F		Alternative G		Alternative H	
New Disturbance	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**	**NFS**	**Total**
Mine Pit	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4	232.4
Additional Pit Reclamation	0	0	94.8	94.8	104.4	104.4	38.6	38.6	0	0	38.6	38.6
PUG	2.6	2.6	2.1	2.1	0.0	2.1	0.0	2.1	2.1	2.1	2.1	2.1
PUG Facilities (including guardhouse)	14.4	14.4	14.5	14.5	0.0	14.0	0.0	14.0	14.5	14.5	14.5	14.5
PUG Haul Road	6.1	6.1	10.6	10.6	2.3	9.4	1.2	8.0	10.6	10.6	10.6	10.6
WRF (including ore stockpiles)	0.2	405.2	61.0	444.5	3.1	378.4	232.6	620.9	61.0	444.5	3.1	378.4
WRF Haul Road[2] and Secondary Haul Road	19.4	21.0	10.9	14.9	0.7	0.9	-	-	10.9	14.9	3.0	3.2
Access Road New Construction	16.7	79.2	50.0	72.0	35.1	61.2	35.1	61.2	15.5	63.5	15.5	63.5
Pit Dewatering Pond	5.1	5.1	7.9	7.9	5.5	5.5	5.5	5.5	7.9	7.9	7.9	7.9
Sediment Pond	4.5	12.1	6.9	9.4	3.6	10.3	6.4	7.2	7.0	9.4	6.9	9.4
Drainage Channel	2.1	5.8	3.0	5.2	2.6	4.9	2.4	2.8	3.0	5.2	2.6	4.9
Water Pipeline	0.4	0.4	0.3	0.3	2.7	5.2	2.5	4.9	0.3	0.3	0.3	0.3
Beaver Creek Diversion	0	7.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Topsoil Stockpile	27.0	27.0	4.1	20.8	0.3	17.0	0.3	16.9	3.8	24.1	4.1	20.8
Topsoil Stockpile Access	0.2	0.4	NA	NA	0.0	0.1	0.0	0.1	NA	NA	NA	NA
Fence Construction	4.8	4.8	4.4	4.4	3.5	3.5	3.8	3.9	4.4	4.4	4.3	4.3
Fence Maintenance Road	7.3	7.3	5.9	6.6	7.2	7.9	8.1	8.3	5.9	6.6	7.7	8.4
Power Line Substation	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
25kV ROW	5.9	10.3	22.6	29.9	NA	NA	11.5	19.8	6.2	11.6	6.2	11.6
Total New Disturbance	**349.1**	**841.3**	**531.4**	**970.4**	**403.6**	**857.5**	**579.5**	**1,043.9**	**385.5**	**852.1**	**359.9**	**811.0**

Source: Table 4.5-1 (RER, 2014a) and GIS
Totals may not add up exactly due to rounding.

2.14.3 Summary Comparison of Impacts by Alternative

Table 17 summarizes the impacts on resources by alternative.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Issues and Indicators and Section where detailed analysis appears						
Water Quality (Section 3.10)						
• Effects on stream channels	Beaver Creek bypass would be 4,000 feet of engineered channel could result in a loss of functional habitat, could lead to additional sediment and erosion in the bypass.	No diversion channel would be constructed for Beaver Creek.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
	Partial removal of Whitetail Creek and Beaver Creek headwaters by the Mineable Pit	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
	11.8 acres of Water Influence Zones disturbed during construction.	27.3 acres of Water Influence Zones disturbed during construction.	18.5 acres of Water Influence Zones disturbed during construction.	29.0 acres of Water Influence Zones disturbed during construction.	11.0 acres of Water Influence Zones disturbed during construction.	8.2 acres of Water Influence Zones disturbed during construction.
	18,371 linear feet of stream channel disturbed during construction.	8,310 linear feet of stream channel disturbed during construction.	8,740 linear feet of stream channel disturbed during construction.	13,897 linear feet of stream channel disturbed during construction.	8,297 linear feet of stream channel disturbed during construction.	7,762 linear feet of stream channel disturbed during construction.
• In-stream flow	Increased instream flow in Whitetail Creek and lower portion of Whitelaw from pit dewatering (years 7-45).	Increased instream flow in Whitelaw Creek (avoids Whitetail Creek) and lower portion of Whitelaw from pit	Similar to Alternative C.	Similar to Alternative C.	Similar to Alternative D.	Similar to Alternative C.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
	Increased flow increases erosion and sediment in Whitetail Creek during dewatering.	dewatering (years 7-45). Increased flow increases erosion and sediment in Whitetail Creek during dewatering.				
	Less than 1% decrease in flow after augmentation from pit dewatering ceases from pit lake evaporation.	No pit lake evaporation.	Same as Alternative C.	Same as Alternative C.	No pit lake evaporation	Same as Alternative C.
• Surface Water Quality	WDEQ will establish discharge limits and the proponent will be required to meet them. Therefore, all permitted discharge will meet water quality discharge standards even if treatment is required to meet the standard.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.	Water quality standards met as in Alternative C.
	Post-mine pit lake water quality may degrade surface water, indirectly through seepage into Whitetail and Whitelaw creeks.	No pit lake effects.	Same as Alternative C.	Same as Alternative C.	No pit lake effects.	Same as Alternative C.
• Groundwater Quality	Post-mine Pit lake water quality will meet standards to be	No pit lake, no groundwater effects from pit lake.	Similar to Alternative D.	Pit lake water would have similar effects as Alternative C.	Similar but slightly better for groundwater,	Similar to Alternative F.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
	established by WDEQ. Because of flow-through characteristics, pit lake water could enter groundwater and degrade groundwater quality, causing exceedance of current groundwater standards for some constituents (**Table 44**).	Groundwater flowing through the backfill could degrade groundwater quality, causing exceedance of current groundwater standards for some constituents (**Table 44**).		Evaporation of pit lake water would reduce the water that come in contact with partial pit fill which would then enter groundwater and reduce groundwater effects compared to Alternatives D and G (**Table 44**).	although cover would reduce rain and snowmelt water from filtering into the backfill.	
• Groundwater designated uses	Designated uses protected.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Effects of blasting on springs and wells	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Cultural Resources (Section 3.7)						
• Historic Properties directly affected	4 historic properties potentially affected by the PUG and access route; 3 may result in no direct impacts	Same as Alternative C.	No historic properties potentially affected	Same as Alternative E.	Same as Alternative C.	Same as Alternative C.
Health and Safety (Section 3.18)						
• Public exposure to nonradioactive constituents	Higher potential just outside the Mine Area fence. Residential exposure	Additional dust and particulates generated from 18 years of pit reclamation, but	Similar to Alternative D.	Similar to Alternative D, except additional	32 years of additional dust from hauling backfill. At	Same as Alternative D.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
and radioactive materials through dust and material falling from trucks.	along haul route to gamma radiation exposure would be too low to measure.	contaminant concentrations should be lower than those estimated for operations.		dust would occur for 15 years.	closure, exposure potential eliminated.	
• Exposure to radioactive or hazardous elements from ingesting meat from beef, sheep or wild game	Meat not likely to contain significant concentrations of radioactive or hazardous elements, not a significant exposure pathway.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Exposure to contaminants in water	Radium – Exceeds drinking water standard in pit lake.	No pit lake.	Similar to Alternative C.	Similar to Alternative C.	No pit lake.	Similar to Alternative C.
• Impacts on human health from rare elements	Element-specific air concentration estimates indicate potential inhalation hazards from dust during operations.	Same as Alternative C, extended for 18 years due to reclamation.	Same as Alternative D.	Same as Alternative C, extended for 15 years due to reclamation.	Same as Alternative C extended for 32 years due to reclamation.	Same as Alternative C, extended for 15 years due to reclamation.
• Road use	Access road open to public use. Mixed use of mine traffic, recreational, and residential use on Miller Creek.	Access road open to public use. Mixed use of mine traffic, recreational, and residential use on Warren Peak Road, currently the main access route for visitors to NFS lands.	Access road open to public use. Mixed use of mine traffic, recreational, and residential use Warren Peak Road, currently the main access route for visitors to NFS lands.	Same as Alternative E.	Same as Alternative C.	Same as Alternative C

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Social and Economic (Section 3.17)						
• Spent during Construction	$71 million	$65 million	$66 million	$65 million	$106 million (including $37 million for WRF liner)	$65 million
• Employment during Construction	180-240 workers $19 million employee compensation	160-220 workers $18 million employee compensation	160-220 workers $17 million employee compensation	160-220 workers $17 million employee compensation	270-333 workers $21 million employee compensation	160-220 workers $17 million employee compensation
• Operations • Annual spent first 9 years	$14 million	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C
• Annual spent Following Years of Operations	$12 million	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C
• Employment during Operations Year 1-9	145 in Crook County 55 in Weston County	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C
• Employment during Operations Year 10-15	115 in Crook County 50 in Weston County	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C
• Property taxes	$20-25K in Crook County	About the same as Alternative C.	About the same as Alternative C.	About the same as Alternative C.	$30K in Crook County	About the same as Alternative C.
• Sales tax	$1.4 million	About the same as Alternative C.	About the same as Alternative C.	About the same as Alternative C.	$2.1 million	About the same as Alternative C.
• Cost of Closure and Reclamation of Mine Area	$20 million $10 million/year for Mine Area for 2 years.	$165 million $9.2 million/year for 18 years.	$177 million $9.9 million/year for 18 years.	$106 million $9.0 million/year for 12 years.	$426 million $13.3 million/year for 32 years.	$106 million $9.0 million/year for 12 years

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• Employment during closure	70 jobs per year for 2 years.	50-55 jobs for 18 years.	55-60 jobs for 18 years.	50-55 jobs for 15 years.	40-45 jobs for 32 years.	50-55 jobs for 15 years.
• Revenue loss from reduction in hunting or recreational opportunities	It is expected that some revenue losses resulting from recreational activities may occur as individuals choose to no longer participate in activities in the area; however, the exact value cannot be determined due to personal choice. Loss revenues could result from commodities offered from communities or licenses issued by WGFD.					
Access and Transportation (Section 3.4)						
• Traffic increase from process concentrate hauling	13-17 round trips per day on Miller Creek Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, increase in supply trucks particularly for fueling the power generators and personnel transporting to/from work shifts.	13-17 round trips per day on Warren Peak Road, plus supply trucks for fuel and equipment and personnel transporting to/from work shifts.	Same as Alternative C	Same as Alternative C.
• Residences along the access route	5 houses within ¼ mile buffer, 10 driveways total along road	52	52	52	5 houses within ¼ mile buffer, 10 driveways total along road	Same as Alternative G.
• Miles from PUG Plant to Upton	40.2	38.8	38.1	38.1	40.2	Same as Alternative G.
• Miles of Currently Open NFS Roads on NFS lands in Mine Area	5.0	1.6	1.4	2.7	2.6	2.4

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Air and Climate (Section 3.6)						
• Percent of Annual NAAQS limit (**Table 26**)	3.6-87.8	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Greenhouse Gas Emissions	55,929 tons per year of total CO_2e (total, direct and indirect)	Same as Alternative C.	Addition of generators for the life of the project would emit about 7,084 additional tons of CO_2 per year, totaling up to 32,361 tons per year of CO_2.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
Aesthetics and Visual Quality (Section 3.5)						
• Meets SIO	Mine pit meets SIO of low, but not the small portion that is moderate. Miller Creek Access and power line are largely in moderate SIO.	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Warren Peak Access and power line are largely in low SIO	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Access is largely in low SIO and would meet	Mine pit meets SIO of low, but not the small portion that is moderate. Additional reclamation area is generally low SIO and would meet. Access and power line are would meet low SIO but not high SIO.	Mine pit meets SIO of low, but not the small portion that is moderate. Miller Creek Access and power line are largely in moderate SIO	Same as Alternative C.
• Warren Peak Viewpoint	Permanent visual intrusion from pit walls and pit lake in the foreground and WRF in the middle ground, where eventually the color	41% more disturbance at reclamation for backfilling, grading, and revegetation of pit. WRF visible in the middle ground. Eventually the color	45% more disturbance at reclamation for backfilling, grading, and revegetation. WRF visible in the middle ground.	17% more disturbance at reclamation for backfilling, grading, and revegetation. WRF visible in the middle ground.	Mineable Pit would be eliminated and essentially disappear as a meadow is formed. Once reclaimed, the WRF would likely	Same as Alternative F.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
	and form contrast would reduce. The pit lake would create contrast in landform, color, texture.	and form contrast would reduce. The pit lake would not form to create contrast in landform, color, texture.	Eventually the color and form contrast would reduce. The pit lake may create contrast in landform, color, texture.	Eventually the color and form contrast would reduce. The pit lake would create contrast in landform, color, texture.	not be as noticeable in the middle-ground views.	
• NFS Road 831 Viewpoint	Permanent but partially obscured view of WRF and angular, engineered appearance	At reclamation, in the long term, the WRF would eventually become less noticeable as the slopes become revegetated. Visual impacts would be permanent.	Same as Alternative D.	Same as Alternative D.	Mineable Pit would be eliminated and essentially disappear as a meadow is formed. Once reclaimed, the WRF would not be as noticeable in the foreground and middle-ground views. There would not be permanent visual effects.	Same as Alternative D.
• Devils Tower NM, Inyan Kara Mountain, Wyoming Welcome Center Viewpoint, and Crow Peak Viewpoints	WRF visible towards the end of mining and during night activities from lighting, some may notice the engineered and somewhat angular appearance. Eventually, the contrast would be reduced enough that it may not attract the attention of viewers from these viewpoints,	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation	WRF may be visible during construction, particularly at night when lighted – but after reclamation, WRF may be naturally appearing in the background only from the top of the Devils Tower	WRF may be visible during construction, particularly at night when lighted – but not after reclamation	WRF may be visible during construction, particularly at night when lighted – post-mining WRF will be naturally appearing in the background after reclamation

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
	especially once trees become established.					
• Night skies	At night, lighting from mining operations and headlights would change the nighttime landscape character by increasing sky glow. Night sky observation would be adverse in the foreground and middle ground (Warren Peak Fire Tower and NFS Road 831). Nighttime lighting of the WRF during operations may be visible from Devils Tower National Monument as the WRF elevation increases in the second half of the mine life at a distance of 13 miles.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C with additional time where WRF operations would be lit and visible at night as the waste rock is hauled back to the pit, possibly another 20 years.	Same as Alternative C.
Soils (Section 3.8)						
• Cubic yards of stockpiled soil from NFS lands	672,474	834,900	572,330	1,035,760	763,913	697,176
• Cubic yards of stockpiled soil	0	191,136	207,381	84,095	0	84,095

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
from NFS lands due to pit reclamation total						
• Cubic yards of stockpiled soil from NFS lands due to access road on NFS	27,667	66,240	61,017	66,240	17,550	17,550
• Cubic yards of stockpiled soil from NFS lands WRF	284	122,246	6,327	458,940	122,246	6,327
• Cubic yards of stockpiled soil from WRF total	634,042	874,277	742,708	1,218,436	874,277	742,708
Geology, Minerals, Stability (Section 3.9)						
• Material removed from the Mineable Pit	Approximately 151 million tons	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
• Mineral Resources Recovery Impaired by Reclamation	None	978 million pounds of rare earth elements worth $10.93 billion	Same as Alternative D.	Same as Alternative D.	1,160 million pounds of rare earth elements worth $12.94 billion	Same as Alternative D.
Fish and Wildlife (Section 3.11, Table 47)						
• ESA Listed Species	May affect, likely to adversely affect.					

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• R2 Sensitive Species	Species known to occur in the project area may be adversely affected, but not likely to affect population viability or contribute to federal listing.					
• MIS	Species known to occur in the project area may be affected by habitat removal. Some species may benefit from altered habitats.					
• Species of Local Concern	The proposed project would not conserve or enhance habitat for these species of local concern. Individuals would likely be affected by loss of habitat.					
• Big Game Species	Loss and alteration of habitat and increase in human presence would likely affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Mortalities may occur due to vehicle collisions and fence entrapments. Not likely to cause a loss of species viability range-wide.					
• Migratory Birds	Loss and alteration of habitat and increase in human presence would affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Not likely to cause a loss of species viability range- wide, as individuals would be able to move away from activity.					
• Wild turkey	Likely to adversely impact individuals and local population viability in the analysis area. Not likely to cause a loss of species viability range-wide, as populations are known to use other areas of suitable habitat in the vicinity.					
Vegetation (Section 3.11)						
• Acres of Vegetation Type Disturbed on NFS lands						
Already Disturbed	6.9 acres	7.6 acres	8.8 acres	10.9 acres	7.2 acres	7.0 acres
Riparian	13.7 acres	15.5 acres	13.0 acres	19.8 acres	15.0 acres	11.5 acres
Aspen	22.0 acres	37.5 acres	37.6 acres	35.2 acres	25.6 acres	22.9 acres
Grass	47.3 acres	79.8 acres	72.1 acres	65.1 acres	47.2 acres	46.8 acres
Ponderosa Pine	260.4 acres	381.1 acres	270.1 acres	441.8 acres	288.0 acres	229.0 acres
Wetland	1.4 acres	2.5 acres	1.1 acres	6.7 acres	2.5 acres	0.7 acres
Cropland	1.9 acres	0.0 acres	0.0 acres	0.0 acres	0.6 acres	0.6 acres
Total	**353.6** acres	**526.6** acres	**402.7** acres	**579.5** acres	**386.2** acres	**318.6 acres**
Wetlands and Riparian (Section 3.12)						
• Total Wetland Affected	2.8 acres	2.8 acres	1.4 acres	7.2 acres	2.8 acres	0.9 acres
• NFS Wetland Permanently Removed by Mineable Pit	0.5 acres	0.5 acres	0.5 acres	0.5 acres	0.5 acres	0.5 acres

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
• NFS Wetland removed due to the PUG Plant	0.1 acres	0.0 acres	0.0 acres	0.0 acres	0.0 acres	0.0 acres
• Wetland Permanently lost from WRF and Roads	0.9 acres	1.4 acres	0.0 acres	5.9 acres	1.4 acres	0.0 acres
Timber (Section 3.13)						
• NFS Timber affected by construction	257 acres	316 acres	208 acres	419 acres	287 acres	206 acres
• Timber Volume Harvested from NFS lands	1,016 MBF 2,122 CCF	1,387 MBF 2,927 CCF	1,063 MBF 1,497 CCF	1,834 MBF 3,865 CCF	1,317 MBF 2,772 CCF	943 MBF 1,985 CCF
• Timber Affected by Pit Reclamation	0 acres	55 acres	62 acres	42 acres	0 acres	Same as Alternative F
• NFS Ponderosa Pine Timber Volume Harvested due to Pit Reclamation	0	228 MBF 492CCF	253 MBF 549 CCF	189 MBF 411 CCF	0	Same as Alternative F

Livestock Grazing (Section 3.15)												
• Acres in Mine Area	NFS Acres	Total Acres	NFS Acres	Total Acres	NFS Acres	Total Acres	NFS Acres	Total Acres	NFS Acres	Total Acres	NFS Acres	Total Acres
Divide Allotment	401	415	336	350	112	126	172	186	336	350	250	264
Ogden Allotment	3	4	2	3	2	3	3	3	2	3	2	3

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Warren Peak Allotment	662 1,281	527 1,146	495 1,114	682 1,302	527 1,146	491 1,110
Total Acres	1,066 1,700	865 1,499	609 1,243	857 1,491	865 1,499	743 1,377
Recreation and Land Use (Section 3.16)						
• Recreation	Recreational experience modified by noise, dust, and lights for the life of mine through reclamation. Concurrent reclamation plus 2 years after closure. Mineable Pit permanently closed,	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 18 years closure plus 2 years reclamation. Partial pit backfill to restore area to multiple land uses.	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 18 years closure plus 2 years reclamation. Post closure access for potential public use.	Similar to Alternative C. Concurrent reclamation plus 12 years closure plus 2 years reclamation. Post closure access for public use.	Noise, dust, and lights same as Alternative C. Concurrent reclamation plus 32 years closure plus 2 year reclamation. Post closure access for public use.	Similar to Alternative C. Concurrent reclamation plus 12 years closure plus 2 years reclamation. Post closure access for public use.
• Loss of public hunting on NFS lands by percent of Hunt Area						
Hunt Area 1	0.6 percent	0.5 percent	0.4 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Hunt Area 2	1.2 percent	1.0 percent	0.7 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Hunt Area 116	1.2 percent	1.0 percent	0.7 percent	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
• Miles of Snowmobile Trails on NFS lands in the Mine Area	3.1	1.6	0.2	0.4	2.2	2.2
• Special Uses affected	1 hunting outfitter within Mine Area. 1 winter recreation event affected by loss of trails.	1 hunting outfitter within Mine Area. 1 winter recreation event and 2 summer recreation events affected by project activities.	1 hunting outfitter within Mine Area. 1 winter recreation event and 1 summer recreation events affected by project activities.	Same as Alternative D.	Same as Alternative C.	Same as Alternative C.

Table 17.
Comparison of Impacts by Alternative

Issue	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Alternative H
Land Uses (also see Table 15)						
• Mineral Withdrawal	Mine fence crosses withdrawn lands	Mine fence, access road, and power line corridor crosses withdrawn lands. Reclamation of mine pit encroaches into withdrawn land by a maximum distance of 1,165 feet and 55 acres.	Mine fence crosses withdrawn lands. Reclamation of mine pit encroaches into withdrawn land by a maximum distance of 1,200 feet and 57 acres.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.	Mine fence crosses withdrawn lands. No reclamation of mine pit into withdrawn lands.

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter summarizes the current conditions and results of the analysis conducted to determine the environmental impacts on the resources from the proposed Bear Lodge Project. References and GIS data used for the resource analysis are in the project file. The resource sections discuss the analysis area and the methods and data used to conduct the analysis.

Implementation of the proposed Forest Plan amendment (Section 2.5.1) would permit the activities analyzed in each of the action alternatives. Therefore, the analysis of the activities within the Mine Area serves as the analysis for the impacts of the proposed Forest Plan amendment.

3.2 Introduction to Direct and Indirect Impacts Analysis

Direct and indirect effects from the alternatives are analyzed in detail in this chapter.

3.2.1 Analysis Areas

Each resource analyzed has a stated direct and indirect impacts analysis area. The majority have a common analysis area that includes the disturbance areas defined below and is referred to as the Project Area. The Project Area totals 3,127 acres, of which 2,366 acres are NFS lands, 750 acres are privately owned land, and 11 acres are Wyoming state lands. The Project Area (**Figure 10**) refers to the analysis area that includes:

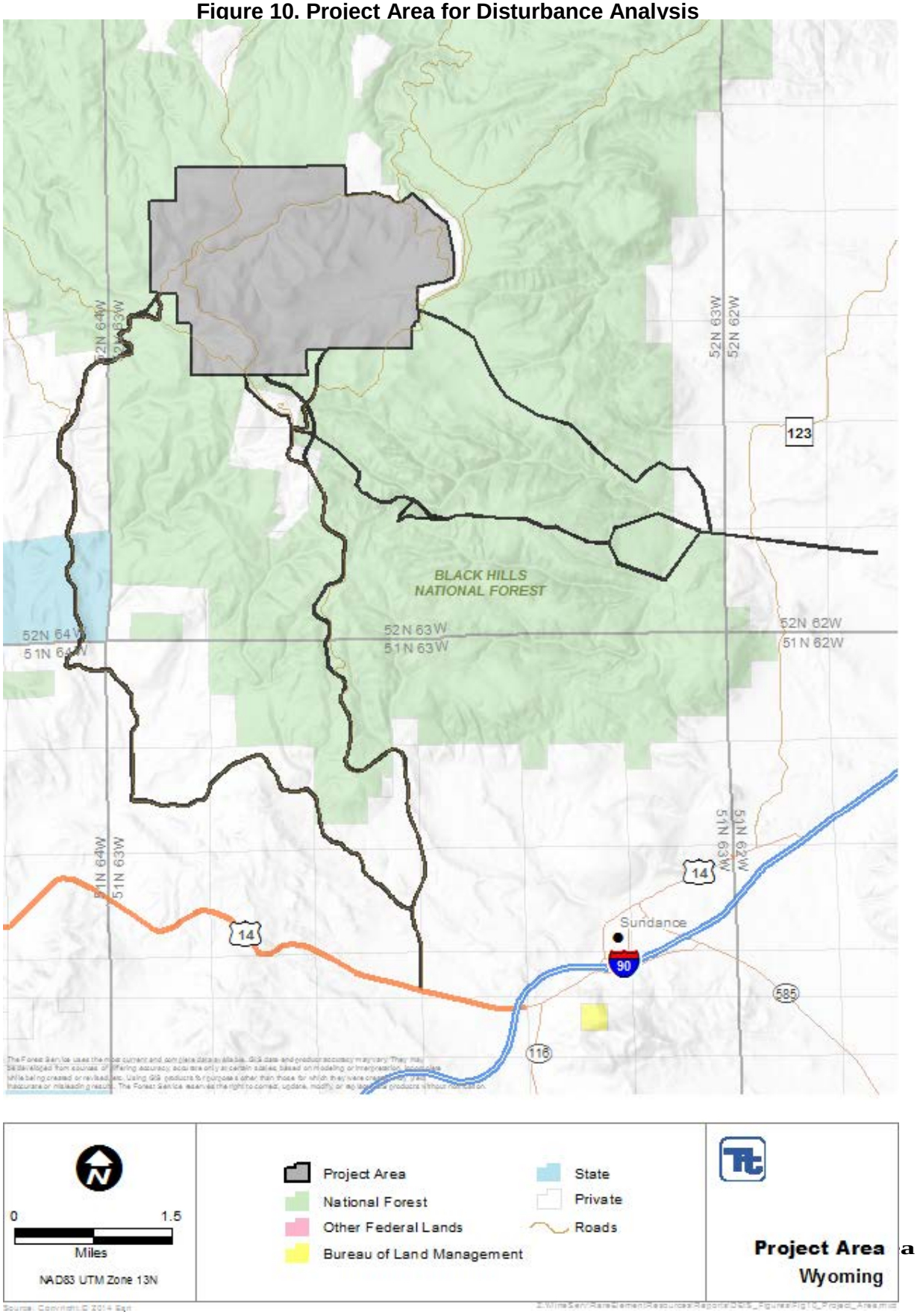
- The fenced Mine Area for all the alternatives, combined, regardless of ownership;
- The exploration boundary (which is the same for all action alternatives);
- Combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads; and
- 30-foot right-of-way on all of the power line routes.

For most resources, the impacts are analyzed for ground disturbance as described for each alternative. The Forest Service uses the most current and complete data available. GIS data, model outputs, and product accuracy may vary. Data may be developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being created or revised, etc. Using GIS products for purposes other than those for which they were created may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify, or replace, GIS products without notification.

The following guidelines were used when calculating the ground disturbance.

- Activities that would cause disturbance include: exploration activities (including access), Mineable Pit, PUG Plant (and adjacent buildings/offices), WRF, access roads, internal roads, ponds, storage areas, and power line.
- Activities that would occur within the same disturbance footprint were not double counted. For example, an internal haul road may be located where pit reclamation would occur. The disturbance has been removed from one or the other disturbance calculation.
- Access to soil stockpiles that are not immediately adjacent to roads would be “overland travel.”
- Although concurrent reclamation would occur where feasible, calculations are made based on total maximum disturbance. The analysis of disturbance impacts overestimates the extent of the area in a disturbed condition at any one time.

Figure 10. Project Area for Disturbance Analysis



The calculation methods listed in **Table 18** apply to all project alternatives unless otherwise noted.

Because they are integral components of the Proposed Action and alternatives, the analysis assumes the design features (Section 2.6) and proponent committed environmental protection measures would be implemented as described.

Connected actions (those that occur on non-NFS lands) are considered to the extent impacts, activities, or issues affect NFS lands. In some cases, information on existing conditions and details of activities that would occur off NFS lands are unknown. Impacts from connected actions where the Forest Service or cooperating agencies do not have any decision-making authority will be analyzed in future NEPA documents conducted by the agencies with decision authority, in particular the NRC and state of Wyoming.

Table 18.
Assumptions Used to Conduct the Disturbance Analysis

Project Component	Disturbance Analysis Assumptions
Within Project Area Boundary	Mapped footprint
Physical Upgrade Plant	Mapped footprint of individual facilities within the PUG area
Mineable Pit	Mapped footprint at construction
Pit Reclamation	Estimated footprint based on 3:1 slope geometry in Alternatives D, E, and F
Waste Rock Facility	Mapped footprint
Sediment Ponds	Mapped footprint
Diversion Channels	Assumes 10 feet disturbance width for mapped channels.
Low Grade Ore Stockpile	Assumes 35 acres of disturbance contained within the WRF.
Topsoil Stockpiles	Mapped footprint. Acreage does not include Topsoil Stockpile #1 because it is within the PUG boundary.
Water Line	Assumes 25 feet disturbance width for pipeline construction.
Secondary Road- Two Lane	Assumes 80 feet disturbance width and does not account for existing road disturbance (e.g., pit rim road).
Haul Road	Assumes 100 feet disturbance width and does not account for existing road disturbance.
Power Line – Right-of-Way	Assumes 30-foot right-of-way disturbance width.
Power Line – Structures	Assumes 0.01 acre of disturbance per structure (25 feet X 25 feet). Average pole to pole distance is assumed to be 300 feet
Fencing	Assumes 5 feet disturbance width for fence construction and 12 foot wide maintenance road inside fence perimeter.
Access Route	Assumes 66 feet width and accounts for the existing 20 feet of existing road disturbance. Alternative C Miller Creek has 80-foot width
Exploration	
Drill Site	Assumes 0.3 acre of disturbance (approximately 100 feet X 100 feet).
Trenching	Assumes 25 foot disturbance width for trench construction.
Temporary Road	Assumes 18 foot disturbance width for roadbed.
Existing Road	Assumes maintenance of existing road width.

3.3 Introduction to Cumulative Effects Analysis

As defined in the regulations for implementing the NEPA, 40 CFR 1508.7, a cumulative effect is an "*impact to the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person*

undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time."

This section provides an introduction for actions considered in the cumulative analysis for each resource discussed later in the chapter. It identifies and describes projects that may contribute effects in addition to the direct and indirect effects from the alternatives analyzed. This list is intended to prevent repetition. Each resource will specifically identify projects that contribute to cumulative effects.

Generally, these projects have the potential to affect one or more natural resources to varying degrees. Potential effects include impacts to air quality, soil erosion and loss of productivity, sedimentation and water quality degradation; alterations to vegetation communities, timber resources, and weed invasions; changes in recreational activities and forest access; alterations to viewsheds, changes in grazing activities; loss of wildlife habitat and disturbance effects on wildlife; and economic growth.

3.3.1 Cumulative Impacts Analysis Area and Temporal Scope

This discussion will include, to the extent possible, projects on National Forest, private, state, or BLM lands. A 5-mile buffer around the Mine Area was used to identify the list of projects considered under the cumulative analysis. Resources that may extend beyond this buffer zone or alternatively, that are constrained to the boundary considered under the direct and indirect effects analyses, are identified in individual resource sections. Likewise, this list was developed considering what is known about the actions likely to occur within the cumulative impacts analysis timeframe, which includes past actions that are still having effects, and current and reasonably foreseeable action that would occur during the life of the mine through reclamation or development of the pit lake (up to 100 years post mining).

Figure 11 shows the 5-mile buffer around the Mine Area and identifies the locations of the past, present and reasonably foreseeable actions described below.

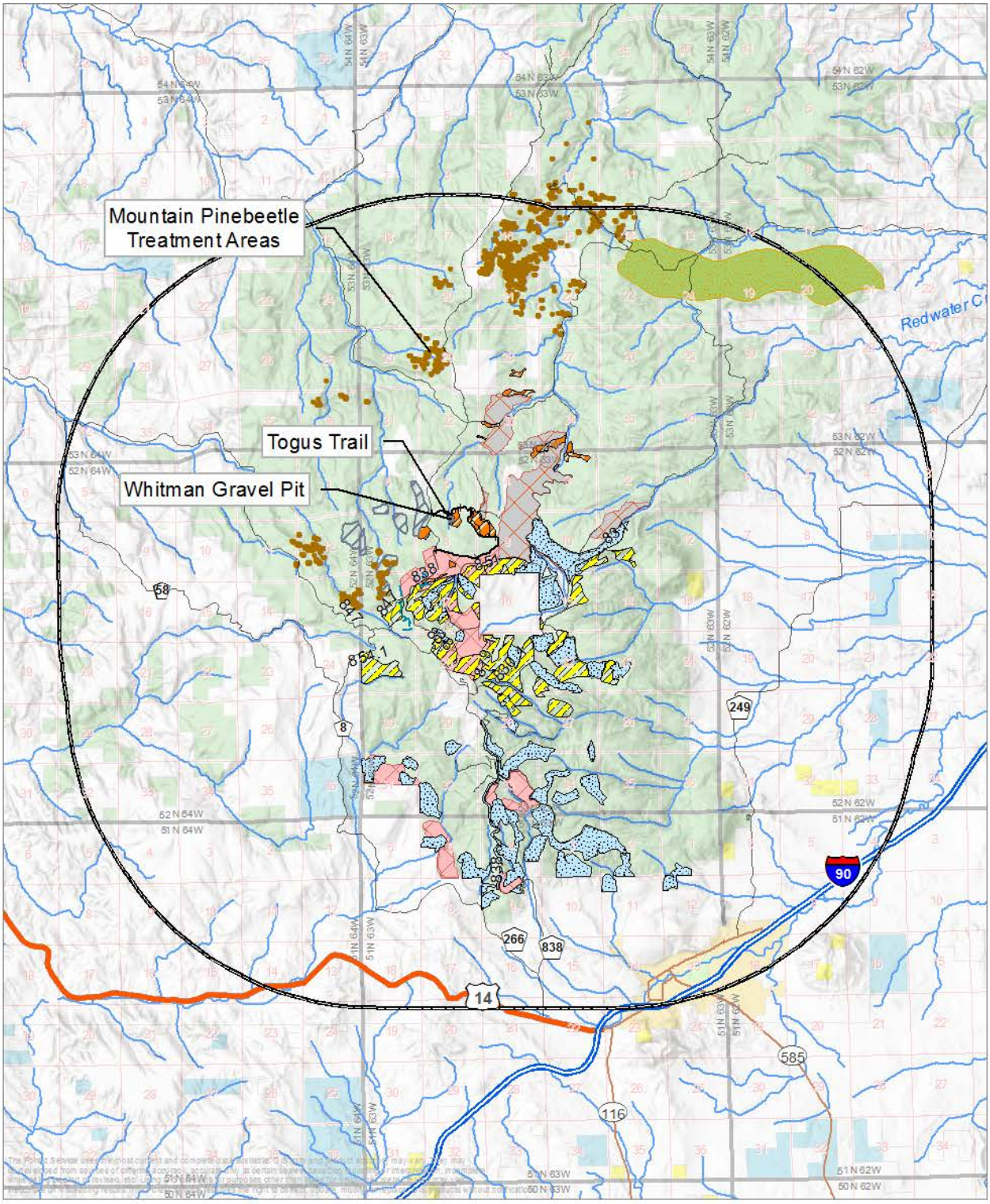
Exploration and Mineral Resources Development

Minerals exploration activities in the cumulative analysis area have included drilling and trenching projects proposed by Paso Rico/RER and Newmont Mining Company. The projects have been reoccurring since 2004 and in 2009 the Sundance Exploration Project Environmental Assessment and Decision Notice was approved. Drilling projects entailed creating a level surface for the drill rigs about 0.1 acres in size along with digging a small hole to capture water utilized in the operation. Trenching involved creating a trench about 10 feet deep to study the soil characteristics. Between 2004 and 2012, approximately 300 drill holes were created and closed and 10,006 linear feet of trenching was completed. Support services for the mineral exploration activities include construction of temporary roads.

The cumulative analysis area includes 2 commercial gravel pits located on private lands in Sections 19 and 30 in T52N R62W (24 acres), and Sections 5, 6, 7, and 8 in T51N R64W (41 acres) and 2 gravel pits on NFS lands; Section 3 (2 acres) and 8 (5 acres) in T52N R63W. The gravel pit in Section 3 T52N R63W is not actively managed for mineral materials, but the others remain active and periodically crush and screen the material. No mineral material is being pursued on state or BLM lands. No additional mineral activity is known to occur on any private, state or BLM lands within the cumulative analysis area.

Timber Harvesting and Forest Treatments

Timber resources on NFS lands have been managed for over 100 years through various selective cutting practices such as thinning, seed tree cuts, and shelterwoods. Each treatment leaves a different level of tree density to achieve a specific purpose for a healthy forest environment or wildlife habitat. Multiple timber harvesting practices occurred and are identified in **Figure 11**. Timber harvesting employs methods using skidders and fellers, where roads and skid trails are constructed to remove trees. Upon completion of the timber removal, the temporary roads and trails are closed and seeded to prevent erosion. Timber resources will continue to be managed to improve and maintain a healthy environment following the same processes. The most recent plans for timber sales are the Herman Project and the Dean Project, beginning in 2016.



0 2.5
Miles

NAD83 UTM Zone 13N

Search Radius

Management Activities

Burner Project
Herman Project
Sleez Project
Tornado Project
Sundance Project
Prescribed Burn (Completed)
Prescribed Burn (Planned)
National Forest
Bureau of Land Management
State
Private
Stream
NFS Road Number

Past, Present, & Reasonably Foreseeable Actions

Wyoming

Source: Copyright:© 2014 Esri

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The cumulative analysis area includes sections that contain state land areas: Section 16 T51N R63W (640 acres), Sections 5, 9, 16, 19, 28, and 29 T52N R62W (640 acres), Section 36 T52N R64W (640 acres). State lands are managed for timber resources. There are no past, present or future plans to remove timber from these state lands.

Inside the cumulative analysis area, there are five sections of public land managed by the BLM; Sections 13 (80 acres), 24 (40 acres), 31 (40 acres), and 32 (90 acres) in T52N R62W and Section 6 (40 acres) in T51N R62W. Aerial photos do indicate several of the parcels to have a timber component, but it is unlikely BLM actively manages the timber resource due to the isolated nature of the parcels.

Section 16 T52N R63W is 634 acres of former state lands, privately owned since 2013. Timber was removed from these acres between 2010 and 2014. It is unknown whether other private land owners in the cumulative analysis boundary are actively managing their timber resource. Aerial photos indicate many land owners have timbered land. The assumption is that land owners manage their timber resource periodically to maintain a healthy environment through thinning and removing trees.

Vegetation Treatments

Money is collected from Forest Service timber sales to treat vegetation that is not merchantable for lumber to benefit various resources. Treatments usually entail cutting with chainsaws, but can sometimes use large mowers called masticators. Timber stand improvements are designed to benefit the timber resource by thinning young stands to increase resiliency to disease and insects and reduce the threat of fires. Wildlife habitat improvements are designed specifically for wildlife species by removing undesirable vegetation and thinning trees.

Timber stand and wildlife habitat improvement projects have occurred on NFS lands in association with timber sales and will likely continue this practice into the future. Future acres of treatment are determined based on forest condition which would be evaluated in specific project planning areas. The Herman Project and Dean Project planning document has been completed and treatment areas will be incorporated into timber sale areas.

The state of Wyoming initiated a mountain pine beetle prevention program in 2013to control beetle spread. State land and NFS lands have been targeted to cut insect infested trees using manual labor and chainsaws. It is unknown whether private or BLM lands have conducted any vegetation treatments.

Prescribed Burns

Prescribed burning is another type of vegetation treatment designed to improve the forest for timber and wildlife habitat. Prescribed burning is used to reduce the amount of dead woody debris in the forest and protect it from catastrophic wildfires. Two types of prescribed burning are used; broadcast burning across a landscape and pile burning. Typically, a dozer is used to construct a control line to bare mineral soil around the proposed broadcast burn unit to prevent the spread into unwanted areas. If the topography is unsuitable for a dozer hand crews will rake a control line. Upon completion of the burning, the control lines are seeded and closed. For pile burning of slash generated through timber and vegetation treatments, the burns are typically conducted in the winter to use the snow cover to control the fire.

State and BLM are known to conduct some type of prescribed burning practice with the management of their lands. It is unknown whether any of the state or BLM lands within the cumulative analysis area have ever had burning activities. The former state land in Section 16 T52N R63W is known to have slash piles remaining from the timber sale activities, but it is unknown whether any plans have been made for future burning. Private land owners with ranches have also been known to burn piles, not necessarily associated with timber or vegetation management practices. It is unlikely that any of the ranches in the cumulative boundary have conducted broadcast type burning to improve grazing conditions.

Invasive Weed Treatments

Herbicide treatments and biological control are the two primary activities on NFS lands used to control invasive weeds within the cumulative analysis area. Herbicide treatments are conducted either by broadcast spraying or treating individual plants. Truck or all-terrain vehicle mounted sprayers are used when roads are present, while backpack sprayers are used in more sensitive areas to treat individual plants. Resources of concern are primarily water-related resources, where herbicides could affect water quality or fish habitat.

All land owners, including local road jurisdictions, actively manage to control the spread of invasive weeds. It is unknown how many acres are treated annually by other land owners.

Projects that cause surface disturbance and involve vehicle traffic may contribute to weed infestations. Control measures combined with revegetation are typically implemented to minimize the potential of weed infestation and spread.

Range Improvement

Range improvements are activities designed to improve production of forage, the range resource, or the management of livestock. They can be structural, non-structural, permanent, or temporary and generally include, but are not limited to, new pipelines, wells, dams, or fences (36 CFR 222.1(21)). Maintenance actions would occur annually. Very little new construction is completed, with the possible exception of new water developments if existing ones fail. Much of the private land associated with the cumulative analysis area is ranch land for livestock grazing (cattle, sheep, or horses). NFS lands in the analysis area are permitted for livestock grazing (cattle) and divided into allotments with pasture rotations. State lands are available to adjacent land owners/livestock producers for leasing and it is assumed the small BLM parcels may also provide grazing opportunities to adjacent land owners. It is difficult to tabulate the acres or linear feet (fences) that might be involved with grazing opportunities annually.

Recreation

NFS lands offer a variety of motorized and non-motorized, developed and dispersed, winter and summer recreation opportunities in the cumulative analysis area. Opportunities include, but are not limited to, trail use, hunting, fishing, sight-seeing, camping, and picnicking. Generally, improvements for recreation take place through maintenance activities mostly associated with trails, such as brushing vegetation with chainsaws, construction of water diversion structures with dozers, or adding gravel to muddy areas. Maintenance of motorized and non-motorized trails and developed campgrounds occurs annually.

A future trail project being planned is a six-mile extension of a motorized trail from Reuter to Warren Peak (bottom of mountain to NFS Road 860). The decision has been deferred until after the mine and campground decisions are made, and it is unknown when or if construction would occur. State and BLM lands are considered open to public hunting opportunities if there is an open public road associated with the properties. Not all state and BLM lands have full public access and land owner permission must be obtained before crossing private land to access those properties. Some land owners, in coordination with the WGFD, will open their properties to walk-in public hunting opportunities. These are documented annually in connection with the hunt season and typically signed along fences.

Road Maintenance

Roads on the Bearlodge District that serve as the main artery road system for public travel are maintained through a contract. The contract includes maintenance on Level 3, 4, and 5 roads in the spring and fall with blading to remove wash-boarding and ditch cleaning to remove encroaching vegetation and maintain drainage. Culverts are checked annually and fixed as needed to maintain water flow. Some higher use roads (NFS Roads 838, 843, and 849) are bladed twice a year, while others (NFS Road 847, 841, and 851) may only receive maintenance once a year. Additional contracts are issued to replace gravel as needed on these main system roads.

Additional NFS road maintenance is conducted occurs every 5 years in specific areas of the Forest. Within the cumulative analysis area, this includes the Level 1 and 2 roads. Maintenance is conducted as needed to protect the road surface and prevent erosion. In addition, Forest Service crews perform special projects as needed, such as culvert replacement, cattleguard cleaning, and sign replacements.

Outside of NFS lands, it is known that other road management agencies conduct similar maintenance on gravel roads, such as county roads. WDOT does have future special reconstruction/reroute plans for paved highways; such as Interstate 90, Highway 14, and Highway 116 within the cumulative analysis area.

Lands

Occasionally, the Forest Service issues permits for special uses when no other opportunity exists to accomplish the need. The special uses associated with the cumulative analysis area include private road permits, waterline permits, ditch conveyance easements, reservoir permit, grazing and cultivation permits, communication towers, utility corridors, snow measurement site, and a weather station. Private individuals submit an application for their special need which is evaluated for compliance with Forest Plan goals and objectives. These are generally small in scale and once construction is complete require very little maintenance activity.

The Crook County Forest Roads and Trails Act Easement Categorical Exclusion, in progress, would allow issuance of a permit authorizing Crook County jurisdiction over and maintenance of certain roads on NFS lands. Expected implementation is November 2015.

State and BLM lands also have the ability to issue special use permits for use. Some of the state lands are leased by adjacent land owners for livestock grazing opportunities. It is unknown whether any of the BLM lands are permitted for the same purpose, although aerial photos indicate several of the BLM parcels are in grassland environments. Private land owners may also lease parcels of their lands to outfitters for hunting or other ranchers for cultivation or grazing.

In 2013, the state of Wyoming, Office of State Lands and Investments executed a land exchange between RER and the state of Wyoming, Board of Land Commissioners. State trust lands (640 $\pm$ acres) within the cumulative impacts analysis area were transferred to RER in Township 52 North, Range 63 West, Section 16. Prior to the exchange, a timber sale was active through 2013 and all of the merchantable timber was removed.

Wildlife Improvements

Additional wildlife habitat improvements completed on NFS lands include willow planting along riparian areas, installation of bat gates on caves, or transplanting wildlife species. The Whitelaw riparian area project, a partnership project developed in 1992 to restore riparian habitat, may include transplanting beaver and continuing vegetation restoration activities in the future.

Commercial Development

Upton Regional Industrial Park

The Northeast Wyoming Economic Development Coalition developed a 600-acre industrial park in 2010. It is located near Upton along the Burlington Northern Santa Fe Railroad, which serves as a transloading site for materials to be distributed across the Powder River Basin. Commodities such as cement and ammonium nitrate are gathered at the Upton Regional Industrial Park to support energy development. Businesses in place also include a commercial explosives company, a pilot cellulosic-ethanol plant, and an operations and inspections facility. Cement and chemical plants and additional railroad transloading operations are expected to be added.

Other commercial and industrial activities include an oil refinery near Newcastle.

3.4 Access and Transportation

Access and transportation analysis considers the current conditions, uses (level and types), and safety of the roads that are currently used for motorized travel associated with the proposed mine. Other access, such as recreational access on trails is considered under Recreation (Section 3.16).

3.4.1 Area of Analysis and Methods

The federal and state highways, local roads and NFS access roads from the Mine Area to the Upton Hydromet Plant were evaluated.

Existing traffic counts obtained from the WDOT and the Access Report (HDR and Stetson Engineering, 2012) were reviewed. Projected traffic counts were calculated based on the additional mine traffic identified in the Plan of Operations. The State Transportation Improvement Plan (WDOT, 2015) was reviewed to identify any planned construction projects that could change the potential impacts from additional mine traffic. The Access Report provided information for the comparative analysis.

3.4.2 Affected Environment

The impacts on transportation and access from the Mine Area to the Upton Hydromet Plant were evaluated. The Miller Creek Road, the Warren Peak Road or the Warren Peak / Highland Road are the access alternatives from the Mine Area to the intersection of Highway 14 and Highway 116.

Miller Creek Road

Traffic data shows that Miller Creek Road traffic is 69 vehicles per day. Highway 14 traffic from the Warren Peak Road turnoff to Highway 116 is 732 vehicles per day. Between 1995 and 2011 there were 5 crashes on the Miller Creek Road (HDR and Stetson Engineering, 2012).

There are 10 private drives and residences along the Miller Creek Road route with 5 residences within a ¼ mile buffer of the road.

Miller Creek Road is gravel surfaced.

Warren Peak Road and Warren Peak/Highland Road

Existing traffic data shows that Warren Peak Road traffic is currently 509 vehicles per day. Highway14 traffic from the Warren Peak Road turnoff to Highway116 is 732 vehicles per day. Between 1995 and 2011 there were 19 crashes on Warren Peak Road (HDR and Stetson Engineering, 2012).

The Vista West Subdivision with an estimated 52 residences use a single driveway access onto Warren Peak Road.

Warren Peak Road is asphalt-paved surfaced for about 6 miles to the top of the mountain and then switches to a gravel surface road.

Common Truck Routes

The route from the intersection of Highway 14 and Highway 116 to Buffalo Creek Road where the proposed Hydromet Plant would be located is common to all alternatives. This portion of the route is described as follows: from the Highway 116 and Highway 14 intersection, the route proceeds south 30 miles to the junction of Highway 116 and Highway 16. The route turns northwest onto Highway 16 and proceeds 1.5 miles to Buffalo Creek Road, and continues 1 mile south on Buffalo Creek Road to the Hydromet Plant. The route from Sundance on Highway 116 is approximately 30 miles with a north and southbound passing lane located about 7 miles south of Sundance.

The State Transportation Improvement Plan (WDOT, 2015) indicates that there are two projects on Highway 116, 0600017 (O'Haver Peak Section) and 0600018 (Cundy Creek Section), scheduled to occur between 2015 and 2020. Project 0600017 was originally planned to be a roadway widening and overlay, but the scope was

revised to an overlay only with safety improvements in climbing lane areas. The safety improvements include constructing flatter side slopes on roadway edges, and/or the addition of guardrail. The scope for Project 0600018 remains a widening and overlay, but may be revised during the design phase depending on funding.

NFS Roads

There are sections of NFS Roads 838.2A, 851, 851.1B, 879.1 and 879.1A that would be within the fenced Mine Area. Public access on these roads would be prohibited within the Mine Area. The reroutes and miles closed to the public would be different under each alternative Mine Area footprint. NFS Road 879.1 (Warren Peak Road) and NFS Roads 854.1 and 847 (Miller Creek Road) are both access route alternatives.

3.4.3 Environmental Consequences

3.4.3.1 Direct and Indirect Effects

Alternative A – No Action Alternative

Under Alternative A- No Action, no additional road construction, development, or use would be required. Traffic patterns would not change.

Effects Common to All Action Alternatives

The Plan of Operations, Appendix C estimates a maximum of 17 truckloads per day in each direction (17 roundtrips). The existing and proposed traffic volumes are shown in **Table 19** (HDR and Stetson Engineering, 2012). Highway14 traffic from the Warren Peak Road turnoff to Highway116 is 732 vehicles per day. There would be a 4 to 6 percent increase in truck traffic on Highway 116 between Highway 14 and Upton from the additional 17 roundtrip truck loads. There would also be supply trucks making deliveries to the mine which would increase truck traffic. The number of deliveries per day is unknown.

Gravel trucks with pup trailers would be used to transport pre-concentrate from the PUG Plant. There are some locations on NFS roads and county roads where roadway geometrics do not provide adequate sight distance or turning radius to allow for this type of vehicle. The maximum road grade for safety was set at 6 percent. Any intersections that require improvements would have an 80-foot radius to allow for navigation of intersections without encroaching on the oncoming roadway lane. The intersection of Warren Peak Road and Highway 14 would need to be reconstructed to accommodate the increased truck traffic. Reconstruction would include widening and acceleration / deceleration lanes. Increased truck traffic, especially long units, can impede passing opportunities and encourage unsafe passing movements.

Table 19.
Existing and Proposed Traffic Volumes

WYDOT Roadway Section Description	2013 Traffic Volumes			Projected Traffic With Mine Haul Trucks		
	All Veh.	Trucks	% Trucks	All Veh.	Trucks	% Trucks
JCT Route 607 (Highway 14)	402	90	22	436	124	28
JCT County Road East to Highway 585	381	80	21	415	114	27
Weston - Crook County Line	380	101	27	414	135	33
Dry Draw	469	94	20	503	128	25
JCT Arch Creek County Road	676	97	14	710	131	18
Upton Corp Limits	645	112	17	679	146	22

Based on the projected level of increased use on the roads shown in **Table 19**, the project would not require any changes to the State Transportation Improvement Program (WDOT, 2015).

The proposed mine is expected to employ up to 70 workers 5 days per week, 20 hours per day (two 10-hour shifts). Transportation to the mine site would be by bus or transport vans. The transport of workers to and from the mine is not included in the projected traffic data because it is expected that only two vans would be necessary. Traffic data for the non-highway access roads is discussed in the individual alternatives. The improved road conditions on access routes may result in an increase in visitor use to the area, or the increased mine traffic may deter and displace visitors, or there may be no change in use.

The criteria used in the road design criteria analysis exceeds some American Association of State Highway and Traffic Officials standards for Rural Roads, such as the 30 foot clear zone, so it provides for a conservative safety design (HDR and Stetson Engineering, 2012). Maintaining safe access for school bus stops along all routes including the state highway is necessary. The primary access route already has adequate turn out widths and sight distance for buses to stop to load and unload students.

Because the access road would be maintained for year round vehicular traffic, in open areas where blowing snow is a concern, a 10-foot-wide flat bottom ditch would be incorporated. In timbered areas, where snow storage is a concern, the roadway section would incorporate 20-foot-wide flat bottom ditches. Providing year-round access would increase the total annual use of the access road and therefore increase annual maintenance expenses. The adequate snow removal areas proposed along the access road would reduce potential impacts to fencing from snow storage.

For safety, NFS roads within the fenced Mine Area would be closed to public use (**Figure 12**). Turnarounds would be installed at the Mine Area fence for open motorized NFS roads. The different configuration of the Mine Area in each alternative varies the amount of NFS roads that are closed.

Access to existing NFS roads that have been cut-off by the Mine Area may use NFS Road 830.1, 838, and 838.2D as connection points to other routes outside the Mine Area fenced boundary. As a result of the land exchange on Tract 42 with the State of Wyoming in 2013, NFS Road 879.1 is no longer open to public motorized use on private property. Public motorized travel is still available around the Mine Area to NFS lands on NFS Roads 830.1, 838, and 841.

Planned dust suppression would maintain driver visibility (see Section **2.6.1**).

The Town of Upton would experience an increase in traffic in town and on highways coming into the community from the construction and operation of the Hydromet Plant.

Effects on access for grazing permittees are stated in Section 3.15.3.

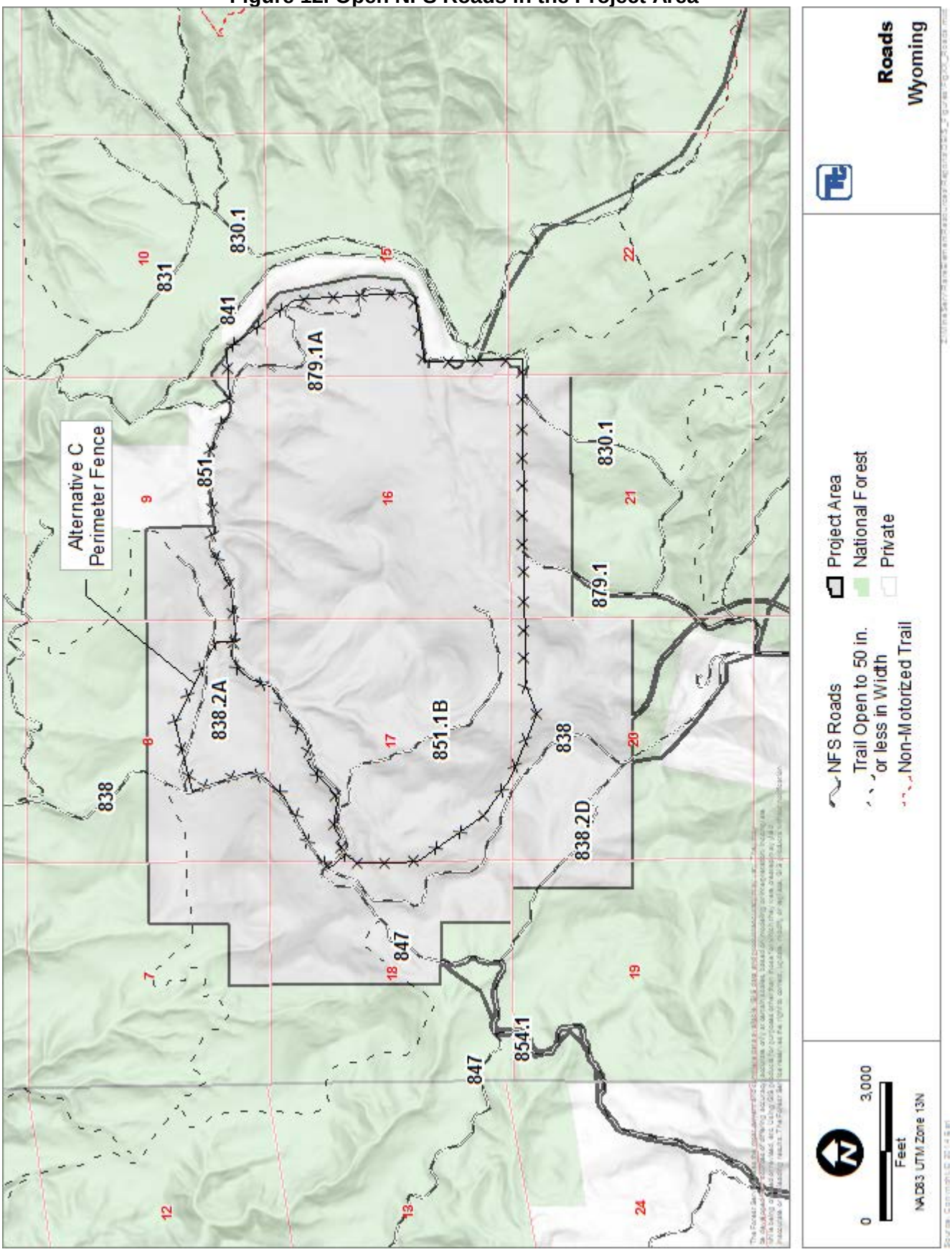
Reclamation to NFS roads that are widen and upgraded for the mining project would be returned to the pre-mining condition. Other road jurisdiction agencies would decide the reclamation of their roads.

Alternative C

Miller Creek Road would be the main access to the Mine Area (County Roads 208, 266, and 8 and NFS Roads 854.1 and 847). The total haul distance from the Mine Area to Upton using the Miller Creek Road access is approximately 40.2 miles. An additional 34 trucks per day (17 round-trips) added to the current estimate of 69 vehicles per day suggests that Miller Creek Road traffic would increase by approximately 49 percent to 103 vehicles per day with the increase being gravel trucks with pup trailers. Highway 14 traffic from the Warren Peak Road turnoff to Highway 116 would increase by approximately 4.6 percent from the current estimate of 732 vehicles per day to 766 vehicles per day.

Sections of Miller Creek Road would require being upgraded to 80 feet width to meet safety criteria for turn radii and sight lines. The Miller Creek Road gravel surface would be resurfaced with road base. Approximately 80 percent of the Miller Creek Road route is at or below the maximum 6 percent grade, with the longest 6 percent segment at approximately 1.3 miles. As a substantial portion of the profile grade is below the maximum 6 percent grade, the potential for accidents, especially during icy conditions, is the lowest of the routes proposed.

Figure 12. Open NFS Roads in the Project Area



Miller Creek route affects the fewest residences and driveway access, with 10 driveways and 5 homes within a quarter-mile of the road.

NFS roads within the Mine Area would be closed to public use. There would be 7.3 miles (5.0 miles on NFS lands) within the Mine Area. These include NFS Road 879.1 with 2.6 miles (0.3 miles on NFS lands), NFS Road 851.1B with 1.3 miles, NFS Road 838.2A with 0.4 miles, NFS Road 879.1A with 0.8 miles and NFS Road 851 with 2.2 miles. There would be turnarounds installed at the fence line for NFS Roads 838.2A and 879.1 that would dead-end as a result of the proposed mine fence. No reroutes are proposed for public motorized use for Alternative C. NFS Roads 830.1, 838, 838.2D, and 841 would be connection routes to access areas outside of the fenced Mine Area. Public access to NFS lands outside of the fenced Mine Area would be maintained in accordance with the Black Hill travel management plan; however the roads and recreational opportunities in the fenced Mine Area would not be accessible for the life of the mine.

Alternative D

Warren Peak Road would be the main access road in Alternative D. The total haul distance from the Mine Area to Upton using the Warren Peak Road access route (Figure 5**)** is approximately 38.8 miles.

With the addition of 34 gravel trucks with pup trailers per day (17 round trip) traffic would increase approximately 6.6 percent from the current traffic estimate of 509 vehicles per day for Warren Peak Road, would increase approximately 6.6 percent to 543 vehicles per day. As in Alternative C, Highway 14 traffic from the Warren Peak Road turnoff to Highway 116 would rise by approximately 4.6 percent from 732 to 766 vehicles per day.

During operations, an estimated 17 trucks per day running 24 hours per day would average less than 1 per hour.

Vertical grades in roadway geometry can affect driver safety. Approximately 70 percent of the Warren Peak Road route is at or near the maximum 6 percent grade. One segment has a 6 percent grade that continues for approximately 4.8 miles. As approximately 70 percent of the road grade is at or near 6 percent, the potential for accidents, especially during icy conditions, is higher than Alternative C.

The Warren Peak Road surface would be changed from asphalt pavement to gravel from Highway 14 to the mine. Some relocation and reconstruction (about 2.8 miles on NFS lands) of the Warren Peak Road would be necessary for safety. Unless needed for future land management, the old road template would be reclaimed where the road is relocated. Steeper sections may need a runaway truck ramp for safety. Segments of the road that retains the old road template would continue to be paved until it deteriorates and then replaced with aggregate. The Warren Peak Road access affects the most residences and their common driveway access with 52 homes (Vista West community).

NFS roads within the Mine Area would be closed to public use. There would be 3.9 miles (1.6 miles on NFS lands) within the fenced Mine Area. These include NFS Roads 879.1 with 2.6 miles (0.3 miles on NFS lands) and 851.1B with 1.3 miles. No reroutes are proposed for public motorized use for Alternative D. A turnaround would be constructed at the fence line for NFS Roads 879.1 as a result of the proposed mine fence. Public access to NFS lands outside of the fenced Mine Area would be maintained in accordance with the Black Hill travel management plan.

Alternative E

The main access route in Alternative E would be NFS Road 879.1 to NFS Road 830.1 and connect to Warren Peak Road (County Road 100 and NFS Road 838). The total haul distance from the Mine Area to Upton is approximately 38.1 miles (HDR and Stetson Engineering, 2012).

Existing and projected traffic data are the same as Alternative D.

Vertical grades would be close to the same as Alternative D. The grade on NFS Road 879.1 portion of the route is similar to the Warren Peak Road, where 70 percent is at or exceeds the maximum 6 percent grade.

One segment has a 6 percent grade that continues for approximately 4.8 miles. Because the grade exceeds safety design standard of 6 percent, the potential for accidents would be increased, particularly in icy conditions. Run-away ramps may be required in steeper sections of the road for safety.

The Warren Peak/ NFS Road 879.1 would follow the existing template more than in Alternative D. The Warren Peak Road surface would be changed from asphalt pavement to gravel from Highway 14 to the mine. Some relocation and reconstruction (about 1.5 miles on NFS lands) of the Warren Peak Road would be necessary for safety. Unless needed for future land management, the old road template would be reclaimed where the road is relocated. Steeper sections may need a runaway truck ramp for safety.

The Warren Peak Road access affects the most residences and their common driveway access with 52 homes (Vista West community).

NFS roads within the Mine Area would be closed to public use. There would be 3.7 miles (1.4 miles on NFS lands) within the Mine Area. These include NFS Road 879.1 with 2.4 miles (0.1 on NFS lands), and NFS Road 851.1B with 1.3 miles. No reroutes are proposed for public motorized use. No turnarounds are needed for Alternative E. Public access to NFS lands outside of the fenced Mine Area would be maintained in accordance with the Black Hill travel management plan.

Alternative F

The main access route in Alternative F would be the same as Alternative E.

NFS roads within the Mine Area would be closed to public use. There would be 5 miles (2.7 miles on NFS lands) within the Mine Area. These would include NFS Road 879.1 with 2.6 miles (0.3 miles on NFS lands), NFS Road 851.1B with 1.3 miles, NFS Road 879.1A with 1 mile and NFS Road 851 with 0.1 mile. No reroutes are proposed for public motorized use. No turnarounds are needed for Alternative F. Public access to NFS lands outside of the fenced Mine Area would be maintained in accordance with the Black Hill travel management plan.

The final reclamation of the Mineable Pit would require the relocation of approximately 0.4 miles of NFS Road 838.

Alternative G

Alternative G would use the Miller Creek Road access route. Impacts on transportation and access would be the same as Alternative C except that the easement would be 66 feet instead of 80 feet. This reduced right of way width will affect adjacent landowners to a lesser degree.

NFS roads in the Mine Area would be closed to public use. There would be 4.9 miles (2.6 on NFS lands) in the Mine Area. These would include NFS Road 879.1 with 2.6 miles (0.3 on NFS lands), NFS Road 851.1B with 1.3 miles and NFS Road 851 with 1.0 mile.

To provide continual motorized access around the mine area, a re-route is considered under Alternative G for NFS Road 851 to extend to NFS Road 838.2A. Upgrades to NFS Road 838.2A would be completed to match the template of NFS Road 851. The old road template for NFS 838.2A beyond the upgraded portion would be gated and closed to motorized use. See the recreation analysis section 3.16 (Alternative G) for a map and more details

Alternative H

Impacts on transportation and access would be the same as Alternative C except that the easement would be 66 feet instead of 80 feet. This reduced ROW width will affect adjacent landowners to a lesser degree.

NFS roads in the Mine Area would be closed to public use. There would be 4.6 miles (2.4 on NFS lands) in the Mine Area. These would include NFS Road 879.1 with 2.4 miles (0.1 on NFS lands), approximately 1.3 miles of NFS Road 851.1B (all on NFS lands) and 1.0 miles of NFS Road 851 on NFS lands. Turn-arounds would be constructed on NFS roads 879.1and 851 as a result of the mine area fence crossing the roads.

3.4.3.2 Cumulative Effects

The analysis area for cumulative effects to access and transportation is the same as the analysis area used for direct and indirect effects (Section 3.4.1). The federal and state highways, local roads and NFS access roads from the Mine Area to the Hydromet Plant were evaluated.

Alternative A – No Action

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects.

Cumulative Effects Common to All Action Alternatives

State highways, local roads, and NFS roads are used in support of timber harvesting and forest treatments, exploration and mineral resource development, and general forest management activities. They are also used by recreationists and to access commercial and private developments, and NFS lands. Segments of federal and state highways, local roads, and NFS access roads between the Mine Area and the Hydromet Plant used in support of project activities may experience cumulative effects such as increases in traffic, in particular truck traffic, and the need for maintenance. Effects would vary by alternative, but would likely include short-term delays and general inconvenience to other users on Highway 116, between Highway 14 and Upton, the Miller Creek Road, Highway 14 and the Warren Peak Road, and on supporting NFS roads. Cumulative effects on safety due to increased use are not anticipated due to proposed road improvements that would minimize the direct and indirect effects on safety.

3.4.3.3 Irretrievable and Irreversible Consequences

Post closure reclamation of the mine area would re-evaluate the NFS roads closed by the proposed activities to determine suitability for public access. Alternatives C, E, F, and H may eliminate NFS Road 851.1B within the mine pit as a result of the pit lake. Public roads within Tract 42 were lost upon completion of the land exchange in May 2013. All other NFS roads within the mine area are expected to be reestablished during reclamation.

3.5 Visual Quality

This section analyzes the impacts on visual quality from various viewpoint.

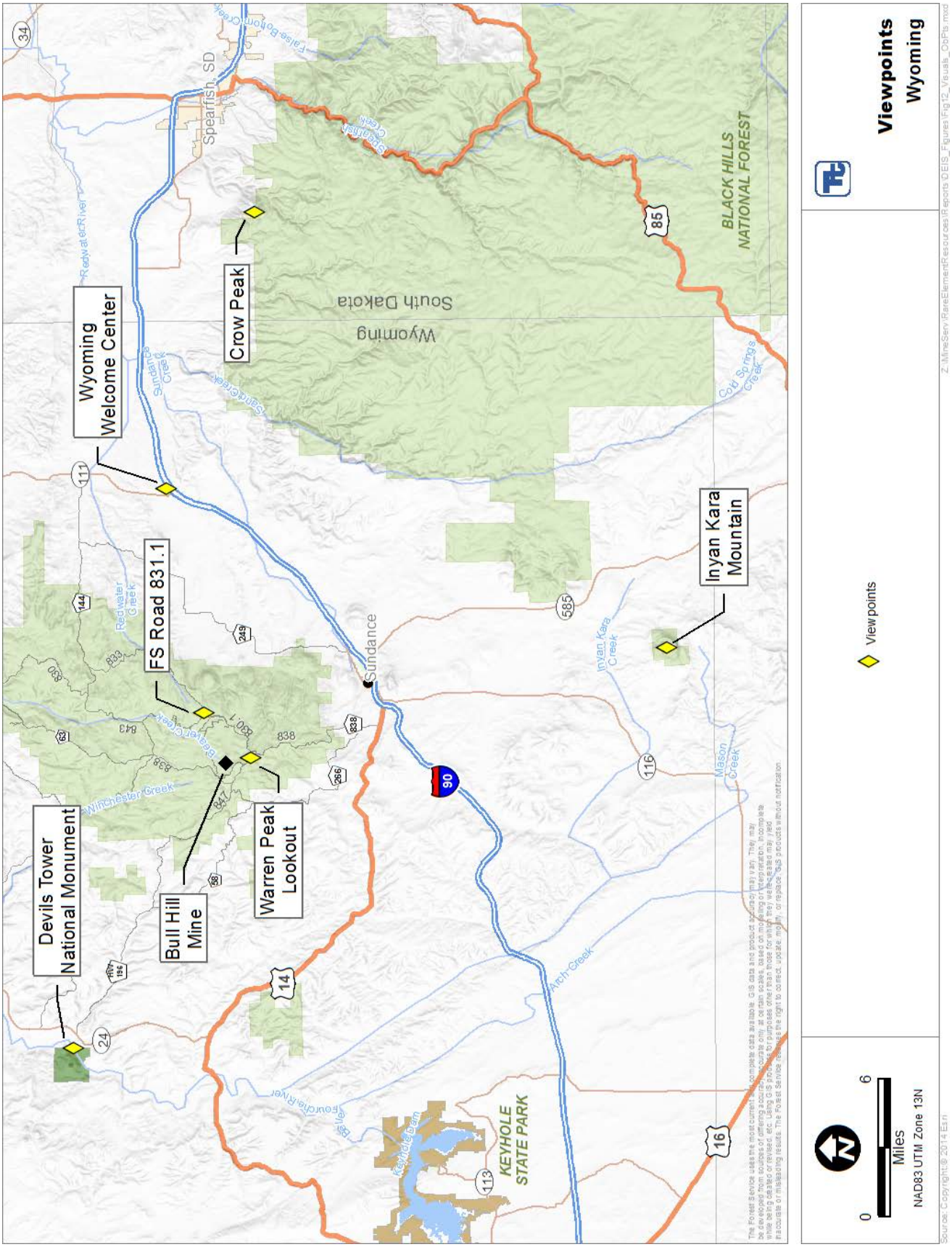
3.5.1 Area of Analysis and Methods

The visuals analysis area is where activities would directly disturb lands (Mine Area, roads, power line, and exploration) and selected sensitive viewpoints outside the area of direct impacts where ground disturbances, lights, dust, or noise may be of concern. Six viewpoints are defined in Section 3.5.2. Viewpoints are shown on **Figure 13**.

Impacts were analyzed using the Scenery Management System, as described in the Forest Service's *Landscape Aesthetics A Handbook for Scenic Management"* (US Forest Service, 1995). Visual analysis viewpoints were selected to evaluate representative views within the foreground, middle ground, and background viewing distances. The representative viewpoints were established in places and travel ways with moderate and high concern levels.

To determine whether the WRF at closure would be visible from the viewpoints, a "seen area" analysis was conducted based on the estimated final or maximum height of the WRF. A GIS analysis was used to interpret what could be seen from the highest elevation of the WRF considering elevation and the topography between the WRF and the viewpoints. The assumption was made that if a viewpoint was visible from the WRF, the WRF would be visible from the viewpoint. Figures generated for the seen area analysis are in the project file.

Figure 13. Viewpoints



3.5.2 Affected Environment

The visuals analysis area includes public use areas, trails, NFS roads, county roads, state highways, and an interstate highway, all of which provide various opportunities for viewing the Project Area. Public use areas include sites that receive concentrated public viewing use. Travel ways include recreational and local roads and recreational trails. Viewers include residents, tourists, and recreational users.

Scenic Integrity Objectives (SIOs) were established in the Forest Plan. The Scenery Management System (US Forest Service, 1995) was used to determine whether the project would meet the SIO on NFS lands.

Scenic Integrity Objectives

Scenic integrity is defined as the naturalness of appearance or the state of disturbance created by human alterations. Scenic integrity is classified in five levels that range from very high to very low which indicates the degrees of deviation from the existing landscape character on NFS lands (US Forest Service, 2006). The visual analysis area has moderate and low SIOs for NFS land in the analysis area because past human alterations have resulted in deviations from the natural landscape. Deviations include several developed sites and structures along ridge lines that can be viewed from surrounding areas.

- Moderate: The landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being altered.
- Low: The landscape character "appears moderately altered." Deviations begin to dominate, but they borrow attributes such as size, shape, effect and pattern of natural opening, vegetative type changes, or architectural styles within or outside the landscape being viewed. They should not only appear outside the landscape being viewed but compatible or complimentary to the character within.
- Very Low: The landscape is "heavily altered." Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.

Scenery Management System

The affected environment is described in terms of viewing distance from the potential impact using distance zones (US Forest Service, 1995):

- Foreground is defined as a distance up to 0.5 mile;
- Middle ground is 0.5 to 4 miles; and
- Background is 4 miles to the horizon.

The descriptions of the view at each distance zone includes the visual contrasts. Foreground, middle ground, and background views can be obscured by the proximity of the landforms and vegetation. Contrast is assessed considering changes in:

- Landscape forms – Analysis area landform features are rolling hills.
- Colors - Intermittent aspen stands make for color contrast from dark green ponderosa pine to light green and are noticeable. Frequent open meadows provide another shade of green (summer) and typically have ponderosa pine encroachment. Colors are greatly affected by season and by variations in lighting, sun angle, dust, air quality, and distance.
- Textures - Textures in the ponderosa pine and aspen stands appear coarse in foreground and middle ground viewing. Meadows appear mostly smooth with occasional rough clumps of shrubs and converge into the denser ponderosa pine stands. Riparian areas appear coarse and clumpy in foreground and become mostly screened by topography as elevation increases.

- Lines - Meandering drainage lines are noticeable. Man-made attributes consist of roads, fences, utility lines, vegetation projects, developed electronic sites and the Warren Peak Fire Tower. Dependent on viewing distance, many are screened by vegetation or topography. A middle ground view likely has a strong line contrast between the sky and the mountainous undulating ridgeline.

Landforms, textures, colors, and lines from all viewpoints are similar to those described above. Exceptions are noted in the individual descriptions.

Warren Peak Fire Tower

This developed site, at 6,658 feet elevation, is located directly south of the Project Area. Forest users frequently visit from May thru October. It is situated on the top, east side, of what is referred to as the Warren Peaks, a series of high points for the Bear Lodge Mountains. The view is unobstructed and expansive in all directions. The Mine Area would be viewed in the middle ground to the north, looking down from an approximately 300 feet elevation (**Photo 2**). Other area high points visible from Warren Peak have developed structures with towers.

Photo 2. View of Bull Hill from Warren Peak Fire Tower

NFS Road 831.1

This viewpoint, at 5,820 feet elevation, was selected as being typical of forest access roads and trails where the Mine Area would be within the middle ground distance zone. The road is located approximately 0.5 miles directly east of the Mine Area at the junction of NFS Roads 831.1 and 831.1A. Viewing is intermittent along the road with openings between timber stands. The viewing from this perspective is at a slightly lower elevation than the Project Area by approximately 100 feet. A 0.75-mile section of this road allows for off road dispersed campsites used primarily during hunting seasons. Peripheral viewing is limited by dense forest.

Devils Tower National Monument

Visitation to the monument is especially high during the summer tourist season. The views are generally panoramic, expansive, and rural, bounded only by the various distant mountain ridges to the east, foothills to the west and south, and prairie to the north. The Mine Area would be in the background, nearly 13 miles southeast of the Devils Tower National Monument. The featured attribute of the monument is Devils Tower, where the top elevation is 5,112 feet elevation. The Bear Lodge Mountains are visible in the background from the Tower summit, which is visited by thousands of climbers each year, and from several locations along the hiking trails within the monument.

The forested Bear Lodge ridgelines define the background view from Devils Tower. From this perspective, Project Area landscape appears as rolling mountaintops and background sky (**Photo 3**). From this point of view, and looking toward the Project Area, the foreground is composed of a series of long, smooth meadows into irregular low hills that block most of the middle ground from view. Grasses and a scattering of dark green trees are visible in the foreground. Highway 24 and county roads recede from the foreground into the middle ground. Visible middle ground views are a continuation of the foreground landscape features. Background views are composed of the middle to upper slopes of the Bear Lodge Mountains. It is an indistinct view of the range because of the long viewing distance but with the larger features such as dense forest and the ridgeline are distinctly visible.

Photo 3. Highway 24 Pullout at Devils Tower National Monument

The foreground-middle ground view is of undulating, rugged, sharp irregular drainages that rise to sparsely-vegetated rolling foothills. Rising from foothills, middle to background views are a moderate transitional uplift with sparse vegetation transitioning to mountainous dark green forest with rounded ridgelines against the background sky.

Inyan Kara Mountain

The top of the Inyan Kara Mountain is at 6,345 feet elevation. The mountain is surrounded by prairie badlands on an isolated portion of the Black Hills National Forest surrounded by private land ownership and public visitation is limited. The Project Area is approximately 19 miles north and slightly west, so the view of the Mine Area would be in the background. This distance is considered seldom-seen viewing. The background and seldom-seen zone viewing is unobstructed toward the Project Area and is pronounced by the Bear Lodge mountaintops and ridgelines against the horizon. Background colors are predominantly dark green, forested slopes against blue sky.

Wyoming Welcome Center

The Wyoming Welcome Center is at 4,085 feet elevation and is approximately 10 miles northeast of Sundance, adjacent to U.S. Interstate 90. The Mine Area is approximately 11 miles directly west and slightly south. The center is a pullover for travelers on U.S. Interstate 90 and visitation is considered high during the tourist season. Between the center and the Mine Area, the foreground-middle ground view is of undulating, rugged, sharp irregular drainages that rise to sparsely vegetated, rolling foothills (**Photo 4**).

Photo 4. View from Wyoming Welcome Center

The background views are a moderate transitional uplift with sparse vegetation transitioning to mountainous, dark green forest with rounded ridgelines against the background sky.

Crow Peak

Crow Peak is a prominent skyline summit of 5,768 feet elevation and approximately 22 miles east of the Mine Area, so the view of the Mine Area would be in the background. This distance is considered seldom-seen viewing. Hiking trail access is considered one of the most popular destination hikes for panoramic viewing of the surrounding landscapes in the northern Black Hills. Background views of the Mine Area to the west are distant mountain ridges defined by the upper slopes of the Bear Lodge Mountains. From this perspective the landscape details are indistinct because of viewing distance but dark green vegetation and ridgelines are visible against the sky.

Night Sky Conditions

Night sky conditions in the Bear Lodge Mountains are minimally affected by artificial lights from headlights on vehicles traveling along NFS roads and lighting associated with structures along Warren Peak. Distant sky

glow is caused by lighting from Rapid City and Spearfish, SD to the east, and Sundance and Newcastle, WY to the south and Gillette, WY to the west. Isolated parcels of private land could add artificial light.

3.5.3 Environmental Consequences

3.5.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A - No Action, the analysis area and surrounding landscapes would remain as they presently exist, including changes in color and line from previously completed exploration. The associated reclamation would continue, which would include recontouring roads that would not be used again and revegetation of all pads and roads. Reclamation would reduce contrast caused by changes in color and line as more natural looking vegetation returns in one to two years. There would be no long term change in the landform, color, texture, or line or effects on the scenic integrity from Alternative A. There would be no effects on dark skies.

Effects Common to All Action Alternatives

Atmospheric effects (e.g., haze, fog, dust, smoke) and the viewing distance, the angle of view, lighting conditions, and time of day affect the line, form, color, and texture during construction, operations, and reclamation.

Exploration

Exploration is the same under all action alternatives. Small leveled pads would create a color contrast when vegetation is removed for drill pads or access roads, which would also create lines. Depending on the viewing location, these contrasts from color and lines may be visible in the foreground, middle ground, or background. Human activities and equipment would affect visuals as they operate for up to three months in one location. As drilling locations would be reclaimed once the drilling is completed, the color and line contrasts would be diminished in two years because of recontouring and revegetation. **Photo 5** compares before and after photos of drilling and reclamation.

From Warren Peak and NFS Road 831, exploration activities may be

Photo 5. Before and After Aerial Photos of Bull Hill Drilling and Reclamation

Exploration drilling in progress 2011

Post drilling reclamation. Photo from 2014

Source: http://www.arcgis.com/home/webmap/viewer.html?webmap=3a59ea0b5ff7486bae9130d6f4684016

partially obscured by topography and vegetation screening. Adverse visual impacts would result from the construction of roads, drill pads, and trenches removing vegetation, topsoil, exposure of subsurface material and fugitive dust. Visual impacts would be temporary until exploration roads, drill pads, and trenches are reclaimed and revegetated.

Due to the distance, exploration activities would not affect the visual quality from Devils Tower Monument, Inyan Kara Mountain, the Wyoming Welcome Center, or Crow Peak.

Construction and Operations

The impacts from construction and operations are discussed together because they are largely the same.

The impacts on each viewpoint from each mine component and phase depends on which areas would be seen, from where, and for how long. The Mineable Pit and the WRF are the two components that would attract the most attention and be the most noticeable due to contrast created in landform, color, texture, and line under any alternative. The degree of visibility of the WRF changes between alternatives; however, the geometric appearance of the WRF even after reclamation would be visible, to some degree, depending on the alternative. Construction of roads would have similar effects on line and color. These changes would occur at all distance zones and include:

- Removal of vegetation and topsoil would expose subsurface materials changing the land form, color, and texture. This would occur at all mine components including exploration;
- Dust from blasting and use of roads would be effectively controlled for air quality but may still be visible occasionally, affecting color;
- There would be changes in color from the introduction of building materials and equipment for the PUG Plant and heavy equipment used for mining and ore hauling operations; and
- The fence around the Mine Area in all action alternatives and new power lines (except in Alternative E) would change the visual contrast by reducing vegetation and repeating unnatural symmetry with the fence, lines, and poles. Beyond foreground and middle ground viewing, power lines can be quite evident when the ground is snow covered and the cleared opening in the vegetation appears as a line across the landscape – this is particularly true when the power line and the viewer's position are in alignment.

Operations at night in the Mineable Pit and the WRF may be visible from any of the viewpoints when cloud cover reflects lights or on clear nights when lighting is not screened by haze, vegetation, or topography. Depending on the amount of night-time lighting, astronomical features may be harder to see. To reduce impacts on night sky viewing, design features identify 80 percent downward illumination for operations lights and turning off lights at the end of the day. Securing lighting on buildings and parking areas would not affect astronomical viewing from distance locations.

Warren Peak Fire Tower

Changes in middle ground would be dominant from the Warren Peak Fire Tower and many forest roads, trails and dispersed areas. The foreground and middle ground would be affected by all of the Mine Area activities and facilities.

From elevated location of the fire tower, visitors would be able to see into the interior of the Mineable Pit, with its strong color, line, texture contrasts, and activity compared to the surrounding landscape.

The WRF and haul road would be visible in the middle ground, with a strong color and textural contrast of the open mining roads and exposed earth of the WRF. As the WRF becomes higher, the trapezoidal form of the WRF would become more dominant in the landscape.

The PUG Plant would be visible in the middle ground. The large block forms of the buildings in the open areas (cleared of vegetation) would dominate the view.

In the foreground and middle ground, the scenic integrity would be very low during operations. Activities would not occur in the background from this viewpoint, so there would be no effect on that distance zone.

At night, lighting from mining operations, PUG Plant, WRF, and headlights would change the nighttime landscape character by increasing sky glow. Night sky observation would be adverse in the foreground and middle ground.

NFS Road 831

Traveling views of the Mine Area would be in the foreground and middle ground intermittently due to screening from roadside vegetation and topography.

The proposed mine pit and PUG Plant would be mostly obscured by the WRF and topography and would not increase strong contrasts with the surrounding landscape from this viewpoint.

As the WRF is constructed, it would likely be clearly visible and abrupt in the foreground and middle ground when not obscured by vegetation. Foreground viewing of the WRF would be dominant and intermittent but highly visible to passing motorists. These structures would create strong contrast related to line, form, color, and texture that would attract viewer attention and would likely dominate the view. Background views of the Bear Lodge Mountains, as seen from this location, would be interrupted by the closer WRF.

Most of the power line and disturbance for haul road would be screened from view by foreground topography. Indirect visual impacts would occur from fugitive dust created by vehicles, blasting, and general mining operations.

At night, lighting from mining operations, PUG Plant, WRF, and headlights would change the nighttime landscape character by increasing sky glow. Night sky observation would be adverse in the foreground and middle ground.

Devils Tower National Monument

Impacts from exploration activities and the power line corridor would be obscured because of the viewing distance and screening from topography and vegetation. Access to the top of the tower is limited by regulation, season, and physical ability of people to climb the tower. Camping on the tower is prohibited.

Because of topographic screening and viewing distance to the Mine Area, the landscape contrasts and visible mine components would be very similar for all of the action alternatives as seen from this viewpoint. The PUG Plant and Mineable Pit would not be visible from the monument. Although rarely, night time lighting would be seen from the monument when there is no other light interference or cloud cover. Considering that public access is limited and camping is prohibited on the tower itself, few viewers would notice the lights.

The WRF would be visible in the background viewing and impacts would be permanent for all action alternatives except Alternative G. The uniformly graded level would create linear and color contrasts with the upper slopes of the Bear Lodge Mountains and surrounding darker vegetation until reclamation is complete.

Other mine components, dust, and noise would not be perceivable because of the viewing distance.

Inyan Kara Mountain

Impacts from exploration activities and power line corridor would be obscured because of the viewing distance and screening from topography and vegetation.

The Mine Area would lie within the far background landscape of dark smooth ridgelines. The PUG Plant and Mineable Pit would not be visible because they would be hidden behind background vegetation and topography. Rarely, night time lighting would be visible when there are is no other light interference or cloud cover. Considering that public access is limited and visitor use low, few viewers would notice the lights.

Moderate line and form contrasts would be created by the height of the WRF. The color of the exposed rock would create moderate linear contrasts with the surrounding rolling ridgelines and with the vegetation colors

along the upper slopes of the Bear Lodge Mountains. The existing scenic quality from this perspective would be modified until revegetation on the WRF at reclamation and weathering would reduce the contrasts to blend in with the surrounding upper slopes of the Bear Lodge Mountains.

Wyoming Welcome Center

Impacts from exploration activities, road and power line corridors would not be visible because of the viewing distance and screening from topography and vegetation.

Due to topography, the Mine Area would not be visible except for the uppermost levels of the WRF.

Construction of the WRF in the later stages would cause long term color, line and form contrasts visible from the center in the background. The WRF would be the most evident in the morning and afternoon light. Once the WRF is backlighted by the sun, color contrasts should diminish, and the form of the WRF would be more evident. The uniformly colored WRF would create moderate linear and form contrasts with the surrounding, uneven smooth ridgelines and with the vegetation colors along the eastern slopes of the Bear Lodge Mountains. Seasonal changes may increase or decrease visibility dependent on waste rock color. There are few intervening landscape features to obscure the view. The WRF facility would be evident for the rest of time unless the material is reduced in height (i.e. – used to back-fill the pit).

Westbound motorists on U.S. Interstate 90 may notice the WRF but it would not likely dominate the view at this distance. It would be most noticeable in the morning light, when the sun is at the motorists' back. There would be no viewing time for eastbound motorists because they would be traveling away from the Project Area. Occasionally, night time lighting from the Mineable Pit or the WRF would be seen when there are is no other light interference or cloud cover.

Crow Peak

The Mine Area or dust would not be visible because topography and vegetation would obscure the view. Occasionally, night time lighting would be visible but likely would not attract attention. Noise would not travel the 22 miles to the viewpoint.

The uppermost levels of the WRF would be visible in the background. Exposed rock would create a linear color contrast. The impacts would be long term, until rock weathering and vegetation reduce the color contrasts.

Reclamation/Closure

At reclamation, the Mineable Pit, facilities, roads, power line, and WRF would weather and vegetation would reduce line and color contrasts.

Over decades, the color impacts of WRF would gradually diminish because of rock weathering and vegetation establishment, including trees (except Alternative G). However, the underlying geometric shape of the WRF would remain even after reclamation.

Concurrent reclamation and revegetation (where possible – the WRF, some areas of the Mineable Pit in all alternatives except Alternative G, some internal access roads as the mine develops) would partially reduce the length of time visual impacts occur.

Erosion and slope failures may cause line and color contrasts long after reclamation, however, these would be minimal and would be repaired and revegetated quickly as part of the Environmental Protection Measures (see Appendix A).

Alternative C

Construction, Operations, and Reclamation

Warren Peak Fire Tower

Most of the power line and disturbance for haul road access would be screened from view by topography.

The diversion channel for Beaver Creek would create a change in landform and color in the middle ground. This would not occur under any other alternative. The diversion channel would be shielded by vegetation and topography. The diversion channel would not be reclaimed as it would be needed in perpetuity. Over time, natural forces would cause the contrast to soften and blend in with the surroundings. The WRF and Beaver Creek diversion channel would be located on private lands, so the Forest Plan scenic integrity objectives do not apply.

At reclamation, the visual impact from the Mineable Pit would be permanent as reclamation of pit walls would be as constructed. The more striking lines within the pit from the bench construction would be softened but not eliminated and would not appear natural. Soil would be placed and revegetation planted which would reduce the color contrast but again, would not eliminate it. The formation of a pit lake up to 100 years after dewatering is stopped would create a land form, line, color, and texture contrast in the middleground. Over time, as natural forces change the color of the exposed pit walls and erosion further reduces the line and landform contrast, the lake may become a more natural appearing feature.

NFS Road 831

The impacts from the WRF would last beyond reclamation. These structures would create strong surface disturbance related line, form, color, and texture contrasts that would attract viewer attention and dominate the view. Contrast may decrease over time as vegetation (including trees) obscures portions of the view and softens the line and color.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, and Crow Peak

Operational nighttime lighting at the WRF may be visible as the WRF elevation increases in the second half of the mine life at a distance of 13 miles.

Once reclamation is complete, the WRF would be recontoured to blend with surrounding topography and vegetated, which would reduce the contrast, however it would likely be visible in the background permanently.

Alternative D

Warren Peak Fire Tower and NFS Road 831

In the long term, reclamation of the Mineable Pit would, at first create additional contrast in color and line as approximately 41 percent more area would have vegetation removed and soil and rock exposed while the pit slopes are reduced to a maximum 3:1 slope. After backfilling, grading, and revegetation, the contrast in color and line would diminish. At reclamation, in the long term, the WRF while remaining geometric in shape, would eventually have less color and texture contrast as the slopes become revegetated. The visual impact of the large mountain-sized form would be permanent.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, and Crow Peak

As in Alternative C, development of the WRF would become visible from each of these viewpoints as the height increases during operations. At reclamation, the WRF would be visible from these viewpoints. The backfilling would remove less than one percent of the total WRF volume, therefore visual effects would be similar to Alternative C. The WRF reclamation would recontour lifts on the WRF and establish more natural

appearing landform patterns. The recontouring, along with the eventual revegetation, including the establishment of trees, in 100 years or more, would further soften the form and texture of the WRF, moving slowly toward a natural appearing landscape.

Nighttime lighting of the WRF may be visible as the WRF elevation increases in the second half of the mine life at a distance of 13 to 26 miles.

Alternative E

Warren Peak Fire Tower and NFS Road 831

Effects would be the same as for Alternative D, except that pit reclamation would increase the area with vegetation removal by 45 percent and a shallow pit lake may form, the final size is unknown. The pit reclamation and WRF visual impacts would be similar to those described in Alternative D, except the formation of a pit lake up to 100 years after dewatering is stopped would create a land form, line, color, and texture contrast in the middleground.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, Crow Peak

Visual effects during operations and at reclamation would be similar to Alternative D.

Alternative F

Warren Peak Fire Tower and NFS Road 831

Reclamation would disturb 39 acres (17%) more than Alternative C. A pit lake would form. The pit lake impacts would be similar to those described in Alternative C.

At reclamation, the WRF would be different from Alternatives C, D, E, G, and H, with more natural contouring. However, even with Alternative F, there would be a change from a forested environment to a grassland with the establishment of a natural appearing forest taking as much as 50 years after closure and reclamation.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, and Crow Peak

As the WRF is used for storage, activities and rock may be visible. Nighttime lighting of the WRF operations would be visible at night as the waste rock is hauled back to the pit, for possibly another 20 years of reclamation. When reclamation is complete, the WRF, while not generally visible, it may be visible from the top of the Devils Tower National Monument. The reclaimed WRF would be in the background and once vegetation, including trees become established would appear less geometric in shape.

Alternative G

Warren Peak Fire Tower and NFS Road 831

The total area affected by the Mineable Pit during reclamation would be the same as Alternative C. Once reclamation is complete, the Mineable Pit would be eliminated. The view of the pit would essentially disappear as a meadow is formed. Trees would never be allowed to become reestablished on the site.

At reclamation, in the long term, the size and visual impacts from the WRF would be reduced from Alternatives C, D, E, F, and H because as much as 70 percent of the WRF would be moved back to the pit. Once reclaimed, the WRF would be less dominant in the foreground and middle-ground views. There would continue to be long lasting visual effects, as not all the waste rock would go back into the pit, and there would continue to be a large open area as the WRF and the Mineable Pit would have an impermeable cap which would never be allowed to grow trees or shrubs. If the WRF is lighted for nighttime operations during backfilling, the period of night sky impacts from the WRF and from lights on vehicles would extend as long as 32 years more than Alternative C.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, and Crow Peak

As the WRF is used for storage, activities and rock may be visible from the Devils Tower. However, at reclamation, the WRF would not be visible because the size would be greatly reduced from Alternatives C, D, E, and F because much of the WRF would be moved back to the pit.

Alternative H

Warren Peak Fire Tower and NFS Road 831

The total area affected by the Mineable Pit during reclamation would be the same as Alternative F.

At reclamation, the size and visual impacts from the WRF would be the same as discussed under Alternative D.

Devils Tower National Monument, Inyan Kara Mountain, Wyoming Welcome Center, and Crow Peak

At reclamation, the size and visual impacts from the WRF would be the same as discussed under Alternative D.

Cumulative Effects

The analysis area for cumulative effects to aesthetics and visual resources includes the same six viewpoints analyzed under direct and indirect effects and considers past, present, and reasonably foreseeable future projects within a 5-mile buffer of the project area.

Alternative A – No Action

No activities would occur under the Bear Lodge project that would create direct and indirect effects, therefore, the Bear Lodge Project would not have cumulative effects. Past and present development activities would continue to have impacts on the natural appearance.

Cumulative Effects Common to All Action Alternatives

Past and present development activities which continue to have impacts on the natural appearance of the landscape include road construction, timber harvesting, forest treatments, vegetation treatments, and exploration and mineral resources development. These same activities may also occur in the future. Effects include altered landscape forms, colors, textures, and lines. The effects from activities that change the contours of the land, including road construction and mining exploration, where no re-contouring occurred, are generally evident 100 years later.

Effects vary depending on the viewpoint and the viewing distance. Effects also vary depending on time since disturbance, as activities that include reclamation following disturbance would revegetate or would be restored over time, but visual effects would persist with changes in form, color, texture, and lines until vegetation blends with the surrounding conditions. The degree to which the viewshed may be altered would vary by alternative, but the overall cumulative effect of changes in landscape forms, colors, textures, and lines would be common to all action alternatives and dominate the landscape for likely over 100 years.

3.5.3.2 Irretrievable and Irreversible Consequences

Visual impacts discussed above that would be considered irreversible and irretrievable include:

- Mineable Pit and WRF and their reclamation in all action alternatives.

3.6 Air and Climate

This section evaluates the impacts on air quality and greenhouse gas emissions. Public comments included the concern that radioactive dust may be generated which would have adverse impacts on humans and wildlife. This issue is addressed in Public Health, Section 3.18.3.

3.6.1 Area of Analysis and Methods

The air quality analysis consists of two separate analyses. The American Meteorological Society and EPA Regulatory AERMOD Version 13350 air dispersion model was used to estimate near-field (within 30 miles) ambient air quality impacts and the EPA-approved CALPUFF (Version 5.8.4 – Level 130731) model was used to estimate far-field (out to a distance of 124 miles) impacts on Air Quality Related Values (AQRVs).

Near-field (AERMOD) ambient air quality impacts were assessed for emissions of criteria pollutants including particulate matter less than ten microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), and sulfur dioxide (SO_2) and oxides of nitrogen (NO_x). Impacts for the criteria pollutants were compared to the National and Wyoming Ambient Air Quality Standards (NAAQS and WAAQS), which are the same. Impacts of formaldehyde were modeled, and because there are no NAAQS for formaldehyde, they were compared to EPA's Reference Exposure Level and the Occupational Safety and Health Administration's Permissible Exposure Level (29 CFR1910).

CALPUFF was used to model PM_{10}, $PM_{2.5}$, SO_2, and NO_x emissions. However, CALPUFF was enabled to account for the potential formation of sulfate (SO_4), NO_x, ammonium nitrate (NH_4NO_3), nitrate (NO_3), elemental carbon, and secondary organic aerosols. The assessment of impacts on AQRVs included an evaluation of Prevention of Significant Deterioration increment consumption at Class I and sensitive Class II areas for criteria pollutants and an assessment of impacts on visibility and acidification of sensitive lakes. The Bear Lodge Project is defined as a minor source[7] and is not subject to Prevention of Significant Deterioration permitting requirements. However, a comparison to Prevention of Significant Deterioration increments and an assessment of impacts on AQRVs was performed to provide a comparison with known benchmarks, in addition to the NAAQS.

Although ozone is also a criteria pollutant, it was not modelled. Ozone modeling is typically performed in conjunction with regional scale long range planning and development for multiple sources. A single minor source, such as the Bear Lodge Project, would not be expected to impact the type of large scale regional modeling employed for ozone predictions.

Greenhouse gas (GHG) emissions were estimated based on equipment used and operations.

3.6.2 Affected Environment

The Mine Area and surrounding area lie within a Class II airshed under the Clean Air Act. The nearest Class I area is Wind Cave National Park, approximately 80 miles southeast of the Mine Area. Under the Clean Air Act, a Class I area is one where ambient air quality is more stringently protected than under the NAAQS. Class I areas have limitations on visibility degradation.

The sensitive Class II areas include Devils Tower National Monument, Jewel Cave National Monument, Black Elk Wilderness Area, and Mount Rushmore National Memorial (BLM, 2014).

Crook and Weston Counties are classified by the EPA as being in attainment for all criteria pollutants, including ozone (WDEQ, 2015a).

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[7] A minor source is defined as a source who's criteria pollutant emissions are less than 250 tons per year and who's HAPs are less than 10 tons per year for any one hazardous air pollutant (HAP) or 25 tons per year for any combination of HAPs.

Table 20 shows the background concentrations provided by WDEQ for PM_{10}, $PM_{2.5}$, CO, SO_2, and NO_2 at the WDEQ Permit boundary. The background levels are assumed to be representative of background levels at the proposed mine site, as site-specific ambient data was not collected at the Mine Area.

Table 20.
Assumed Background Concentrations for PM_{10}, $PM_{2.5}$, CO, SO_2, and NO_2

Pollutant	Averaging Interval and Statistic	Background (µg/m³)	NAAQS Limit (µg/m³)
PM_{10}	Annual Average	15	--
	4th High 24-Hr Maximum	40	150
$PM_{2.5}$	Annual Average	3.4	12
	24-Hr High	8	35
NO_2	Annual Average	6	100
	98th Percentile of daily 1-Hr Highs	21	187
SO_2	Annual Average	1.3	--
	24-Hr	16.3	--
	3-Hr	124.7	1300
	99th Percentile of daily 1-Hr Highs	43.2	200
CO	8-Hr High	378	10000
	1-Hr High	680	40000

Source: (IML Air Science, 2014)

The principal standards for evaluation and comparison of air quality are the NAAQS/WAAQS (**Table 21)**. These NAAQS/WAAQS are established to protect the public health and welfare and have been set for varying averaging periods based on the pollutant.

Table 21.
NAAQS/WAAQS Standards

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
CO [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 µg/m³ (1)	Not to be exceeded
NO_2 [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	PM2.5	primary	Annual	12 µg/m³	annual mean, averaged over 3 years
		secondary	Annual	15 µg/m³	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m³	98th percentile, averaged over 3 years

Table 21. NAAQS/WAAQS Standards					
Pollutant [final rule cite]		**Primary/ Secondary**	**Averaging Time**	**Level**	**Form**
	PM10	primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2 [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: http://www.epa.gov/air/criteria.html

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971.

3.6.3 Environmental Consequences

3.6.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, if the mine is not constructed, the air quality in the area would only be affected by new emissions sources.

Effects Common to All Action Alternatives

Exploration

Exploration activities would create emissions from diesel motors and fugitive dust; however, emissions would be much lower than during construction and operations. Exploration was included in the modeling for the maximum emission years, discussed below.

Construction and Operations

Construction and operation would cause particulate and combustion emissions from constructing the facility, material handling, and fugitive dust from travel on unpaved roads.

The NAAQS/WAAQS or Prevention of Significant Deterioration increments is based on the annual, 24-hour emissions, therefore, the duration of the project, including reclamation alternatives, is not the determining factor when assessing potential maximum impacts. An emissions inventory and modeling of air quality impacts was prepared in the *Ambient Air Quality Modeling Protocol and Results Bear Lodge Project – Bull Hill Mine*, prepared by IML Air Science (IML, Air Science, 2015a). The emissions inventory was prepared for the Plan of Operations for the year with anticipated maximum emissions (which occurs during project years 20 to 25). The IML report addresses impacts as proposed in the Plan of Operations development.

The input to the dispersion models is in grams per second, derived from the annual emissions in tons per year. The models do not consider the number of years of emissions because the maximum averaging period of concern is one year for comparison to the annual standards.

Fugitive emissions include criteria pollutants (PM_{10}, $PM_{2.5}$, CO, SO_2, and NO_2), volatile organic compounds (VOCs), HAPs, and GHGs were estimated. The emission estimates for the criteria pollutants were then used to model the impacts on air quality (IML, Air Science, 2015a). The majority of the HAPs consist of formaldehyde emissions resulting from diesel engine exhaust. Emissions and impacts for the diesel generators were not assessed, as they would not be operating when the maximum emissions for the entire facility are anticipated to occur in year 20. This excludes Alternative E, where the generators would be operating for the entire mine life.

Table 22 provides a summary of the fugitive emissions for the maximum yearly equipment activity and **Table 23** summarizes the potential combustion emissions (engine and heater) associated with the maximum vehicle activity.

Table 22.
Maximum Potential Fugitive Emissions (tons/year) From Equipment Activity

Activity	Square Feet	PM_{10} tons/year	$PM_{2.5}$ tons/year
Blasting	17,000	2.10	0.12
Wind Erosion on Disturbed Areas	38,821,108	101.60	15.24
Equipment Item	Quantity	PM_{10} tons/year	$PM_{2.5}$ tons/year
Front Shovel	2	26.24	3.94
Front End Loader - Large	1	9.69	1.45
Front End Loader - Small	1	4.85	0.73
Haul Truck	13	202.37	20.24
Rotary Drill	2	1.04	0.16
Track Dozer	3	0.18	0.03
Motor Grader	3	10.96	1.10
Water Truck	2	11.63	1.16
Backhoe	1	1.22	0.18
Track Drill/Compressor	1	0.52	0.08
Fuel and Lube Truck	1	4.52	0.45
Mechanic Service Truck	2	6.62	0.66
Flatbed Truck	2	2.20	0.22
Worker Transport Bus	2	2.05	0.21
Pickup Truck	5	10.25	1.02
Pre-concentrate Transport Truck	2	5.20	0.52
Commercial Delivery Truck	1	0.78	0.08
Total Fugitive Dust Emissions (Tons/Year)		**404.02**	**47.58**

Source: (IML, Air Science, 2015a)

Table 23.
Potential Engine and Heater Emissions (tons/year) from the Maximum Vehicle Activity

Total Tons/Year by Equipment Item	Total Hydro-Carbons	NO_x	CO	SO_2	CO_2	PM_{10}	$PM_{2.5}$	VOC	HAP
Front Shovel	6.93	18.24	15.81	4.00	3,174	0.91	0.88	6.82	0.24
Front End Loader - Large	0.82	2.15	1.86	0.47	374	0.11	0.10	0.80	0.03
Front End Loader - Small	0.44	1.17	1.01	0.26	203	0.06	0.06	0.44	0.02
Haul Truck	26.76	70.44	61.05	15.47	12,259	3.52	3.42	26.33	0.92
Rotary Drill	4.07	10.70	9.28	2.35	1,863	0.54	0.52	4.00	0.14
Track Dozer	1.91	5.03	4.36	1.10	875	0.25	0.24	1.88	0.07
Motor Grader	1.56	4.11	3.56	0.90	715	0.21	0.20	1.54	0.05
Water Truck	2.05	5.40	4.68	1.19	940	0.27	0.26	2.02	0.07
Backhoe	0.43	1.12	0.97	0.35	195	0.06	0.05	0.42	0.01
Track Drill/Compressor	0.90	2.38	2.06	0.74	414	0.12	0.12	0.89	0.03
Portable Light Plant	0.12	1.45	0.31	0.10	54	0.10	0.10	0.12	0.00
Submersible Pump	0.75	9.30	2.00	0.62	345	0.66	0.64	0.74	0.03
Fuel and Lube Truck	0.50	1.32	1.15	0.29	230	0.07	0.06	0.49	0.02
Mechanic Service Truck	0.63	1.65	1.43	0.36	288	0.08	0.08	0.62	0.02
Flatbed Truck	0.39	1.02	0.89	0.22	178	0.05	0.05	0.38	0.01
Worker Transport Bus	0.70	1.85	1.60	0.41	322	0.09	0.09	0.69	0.02
Pickup Truck	16.20	0.36	4.95	0.44	810	0.54	0.52	16.20	0.36
Pre-concentrate Transport Truck	0.29	0.42	32.43	1.38	1,093	0.02	0.02	0.29	0.08
Commercial Delivery Truck	0.05	0.08	5.97	0.25	201	0.00	0.00	0.05	0.02
Emergency Generator	0.10	0.25	0.22	0.01	44	0.01	0.01	0.10	0.00
Firewater Pump	0.01	0.15	0.03	0.01	6	0.01	0.01	0.01	0.00
Plant Heater	0.01	0.16	0.09	0.00	156	0.01	0.01	0.01	0.00
Shop Heater	0.03	0.37	0.22	0.00	359	0.02	0.02	0.02	0.00
Office Heater	0.01	0.19	0.11	0.00	180	0.01	0.01	0.01	0.00
MINE TOTALS (tons per year)	**65.66**	**139.32**	**156.05**	**30.92**	**25,277**	**7.72**	**7.49**	**64.87**	**2.14**

Source: (IML, Air Science, 2015a)

Mobile source emissions (vehicles) were included when evaluating impacts on local and regional air quality values (IML Air Science, 2014). These emissions include both the tailpipe (combustion) and fugitive dust. The mobile sources are heavy mining equipment, equipment used to move ore and waste rock, delivery trucks, and buses. Impacts on local and regional air quality values are the nearfield (AERMOD modeling) and far field (CALPUFF) modeling. Results are summarized in **Table 24** and **Table 25**.

The combustion from the use of a 2,000-kW diesel generator to generate power during the first two years would increase NO_x, CO, CO_2 and formaldehyde emissions. However, with the exception of CO and CO_2, of the other pollutants, the haul truck emissions exceed the emissions that would be generated in year one or two, including combustion emissions, vehicle exhaust, and indirect greenhouse gas emissions (e.g. emissions from the power plant(s) that provide line power) and predicted GHG emissions.

Table 24. Summary of Near Field Prevention of Significant Deterioration Increment Comparisons (AERMOD)				
Pollutant	**Averaging Interval and Statistic**	**Class II Impact**	**Allowable Class II PSD Increment**	**% of Class II PSD Increment**
PM10 Initial Run (No Dry Depletion)	Annual Average	11.8	17	69%
	Highest Yearly - 2nd High	169.5	30	565%
PM10 Final Run (Top 20 Receptors With Dry Depletion)	Annual Average	7.4	17	44%
	Highest Yearly - 2nd High	80.7	30	269%
PM2.5	Annual Average	1.7	4	42%
	Highest Yearly - 2nd High	25.1	9	279%
NO2	Annual Average	5.8	25	23%
	98th Percentile of Daily 1-Hour Highs	143.1	--	--
SO2	Annual Average	1.2	20	6%
	24-Hr	25.3	91	28%
	3-Hr	91.6	512	18%
	99th Percentile of Daily 1-Hour Highs	115.3	--	--
CO	8-Hr High	355.8	--	--
	1-Hr High	776.7	--	--

Source: (IML, Air Science, 2015a)

Table 25. Summary of Far Field Prevention of Significant Deterioration Increment Comparisons (CALPUFF)				
Pollutant and Averaging Interval	**Class I or Sensitive Class II Area**	**Modeled Maximum Concentration (µg/m³)**	**Class II PSD Increment (µg/m³)**	**Class I PSD Increment (µg/m³)**
PM_{10} Annual	Devils Tower National Monument	0.007	17	4
PM_{10} 24-hour	Black Elk Wilderness Area	0.277	30	8
$PM_{2.5}$ Annual	Devils Tower National Monument	0.001	4	1
$PM_{2.5}$ 24-hour	Black Elk Wilderness Area	0.040	9	2
NO_2 Annual	Devils Tower National Monument	0.002	25	2.5
SO_2 Annual	Black Elk Wilderness Area	0.000	20	2
SO_2 24-hour	Black Elk Wilderness Area	0.008	91	5
SO_2 3-hour	Black Elk Wilderness Area	0.053	512	25

Source: (IML, Air Science, 2015a)

Predicted total ambient concentrations of PM_{10}, $PM_{2.5}$, CO, SO_2, and NO_2 include emissions from the project and background concentrations. The model domain covered 3,783 receptors along the public road corridor and WDEQ Permit boundary. For each pollutant, the concentration at the receptor with the highest concentration (located a few hundred meters from the Mineable Pit) was reported as a percentage of the NAAQS. During the initial model run using the regulatory default settings, only PM_{10} potentially exceeded the NAAQS (**Table 26**).

The AERMOD model has a tendency to overestimate the transportability of PM_{10} and therefore, the resultant air quality impacts of fugitive dust emissions (IML Air Science, 2014) To correct the over prediction in

transportability of PM_{10}, AERMOD was re-run for PM_{10} at select receptors using the dry depletion option. The use of this option during the initial model run would have increased the model run time to several hundred hours if used to model the entire area of study. Therefore, the refined model was only used on areas where the initial runs showed potential high concentrations of PM_{10}. The results from the refined model run were added to background concentrations and the resulting PM_{10} concentrations were modeled to be less than 80 percent of NAAQS for PM_{10}. Thus, there is no predicted exceedance of the NAAQS for any pollutant, including PM_{10}.

Table 26.
Predicted Total Ambient Concentrations Including Background Concentrations

Pollutant	Averaging Interval and Statistic	Ambient Impact (µg/m³)	Back-ground (µg/m³)	Total Ambient Concentration (µg/m³)	NAAQS Limit (µg/m³)	% of NAAQS Limit
PM_{10} Initial Run (No Dry Depletion)	Annual Average	11.8	15.0	26.8	--	
	2nd High 24-Hr Maximum	169.5	40.0	209.5	150	139.7%
PM_{10} Final Run (Top 69 Receptors With Dry Depletion)	Annual Average	7.4	15.0	22.4	--	
	2nd High 24-Hr Maximum	80.7	40.0	120.7	150	80.5%
$PM_{2.5}$	Annual Average	1.7	3.4	5.1	12	42.5%
	24-Hr 8th High	9.7	8.0	17.7	35	50.5%
NO_2	Annual Average	5.8	6.0	11.8	100	11.8%
	98th Percentile of Daily 1-Hr Highs	143.1	21.0	164.1	187	87.8%
SO_2	Annual Average	1.2	1.3	2.5	--	
	24-Hr High	25.3	16.3	41.6	--	
	3-Hr High	91.6	124.7	216.3	1300	16.6%
	99th Percentile of Daily 1-Hr Highs	115.3	43.2	158.5	200	79.3%
CO	8-Hr High	355.8	378.0	733.8	10000	7.3%
	1-Hr High	776.7	680.0	1456.7	40000	3.6%

Source: (IML Air Science, 2014). Table 6-1.

The distribution of pollutants is generally dependent on wind patterns and local topography. The particulate emissions from the project would be highest just south of the pit and WRF. The geographic impact result is repeated for the other modeled pollutants. When the pollutant distribution evaluation is looked at across a wider area, there is a pattern of higher pollutant concentrations west of the haul road and again, south and southwest of the Mine Area, which is located approximately 12 miles north of Sundance, Wyoming.

Formaldehyde emissions were modeled for 1-hour, 8-hour, and annual averaging periods. The maximum predicted 1-hour concentration is 2.71 µg/m^3, the maximum predicted 8-hour concentration is 1.06 µg/m^3, and the maximum predicted annual concentration is 0.02 µg/m^3. The predicted 1-hour value of 2.71 µg/m^3, can be compared to EPA's 1-hour Recommended Exposure Level (REL) of 55 µg/m^3 and the predicted 8-hour maximum of 1.06 µg/m^3 can be compared to OSHA's 8-hour Permissible Exposure Limit of 0.75 ppm (0.92 1.06 µg/m^3).

Results of the CALPUFF modeling (**Table 25**) indicate that related impacts to visibility at the Class I and sensitive Class II areas would be less than 50 percent of the Significance Threshold of 0.5 deciviews. The maximum predicted change in deciviews, including coarse particulate matter is 0.22 deciviews (IML, Air Science, 2015a) .

The CALPUFF model was also used to assess impacts to the deposition of pollutants from the air on to soil and surface waters that could potentially result in acidification. While there are no sensitive lakes within the impact area of the project, the results predict that impacts on Wind Cave National Park or any of the Class II areas included in the modeling are well below the critical loads and concern thresholds established for the area. For example, the concern thresholds for Devils Tower National Monument, where the maximum nitrogen deposition was predicted, are 0.005, 0.005, and 0.010 kilograms per hectare per year (kg/ha/yr) for sulfur, nitrogen, and sulfur+nitrogen, respectively and the modeled one year averages predicted were 0.000128, 0.000403, and 0.000530 kg/ha/yr for sulfur, nitrogen, and sulfur+nitrogen, respectively.

Factors that influence GHG emissions are primarily the combustion of fossil fuels from mobile and stationary sources. CO_2 would be the primary GHG. Direct project GHG emissions (from mining equipment, light and heavy truck traffic and generators) were calculated to generate a maximum of 25,365 metric tons per year. Indirect GHG emissions, or CO_2e, estimated from electricity consumption, has a maximum of 29,866 tons per year (IML, Air Science, 2015a). The total CO_2e (direct plus indirect emissions) is estimated to be 55,929 tons per year, which is less than 0.08 percent of Wyoming's total estimated greenhouse gas and less than 0.0008 percent of the U.S. annual greenhouse gas emissions (IML, Air Science, 2015a). With the exception of Alternative E, the project would not be subjected to reporting requirements under the EPA's 40 CFR Part 98, the Mandatory Greenhouse Gas Reporting Rule because only direct emissions from stationary sources are counted when considering the applicability of the rule.

The project would not increase ambient ozone concentrations more than minimally because, in comparison to existing sources of the chemicals that create ground-level ozone (VOCs and NOx), the amounts likely to be generated by the project are minimal (IML, Air Science, 2015a).

Reclamation

Air pollution, especially particulate matter emissions, abates when sources generating air pollution are removed. The engines and materials handling emissions would end with the project. Emissions during reclamation would be reduced compared to construction and operations because processing would be complete. The remaining heavy equipment and vehicles would continue to emit pollutants as earthmoving associated with reclamation and employee access continue. Reclamation should not cause long term wind-blown particulate emissions. As the magnitude of earthmoving and reclamation activity would be less than during production, fugitive emissions from reclamation activities and fugitive dust resulting from wind erosion of exposed areas would be less than during production and would be short term and there would be no long term air pollution consequences. Impacts from reclamation activities were not modelled as emissions would be less than the maximum emissions which occur during years 20 to 25.

Alternative C

Construction, Operations, and Reclamation

Alternative C effects from construction, operations, and reclamation are common to all action alternatives.

Alternative D

Construction and Operations

Alternative D effects from construction and operations are common to all action alternatives.

Reclamation

There would be an increase in the duration that truck traffic would produce fugitive dust and tailpipe emissions for 18 years due to the pit reclamation. However, annual emissions would not exceed those of the maximum production year(s) modeled and therefore would not exceed NAAQS/WAAQS. There would be additional total greenhouse gasses but, again these would not exceed the emissions associated with maximum activities in years 20 to 25 of the proposed project and as such were not quantified.

Alternative E

Construction and Operations

Alternative E proposes use of 2,000 kW diesel-fired electrical generators for the life of the project. There would be one 2,000kW generator for years 1 through 9 and two 2,000kW generators for years 10 through 45. The addition of these units would increase the criteria pollutants generated over the life of the project. The model results indicated no increase from in ambient concentrations for any constituent compared to the results shown in **Table 26** for the receptor with the highest estimate (see Alternative C), except an increase of up to 0.1 µg/m^3 for 24-hour PM_{10}, annual average NO_2, and daily 1-hour SO_2. None of these increases exceeds NAAQS/WYAAQS (**Table 21**).

Alternative E's use of generators was modeled (IML Air Science, 2015b) and generator use is predicted to emit 7,084 tons of CO_2 per year, in addition to other operations with CO_2 emissions, which are shown in **Table 26**. Added to the 25,277 tons of CO_2 generated per year by other mining, Alternative E, with the generator, would produce a total of 32,361 tons per year of CO_2 during the maximum emission year (year 20). The maximum of 29,866 tons per year of CO_{2e} (IML, Air Science, 2015a) discussed under Effects Common to All Action Alternatives from electricity consumption would be avoided.

The size of generators indicates that reporting under the 40 CFR Part 98 Mandatory Greenhouse Gas Reporting Rule as stationary sources may be required (if over the 25,000 metric ton per year the EPA has used as a *de minimis* level).

Other effects from construction and operations are common to all action alternatives.

Reclamation

Pit reclamation would have the same effects as Alternatives D.

Alternative F

Construction, Operations, and Reclamation

Alternative F effects from construction and operations are the same as discussed under effects common to all action alternatives. Pit reclamation would have the same effects as Alternatives D and E, except the impacts would occur for 15 years instead of 18.

Alternative G

Construction and Operations

Alternative G effects from construction and operations are common to all action alternatives.

Reclamation

Alternative G involves an additional 32 years of truck traffic hauling waste rock back to the pit. While this increase in years of truck traffic would increase the total fugitive dust and tailpipe emissions, it would not exceed the annual NAAQS/WAAQS because it would be less than the emissions from operations (**Table 26**) as processing would be complete. There would be additional annual GHGs emitted by the diesel truck traffic due to the extended duration of the reclamation timeframe.

Alternative H

Construction and Operations

Effects from construction and operations on air and climate are discussed under Effects Common to All Action Alternatives.

Reclamation

Minable Pit reclamation would have the same effects as Alternative F.

3.6.3.2 Cumulative Effects

Alternative A – No Action

The no action alternative would have no cumulative effects, as there would be no direct or indirect effects.

Cumulative Effects Common to All Action Alternatives

Prescribed burning is generally controlled and coordinated with other agencies and airshed groups. Effects from this type of fire are short-term and localized.

Timber harvesting and other vegetation treatments, exploration and mineral development, and use and maintenance of roads in the analysis area would produce combustion emissions and fugitive dust, resulting in cumulative effects to air quality. Effects would be minimal, as these activities are small in scale, localized, and of short-duration. Furthermore, projects are required to incorporate BMPs to minimize dust. With proper materials handling and land reclamation, cumulative effects to air quality would be minimized.

The modeled impacts from the proposed project were added to existing ambient air quality levels to assess the direct and indirect effects in compliance with the applicable NAAQS. Reasonably foreseeable actions were not modeled, although they are largely a continuation of past actions that resulted in the ambient air quality for the region (**Table 20**). Regionally, reasonably foreseeable development was evaluated as part of the Task 1A Report for the PRB Coal Review (BLM, 2014) and any incremental contribution to cumulative impacts would not cause or contribute to an exceedance of applicable standards or criteria (IML, Air Science, 2015a). **Table 27** presents a comparison of anticipated emissions from the proposed project to regional emissions estimated in the PRB Coal Review. The PRB Coal Review indicates that regional impacts projected for 2020 and 2030 for NO_2 and SO_2 will be below the NAAQs and that some localized exceedances of the NAAQS will occur for PM_{10} and $PM_{2.5}$ due to fugitive dust from mining and unpaved roads. The proposed project would not contribute to the predicted localized particulate exceedances as particulate impacts resulting from mining activities and related hauling are greatest in the immediate vicinity of the source of emissions and decrease markedly with distance from the source and so would not contribute to any of the predicted exceedances identified in the PRB Coal Review.

Table 27. Emissions from Regional Projects

Pollutant	BHM[1] (tpy)	PRB[1,2] (tpy)
PM_{10}	300	250,000
$PM_{2.5}$	50	160,000
NO_x	150	240,000
VOCs	150	240,000

1 (IML, Air Science, 2015a)
2 Data for 2008 (BLM, 2014)

3.6.3.3 Irretrievable and Irreversible Consequences

None of the impacts on air quality indicated above are irreversible or irretrievable.

3.7 Cultural Resources

Cultural resources provide information about past human behavior and activities. They are found in a variety of physical forms that include, but are not limited to, material objects, archaeological sites, historic architecture, traditional cultural properties, and cultural landscapes. Cultural resources also include sacred sites which may include non-tangible properties not represented by artifacts or other cultural features or objects. Cultural resources are non-renewable assets that frequently consist of ephemeral materials susceptible to irreparable destruction or deterioration.

3.7.1 Area of Analysis and Methods

The effects analysis in the Cultural Resources section refers repeatedly to the concept of a "historic property". The term, where employed in this document, has a specific meaning under the NHPA:

> *Historic property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.* (36 CFR §800.16(l)(1))

According to the definition above, not all cultural resources qualify as historic properties; consequently, not all cultural resources are subject to protection measures or mitigation treatments.

A-Traditional Cultural Property (TCP) consists of a cultural site that is eligible for inclusion in the National Register of Historic Places (NRHP) because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. The entity evaluated for eligibility for inclusion in the NRHP must be a tangible property; that is, a district, site, building, structure, or object as defined in 36 CFR §64.4-and in National Register Bulletin No. 38 (NPS, 1990). TCPs are managed under the authority of the NHPA. As such, TCPs that are demonstrated to be eligible to the NRHP qualify as "historic properties".

The "at risk" category used in this analysis consists of historic properties and sacred sites with *identified* or *potential* direct, indirect, or cumulative adverse effects. The NHPA implementing regulations define an adverse effect:

> *An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. (36 CFR §800.5(a)(1))*

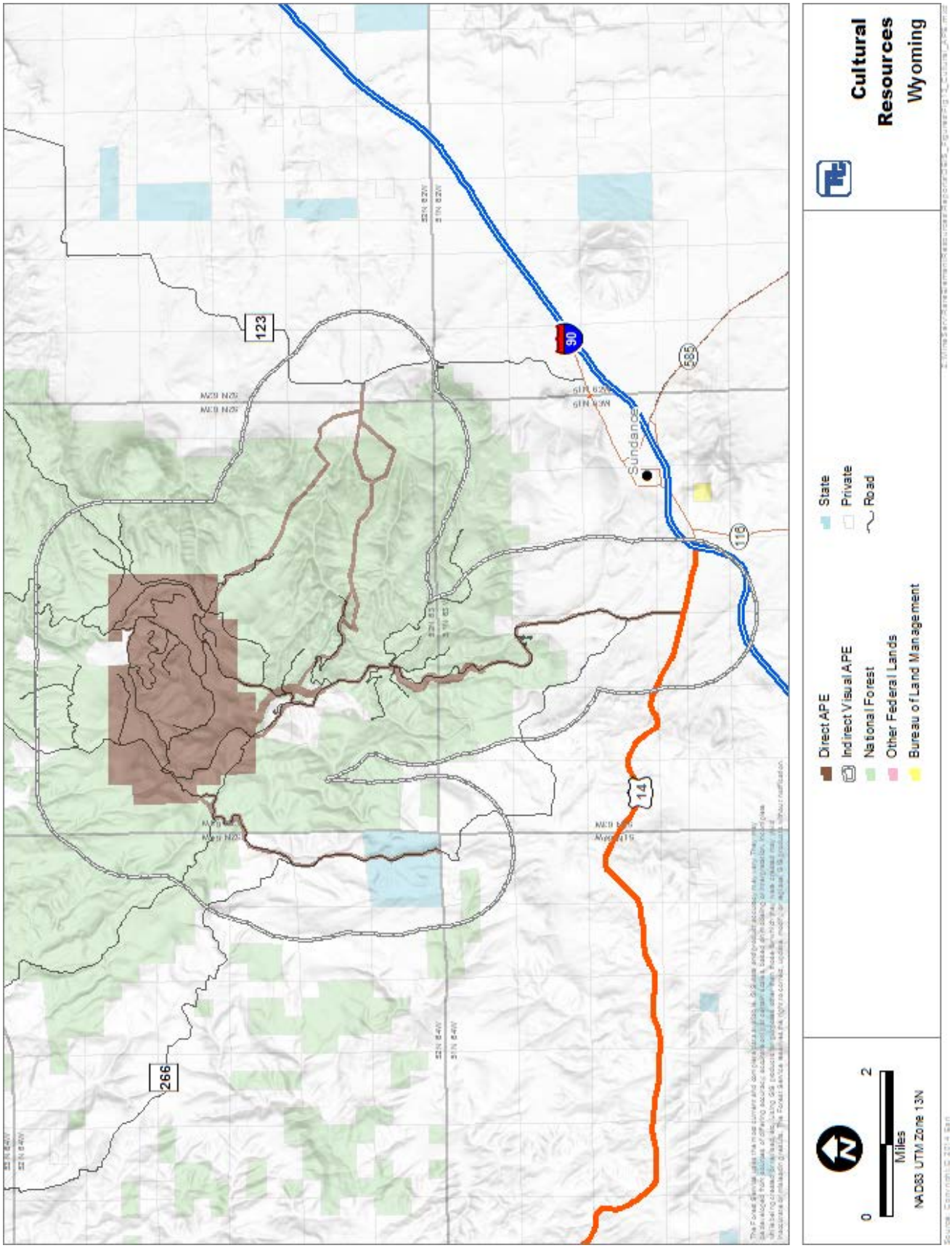
The Forest has identified one primary indicator that is used to determine the potential for adverse effects to historic properties and sacred sites: the number of at-risk historic properties and/or sacred sites within the Area of Potential Effect (APE). The APE must be identified before an assessment of effects on historic properties can be completed. An APE is defined in the NHPA implementing regulations as:

> *… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.* (36 CFR §800.16(d))

The direct APE for the Bear Lodge Project is identical with the WDEQ Permit boundary. In addition, certain segments of the access roads and power lines that extend outside the WDEQ Permit and exploration boundaries are included in the APE (**Figure 14**). The direct APE includes all lands, regardless of ownership.

Indirect effects include the introduction of visual, audible, or atmospheric elements out of character with the property or setting. Indirect effects are possible beyond the defined direct APE. A viewshed analysis was conducted for Crow Peak, Little Crow Peak, Bear Butte and Devils Tower National Monument.

Figure 14. Area of Potential Effects for Cultural Resources



3.7.2 Affected Environment

This section summarizes existing conditions based on currently available data. In the vernacular of the cultural resources legal framework, the affected environment will, by definition, be limited to the APE.

Significant effects on cultural resources can take the form of either direct or indirect impacts to one or more characteristics that qualify a historic property for inclusion in the NRHP. Effects may be characterized by changes in location, setting, use, design, materials, feeling, and association. Examples of potential adverse effects may include physical destruction or damage, isolation from or alteration of setting; introduction of visual, audible, or atmosphere elements; physical deterioration from neglect or from any action; and transfer, sale, or lease.

Western Cultural Resource Management (WCRM) completed an intensive (termed "Class III") cultural resource inventory of lands within the APE as defined above (Guy Hays, 2015). A Class III inventory was conducted of (1) any area not previously inventoried using contemporary methods/standards, or (2) any field survey that had not previously received Wyoming SHPO concurrence, or (3) any area that had been field inventoried more than 20 years ago. WCRM inventoried 3,457 acres and updated or recorded 29 cultural sites within the Class III inventory area. Consultation with the Wyoming SHPO and tribal representatives on WCRM's inventory results will be initiated soon after the preferred alternative is published in this DEIS.

Fifteen of the 29 cultural sites identified within the project APE (as defined above) were previously recorded sites and fourteen were newly identified. Of that number, 20 sites are historic in age and related to habitation or mining/prospecting. Of the 29 sites, 8 are pre-EuroAmerican contact in age with site types composed of four lithic scatters, two open camps, and two stone alignments. The remaining site is a multicomponent site that has produced materials associated with historic prospecting and a pre-contact open camp. Twelve isolated resources were recorded during the course of the survey, nine of which are pre-contact in age and three historic. The results of the inventory are summarized in **Table 28** (pending SHPO concurrence).

Table 28.
Summary Of Cultural Resources in Project APE

Chronological Framework	NRHP Eligible	NRHP Unevaluated	NRHP Not Eligible	Totals
Historic Sites	0	0	20	**20**
Prehistoric Sites	4	0	4	**8**
Multicomponent Sites	1	0	0	**1**
Totals	**5**	**0**	**24**	**29**

Five of the 29 cultural sites are expected to be eligible for the NRHP, pending SHPO concurrence. The five NRHP-eligible sites consist of four pre-contact sites and the aforementioned multicomponent site. All 20 of the historic-era sites, four of the prehistoric sites, and the12 isolated resources are expected to be determined not eligible for the NRHP, pending SHPO concurrence. The analysis that follows is predicated on these baseline data.

3.7.3 Environmental Consequences

The analysis for cultural resources is considered preliminary pending completion of the NHPA Section 106 process for the Class III inventory and assessment of effects. Before publication of the Final EIS, the Black Hills National Forest will complete consultation with the Wyoming SHPO and appropriate tribal officials regarding the potential project effects. Should additional information regarding NRHP determinations, sacred sites, TCPs, or other historic properties be forthcoming as a result of that consultation, the amended results will be reported in the Final EIS.

3.7.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A - No Action, there would be no foreseeable direct or indirect effects to any historic properties. Potential effects on historic properties for previously approved exploration activities were assessed under the Sundance Exploration EA (US Forest Service, 2009a) for which a programmatic agreement (US Forest Service, 2009c) was developed and executed for the management of cultural resources (Wyoming SHPO #0208RLC004). The programmatic agreement called for Forest Service review of the proposed exploration work plan prior to work commencing, avoidance of any and all known eligible or unevaluated cultural resource sites during exploration activities, and inventory of any previously un-inventoried areas within the plan. The programmatic agreement also provided stipulations that would govern cases of inadvertent discoveries or inadvertent effects on cultural resources.

Effects Common to All Action Alternatives

Potential effects to individual historic properties vary from alternative to alternative. To date, no potential effects have been identified that are common to all of the action alternatives. The one possible exception is the planned exploration activities which are addressed in the following section.

Exploration

Exploration in the vicinity of the proposed mine is planned for a period of ten years. Exploratory boundaries are identical for all alternatives. Exploration over the ten-year period would be limited to 2,000 acres. Archaeological survey has been completed for all of the 2,000 acres. Four historic properties have been identified within the area identified for exploration. Design Features (see Section 2.6.4) have been developed to reduce the potential to historic properties as a result of future exploration activities and provide guidance in the event of unanticipated discoveries or inadvertent affects to historic properties during exploration activities. See Figure 3 and Appendix N of Modified 2014 Plan of Operations for additional detail including heritage/cultural resource protection measures during exploration activities

No direct or indirect effects on cultural resources are anticipated during the planned ten-year period of exploration.

Construction

Significant ground disturbance occurs during the construction phase. Consequently, the construction phase has a high potential for direct effects to historic properties.

Five historic properties have been identified within the project APE to date. Each of the five sites is susceptible to adverse effects during the construction phase, although in most cases it will be possible to minimize the potential for adverse effects by implementing modifications to the construction plans. Specific details regarding the Forest's determination of effects are provided for each alternative in the following sections.

The mine is expected to operate for 45 years. Various facilities, roads, and fences are planned to be constructed during the first 25 years of the mine. Any adverse effects for which no protective measures can be identified prior to commencement of construction activities will be resolved in a Memorandum of Agreement. Design Features have been developed to help minimize the potential for adverse effects and provide guidance in cases where unanticipated cultural resources or human remains are discovered or previously identified historic properties are inadvertently affected by construction activities (see Section 2.6.4).

Operation

With the exception of future exploration (discussed above), access roads, and the transmission line needed to power the facility (discussed below), ground disturbance associated with mine operations, would be limited to the footprint inside the perimeter fence. Four historic properties have been identified within the perimeter

fence to date. Each of the four sites is susceptible to adverse effects during the construction phase, although in most cases it will be possible to minimize the potential for adverse effects by implementing modifications to the operation plans. Specific details regarding the Forest's determination of effects are provided for each alternative in the following sections.

Indirect affects during operation of the mine are expected to be minimal. Crow Peak, Little Crow Peak, and Bear Butte were subjected to visual analysis to determine whether or not mining activities during the operation phase could be visible from those prominent landforms (Burgess & Karchut, 2011) and (Guy Hays, 2015). Crow Peak, Little Crow Peak, and Bear Butte are roughly 23, 28, and 50 miles from the proposed mine, respectively. Visual effects from those locations with the naked eye would be nearly nil during daylight hours. It is possible that the lighted mine operations, once fully developed, might be faintly visible in the night sky from Crow Peak and Little Crow Peak, depending on atmospheric conditions. The distance between the points, however, would render any illumination far less significant than the nearby cities of Spearfish, Sturgis, or Sundance, each of which is closer and more prominently visible from one or more of the named landforms than the mine proposed on Bull Hill. Consultation has yet to be completed, but indirect effects by individuals standing on the top of these landforms are expected to be minimal to non-existent.

A visual analysis was also conducted to determine potential indirect effects project-related activities or facilities may have when viewed from Devils Tower National Monument (48CK106). The site is a NRHP-listed locality located 15 miles (24 km) to the northeast of the proposed mine with prehistorically and historically significant attributes. The landform has also been a designated Native American TCP. The proposed Waste Rock Facility (WRF) at the mine may be faintly visible from Devils Tower during the day. The distance between the Monument and the mine would make the visible portion of the WRF a minor addition to the current viewshed. Normal weather patterns and atmospheric conditions would make the WRF only visible at irregular intervals and varying contrast during a calendar year. Existing modern features already within the viewshed between the site and the project include Highway 24, several secondary roads, transmission lines, residences, and associated modern development. From the Monument, the pre-existing features are physically closer, consistently more visible, and of higher contrast on the landscape. The addition of the WRF would not degrade the current viewshed and would not affect the site's integrity of setting, association, or feel. The construction of the proposed project would have no adverse effect on the Monument's viewshed during daylight hours.

During operations phase, nighttime outdoor lights from the mine would be visible from Devils Tower National Monument (42CK106). The planned facility lighting was oriented downward and south to face away from the Monument. The design reduces the quantity of light visible from the Monument during nighttime mine operations. At 13 miles distant, normal weather patterns and atmospheric conditions would make any mine lights only visible at irregular intervals and varying intensity throughout the calendar year. Existing nighttime light sources within 13 miles (21 km) of the site are Highway's 14 and 24, the community of Hulett, Wyoming, several private residences, and associated infrastructure. Light produced by the mine during the operations phase, when visible, will not significantly contribute to the existing nighttime luminance surrounding the Monument. Nighttime mine lighting will have no adverse impact to the site's integrity of setting, association, or feel; therefore operation will have no adverse impact to site.

All potential adverse effects will be eliminated or mitigated prior to commencement of operations at the mine and associated facilities. Design Features have been developed to help minimize the potential for adverse effects and provide guidance in cases where unanticipated cultural resources or human remains are discovered or previously identified historic properties are inadvertently affected by operations activities (see Section 2.6.4).

Reclamation/Closure

The mine is expected to operate for 45 years with variable time for reclamation depending on the alternative selected for mine pit reclamation. Reclamation may include reestablishment of the vegetation and, over the greater project area, nearly simulating the setting of a pre-construction condition. As such the indirect impacts

to the setting of the historic properties are considered short term. Any localized permanent impacts to the setting of historic properties would be mitigated during closure activities as needed.

Design Features have been developed to help minimize the potential for adverse effects and provide guidance in cases where unanticipated cultural resources or human remains are discovered or previously identified historic properties are inadvertently affected by operations activities (see Section 2.6.4).

Alternative C

Under Alternative C, four historic properties near the proposed PUG area would have the potential to be adversely effected. As currently configured, however, three of the four properties will be inaccessible and protected between two fences. As a result, they will be subject to no direct effects. A fourth historic property would be bisected by the perimeter fence. At the time of this writing, it appears possible that the fence can be constructed with no adverse effect to the site's NRHP contributing features. Should that determination prove untenable after consultation with the SHPO and tribal representatives, a Memorandum of Agreement will be drafted to resolve adverse effects.

A fifth site anticipated to be eligible for inclusion on the NRHP and composed of a pre-contact lithic scatter, is located along Miller Creek Road. Upgrades and maintenance of the road, in addition to a proposed transmission line, has the potential to directly affect the property. Direct effects, however, can be prevented by re-designing the road maintenance and transmission line corridor to avoid the site.

Design Features have been developed to help minimize the potential for adverse effects and provide guidance in cases where unanticipated cultural resources or human remains are discovered or previously identified historic properties are inadvertently affected by operations activities (see Section 2.6.4).

Alternative D

Potential effects to historic properties under Alternative D are identical to those reported above for Alternative C. Four historic properties near the proposed PUG area would have the potential to be adversely effected. Three of the four properties, however, will be inaccessibly protected between two fences. As a result, they will be subject to no direct effects. The same historic property reported in Alternative C would be bisected by the perimeter fence, although the Forest anticipates that it may be possible that the fence can be constructed with no adverse effect to the site's NRHP contributing features. That question will be determined by way of consultation with the SHPO and tribal representatives.

Alternative E

Under Alternative E, no historic properties would be adversely affected. All five historic properties would be located outside of the fenced activity area that would contain the Mineable Pit, PUG Plant, and WRF. It is anticipated that mine-related activities proposed outside the fenced area (i.e., access road maintenance, transmission line construction, and future mineral exploration) could be modified to eliminate any potential effects to historic properties.

Alternative F

Potential effects to historic properties under Alternative F are identical to those reported above for Alternative E. Under Alternative F, no historic properties would be adversely affected. All five historic properties would be located outside of the fenced activity area that would contain the Mineable Pit, PUG Plant, and WRF. Mine-related activities proposed outside the fenced area (i.e., access road maintenance, transmission line construction, and future mineral exploration) could be modified to eliminate any potential effects to historic properties.

Alternative G

Potential effects to historic properties under Alternative G are identical to those reported above for Alternatives C and D. Four historic properties near the proposed PUG area would have the potential to be

adversely effected. Three of the four properties, however, will be inaccessible and protected between two fences. As a result, they will be subject to no direct effects. The fourth historic property would be bisected by the perimeter fence, although the Forest anticipates that it may be possible that the fence can be constructed with no adverse effect to the site's NRHP contributing features. That question will be determined by way of consultation with the SHPO and tribal representatives. Mine-related activities proposed outside the fenced area (i.e., access road maintenance, transmission line construction, and future mineral exploration) could be modified to eliminate any potential effects to historic properties.

Alternative H

Potential effects to historic properties under Alternative H are identical to those reported above for Alternatives C, D, and G. Four historic properties near the proposed PUG area would have the potential to be adversely effected. Three of the four properties, however, will be inaccessible and protected between two fences. As a result, they will be subject to no direct effects. The fourth historic property would be bisected by the perimeter fence, although the Forest anticipates that it may be possible that the fence can be constructed with no adverse effect to the site's NRHP contributing features. That question will be determined by way of consultation with the SHPO and tribal representatives. Mine-related activities proposed outside the fenced area (i.e., access road maintenance, transmission line construction, and future mineral exploration) could be modified to eliminate any potential effects to historic properties.

3.7.3.2 Cumulative Effects

The analysis area for cumulative effects includes the direct effects APE and a 5-mile buffer so as to include all the potential visual effects on cultural resources.

Alternative A – No Action

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects. The Plan of Operations would not be approved and therefore, no cumulative effects to historic properties.

Cumulative Effects Common to All Action Alternatives

The potential for cumulative effects to cultural resources is low, and cumulative effects are not anticipated under the action alternatives because the NHPA and 36 CFR §800 implementing regulations outline procedures for protecting historic properties from potential effects as a result of future federal undertakings. Adverse effects can frequently be avoided or minimized through the implementation of appropriate site-specific protection measures through consultation with the Advisory Council on Historic Preservation (ACHP), the SHPO, tribal governments, and the public, as appropriate.

Design Features have also been developed to help minimize the potential for adverse effects and provide guidance in cases where unanticipated cultural resources or human remains are discovered or previously identified historic properties are inadvertently affected by operations activities (see Section 2.6.4).

3.7.3.3 Irretrievable and Irreversible Consequences

As described in the direct and indirect analysis above, the following irretrievable and irreversible impacts would occur:

- Consultation will determination if the projected disturbance to one multicomponent historic property under Alternatives C, D, G, and H is limited to site components that do not contribute to the site's NRHP eligibility. If adverse effects to the property cannot be avoided, a Memorandum of Agreement will be drafted pursuant to stipulations found at 36 CFR §800.6.

3.8 Soils

3.8.1 Analysis Area and Methods

The analysis area for soils is the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes.

Impacts on soils were determined through GIS analysis of soil types from baseline soil surveys (BKS, 2014a), soil data from the Black Hills National Forest (US Forest Service, 2000) and the Natural Resources Conservation Service (NRCS, 2015c), and information provided in the Plan of Operations (RER, 2014a).

3.8.2 Affected Environment

Soil consists of mineral and organic matter on the surface that supports vegetation and stores moisture. Soils are defined by their physical, chemical, and biological characteristics that combine to support plant growth under natural conditions. Soil quality is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants and animals. As an ecosystem, soil can be managed to provide nutrients for plant growth, absorb and hold rainwater for use during dryer periods, filter and buffer potential pollutants and provide habitat for soil microbes to flourish and diversify to keep the ecosystem running smoothly.

Several studies have noted the importance of the native seedbank in soil (Thompson, et al., 1993) (Hulme, 1998) (Honda, 2008) (Hulme & Borelli, 1999).

Soil stability is directly related to the slope on which it occurs. Generally steeper slopes increase the potential for slumping, landslides, and water erosion. GIS analysis was used to calculate the percent of soil slope hazards. The exact stability and susceptibility to water erosion is also dependent on each soil's individual characteristics. **Figure 15** illustrates slope hazards in the Mine Area. The U.S. Department of Agriculture (USDA) National Soil Survey Handbook (NRCS, 2015d) rates general soil slope hazards as:

- minimal - 0 to 25 percent (77 percent of the Project Area);
- moderate - 25 to 40 percent (20 percent of the Project Area); and
- severe - greater than 40 percent (about 3 percent of the Project Area).

The *Baseline Soil Assessment Bull Hill Mine* (BKS, 2014a) delineated soil map units (**Table 29**) in the baseline study area, which included a large area around the Mine Area, but did not include all of the power line and access routes. Information on these areas was gained from NRCS soil surveys (see Section 3.8.1).

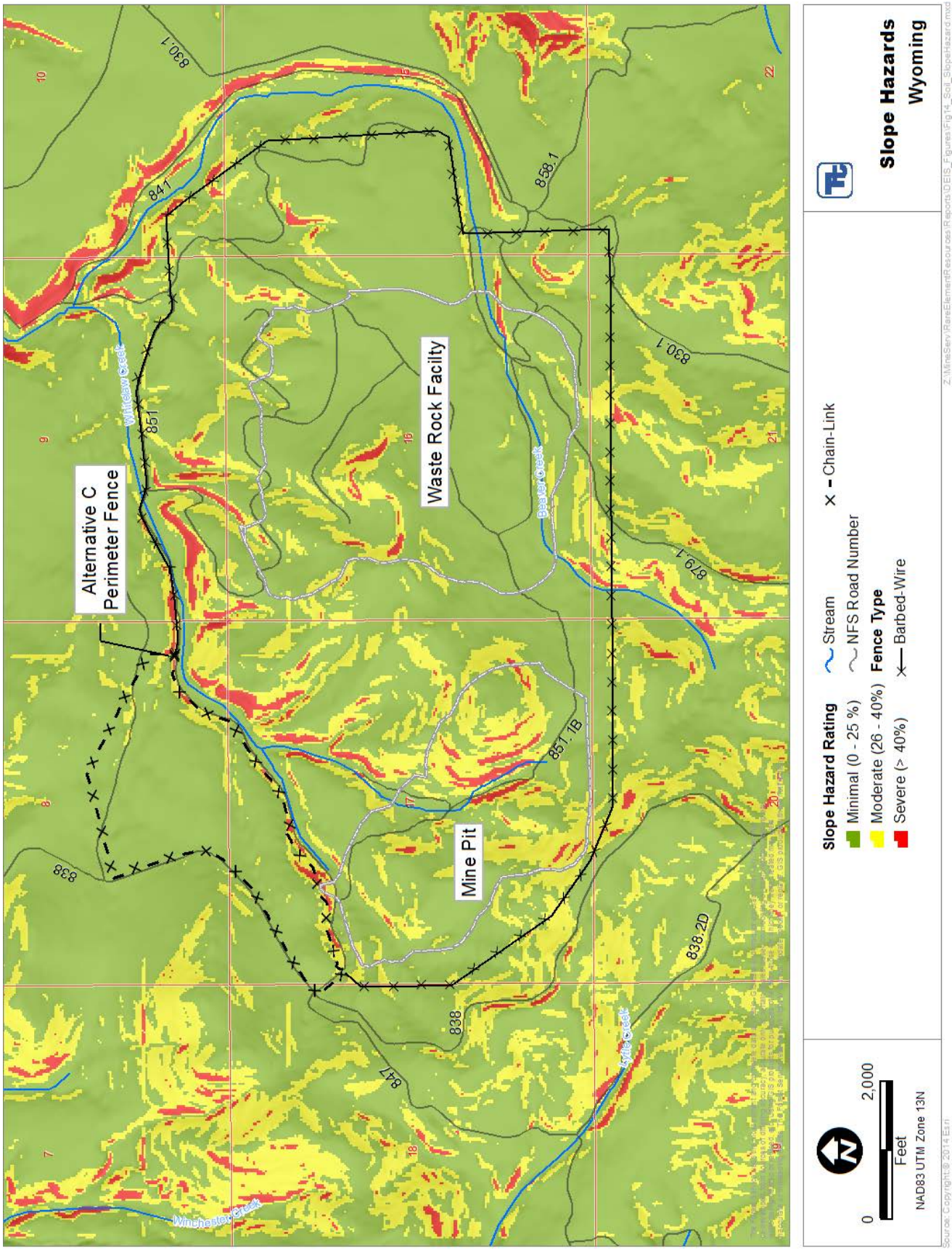
Table 29. Mine Area Soil Map Units

Map Unit Name	% of Analysis Area
Disturbed	1.8
Grizzly-Virkula complex	75.1
Hickok loamy coarse sand	2.4
Cordeston loam	0.9
Pesowyo channery clay loam	4.6
Vanocker gravelly silt loam	15.3

Source: (BKS, 2014a) (NRCS, 2015c) (US Forest Service, 2000), based on Alternative C Mine Area.

A comprehensive pre-mine soil survey included chemical analyses of the various soil types. These results indicated no apparent toxicity concerns related to their measured selenium or boron content. A geochemical characterization of the waste rock material at the Bull Hill Mine was performed (Golder Associates, 2014e) and concluded that the waste rock would be non-acid forming. Analysis of the chemical overburden conducted for the geochemical study also indicated no harmful concentrations of arsenic or molybdenum (RER, 2014a). Topsoil contamination from upward mobilization of these properties is therefore not anticipated in post-mine reclaimed lands.

Figure 15. Soil Slope Hazard



Potential toxicities from rare earth elements were not specifically analyzed and potential impacts are not defined, but the rare earth elements are not generally considered to pose serious environmental threats to either plants or animals (Ernsley, 2001).

3.8.3 Environmental Consequences

3.8.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action there would not be disturbance beyond the levels necessary for reclamation of the exploration program under the Sundance Exploration project (US Forest Service, 2009b). There would, therefore be no other direct or indirect impacts.

Effects Common to All Action Alternatives

General Effects on Soil Productivity from Disturbance and Stockpiling

Soil is a non-renewable resource. Therefore soil loss or degradation can result in irretrievable losses to soil productivity, physical structure, and ecological function.

Soil salvage, storage, and reclamation would result in more uniform systems that perform differently than native conditions. These alterations would lead to irretrievable losses to soil productivity, physical structure, and ecological function on disturbed sites. Reclaimed communities would support an altered suite of vegetation and life-forms that reflect a new environmental equilibrium. This change would result in reclaimed less diverse and less productive lands compared to pre-mine native conditions. The volume of stockpiling is used to measure the alteration of soil productivity and soil development.

Fertility

Mineral extraction would damage topsoil fertility through disturbance from stripping, stockpiling, and reclamation. This damage would include a loss of soil structure, accelerated soil erosion, excessive leaching, compaction, altered soil pH, accumulation of heavy metals in soils, depletion of organic matter, decreased plant available nutrients, reduced cation exchange capacity, decreased microbial activity and an overall reduction in soil fertility (Stahl, et al., 2003; Anderson & Cairney, 2004; Mensah, et al., 2015). Disturbance of soil ecosystems also alters equilibrium of native macro and micro nutrient cycles, which affects nutrient availability to plant communities.

Soil disturbances may also alter oxidative states of mineral compounds within mixed soil layers which affects availability of heavy metals and other toxins. Mixing of layers with low pH during salvage operations may result in overall lower pH values in reclaimed soils and a reduction in long-term soil productivity. Use of marginal pH topsoil on reclaimed landscapes may also risk mobilization of heavy metals into revegetated plants.

Organic Matter and Microbial Activity

Laboratory analyses indicate surface horizons of affected soil series ranged from 4.1 percent to 18.4 percent organic matter. Plants obtain nutrients from both organic matter and inorganic minerals. Organic matter also functions to bind soil particles into aggregates, improving the soil's water holding capacity. Most soils contain 2 to 10 percent organic matter. Mining related disturbances may reduce organic matter content by mixing near surface and subsurface horizons during salvage and reclamation operations. Organic matter decomposition rates may also increase with increased oxidation through soil salvage and reclamation. This later phenomenon would be influenced by length of stockpile storage times and size of storage stockpiles. Topsoil stored for years, and especially the mining overburden material, has little biological resemblance to the undisturbed surface soil result in an unstable and unbalanced soil ecosystem (Fresquez & Aldon, 1984). Other studies show that topsoil salvage and stockpiling results in a reduction in bacteria, actinomycetes, fungi, algae, arthropods and nematodes (Miller & Cameron, 1976; Stanton, 1976). It is therefore anticipated that soil

disturbance and stockpiling, would alter these populations by the same factors that affect organic matter content: dilution, altered nutrient cycles and altered oxidation states.

Native Seed Reservoir

Several studies have noted the importance of the native seedbank in soil (Thompson, et al., 1993; Hulme, 1998; Honda, 2008; Hulme & Borelli, 1999). Disturbance and stockpiling would alter populations of native seed in soil by increased dilution and mixing of the surface soil layers. The length and depth of burial also impacts seed viability (Hulme & Borelli, 1999). Therefore long-term topsoil storage in relatively large stockpiles would reduce residual native seed viability and necessitate the use of a diverse native seed mixture to reestablish desirable native species. However, measures to prevent or minimize impacts (see Section 2.6.9) include the use of a native perennial seed mixture to stabilize all long-term soil stockpiles and help to maintain the native seed bank in stockpiles.

Exploration

Exploration would result in soil disturbance from drill pad construction, trenching and temporary roads, estimated at 0.3 acres per drill site and about 25 square feet per foot of linear trench. Topsoil would be stockpiled for less than a year and used to reclaim exploration areas.

Impacts from stockpiling and reclamation of drill sites would occur as described for construction, to a much smaller degree. In 10 years of exploration there would be a total of about 295,240 cubic yards of soils stockpiled and redistributed from drill holes and about 24,300 cubic yards from trenching.

Construction

Use of the generators would require the diesel fuel to be transported to the Mine Area, creating the risk of a diesel fuel spill. Spill Containment and Countermeasures (see Appendix A) would minimize the hazard by requiring secondary containment for fuel storage areas and a response plan if spills occur anywhere along the transportation route.

Soil productivity would be altered through construction. Mining results in soil damage by altering the physical, chemical, and biological components of soil ecosystems and impacts the vegetation communities they support. Mining disturbances affect overall soil productivity by creating bare and/or compacted areas that are hostile environments for plants and microbial activities, reducing root mass, increasing runoff and erosion. All forms of soil disturbance diminish habitat for soil microbes and soil function (NRCS, 2015c) (NRCS, 2015d).

The Mineable Pit would result in map unit features recognized and described by NRCS in Soil Data Mart generally similar to the Map Unit Q0702F – Pits, quarry. This type of soil has a moderate erosion hazard (NRCS, 2015a).

Soil salvage and storage mixes soil horizons and alters bulk density, porosity, infiltration, air-water relationships, salt content, and pH (Perrow & Davy, 2003; Bainbridge, 2007). Mixing of soil surface horizons results in dilution of residual native seed and plant propagules, reducing the probability of natural regeneration of native plant species from replaced soil. Soil compaction results in increased bulk density, and reduced porosity, infiltration, moisture, air, nutrient cycling, productivity, and biotic activity (Perrow & Davy, 2003; Bainbridge, 2007; Logan, 2001). Altered parameters include organic matter content, biotic activity, nutrient cycles, calcium carbonate concentrations, clay translocation properties, texture class, rock fragment content, structure, and depth to bedrock. Additionally, multiple short overland travel trips between roads and soil stockpiles could cause compaction and erosion. Measures to prevent impacts (Section 2.6) would minimize the extent of compaction impacts.

Spillage and incidental mixing of naturally occurring horizons would result in loss of topsoil and subsoil directly related to disturbance size, equipment type, distance to soil stockpiles, stockpile size and location, stockpile longevity, and site conditions during salvage and replacement (e.g. soil moisture content, wind

speed and direction, etc.). Measures to minimize and prevent impacts (Section 2.6) would minimize losses, although none are completely effective. The degree to which topsoil loss and quality degradation would occur is shown for each alternative as measured by the volume of salvaged topsoil. The volume of stockpiled material was estimated based on 1.25 feet average total soil salvage depth. This depth would generate 2,016.7 cubic yards per acre of topsoil for stockpiling. No soil would be salvaged from disturbed land and outcrops (RER, 2014a).

Noxious weed establishment, especially annuals, could alter soil environments by replacing native perennial species leading to reduced soil fertility or reduced soil moisture content. This can result in accelerated erosion and altered biodiversity (DiTomaso, 2000) (Radosevich, et al., 2007). Design features and environmental protection measures (Section 2.6) to minimize weed infestations along with ongoing monitoring and treatment (Section 2.9) would reduce potential impacts from weeds on soil productivity.

Proper salvage, storage, and replacement of topsoil and subsoil resources would reduce the risk of soil compaction to levels that limit soil productivity. To minimize compaction, heavy equipment would be limited to roads and other disturbance areas that have had surface soils previously removed.

It is anticipated that this mining related activity would alter populations of native seed by increased dilution and mixing of the surface soil layers. The length and depth of burial also impacts seed viability (Hulme & Borelli, 1999). Therefore long-term topsoil storage in relatively large stockpiles would reduce residual native seed viability. Long-term storage in the two main stockpile locations would eliminate the residual native seed viability and necessitate the use of native seed mixture to reestablish desirable native species. A design feature is included requiring the use of a native perennial seed mixture to stabilize all long-term soil stockpiles to maintain a native seed bank.

Mining related disturbances can degrade soil properties and lead to increased soil erosion and runoff. BMPs include both structural controls to prevent soil from leaving the site during storm events (i.e., silt fences, straw bales), management controls to prevent soil loss in the first place (i.e., limiting disturbance footprints), and stabilizing measures following disturbance (i.e., reseeding).

Operations

Impacts from operations would include soil disturbance from periodic maintenance of the power line and roads, although it is possible that the power line will not need maintenance within the mine operation timeframe. Some topsoil losses would inevitably occur. Design Features would be implemented to reduce fugitive dust and accidental spillage including covering haul trucks and spraying roads (see Section 3.18).

Impacts from rare earth mineral contaminants falling from haul trucks and other equipment would be limited to areas immediately adjacent to access and haul roads and adjacent areas receiving run-off sediment from storm waters that collect spilled rare earths. Impacts to soil from rare earth element contamination are unknown but the rare earth elements are not generally considered to pose serious environmental threats to either plants or animals. BMPs for erosion and sedimentation control would reduce contamination (Section 2.6) (see Health Section 3.18).

Impacts from wind-blown or water transported ore materials or waste rock containing possible rare earth contaminates and/or heavy metals from overburden materials could impact soil locations downwind or down-grade from mining, processing, and stockpiling areas. The scale of the elevated radiation in adjacent soils from these sources has not been quantified, but would be expected to be minimal due to the relatively low specific activity of thorium isotopes and their respective decay chains. BMPs for erosion and sedimentation control would reduce these impacts (see Health and Safety Section 3.18).

Acid soils used as cover for waste rock facilities can mobilize heavy metals. Pre-mine soil chemistry indicates that marginal (low) pH values (5.0 to 5.5) were found in the Grizzly, Hickok, Vanocker, and Virkula soil series. These soil series comprise about 95 of the area’s natural cover materials. However, the pre-mine

overburden analysis (RER, 2015) indicate that the waste rock would be non-acid forming. No significant impacts related to soil pH, therefore, are anticipated.

Reclamation/Closure

Once the area is reclaimed, the site would then represent "Soil Map unit Q0705D, Udarents". Udarents represent reclaimed gravel pits with slopes ranging from 2 to 40 percent. This component is also found on mountain slopes. This soil type has a moderate hazard for rutting, moderate hazard for erosion from roads and trails and is moderately suited for hand planting. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is moderately high (NRCS, 2015b).

Post-mining soil replacement depths would average six inches for topsoil and ten inches for subsoil. Disrupted native soil horizons would not be restored to ambient qualities and quantities during initial reclamation activities. Altered soil parameters would in some cases take decades to hundreds of years to recover (Perrow & Davy, 2003). However, replaced soils would support stable and productive vegetation capable of sustaining post-mining land uses (see Section 3.11.3). The soil and vegetation productivity would probably be lower post-reclamation, however. Reestablishment of vegetation productivity would be directly related to altered topsoil productivity. The overall post-reclamation soil function would likely be improved through reclamation efforts to reestablish vegetation cover.

The soil's suitability for use as a plant growth medium after stockpiling is generally constrained by such physical factors as coarse fragment percentage, saturation percentage, and clay content. Chemical limiting factors can include but are not limited to pH, eH and calcium carbonate percentages.

In the short-term, mining related disturbances would result in reduced soil productivity as surface disturbances remove vegetation and native soil profiles. These activities cause protracted disruption in the physical, chemical and biological systems and the naturally evolved nutrient cycling systems that are in temporal balance with their native conditions. Reestablishment of this balance will vary as a function of time. The length of time required is most often related to the practices used for reclamation, the care in which those practices are undertaken and the climatic conditions where the reclamation is taking place. Concurrent reclamation of the WRF (except in Alternative G) would help to minimize soil storage times, erosion issues and the length of time to re-establish overall soil profile balance.

A study of reclaimed coal mine soils throughout Wyoming (Stahl, et al., 2003) found soil organic carbon contents in reclaimed soils that were less than 10 years old to be less than those in adjacent undisturbed native soils, although these sites were at lower elevation. However organic carbon content of reclaimed sites began to equalize and exceed those of undisturbed native soils after 10 years. As the Project Area is at a higher elevation with cooler average temperatures, reduced microbial decomposition rates and consequently reduced organic matter decomposition rates, it is anticipated that it would take a minimum of 10 years after seeding for these affected lands to meet this standard.

Alternative C

Construction

The volume of stockpiled material was estimated based on 1.25 feet average total soil salvage depth (2,016.7 cubic yards per acre) except with areas of disturbed land and outcrops. No soil would be salvaged from disturbed land and outcrops (RER, 2014a). Acreages of affected soil types on NFS lands and estimated salvage volumes under Alternative C are summarized in **Table 30**. An additional 634,042 cubic yards more would be stockpiled due to construction of the WRF in Tract 42. The Miller Creek Road construction would require stockpiling 284 cubic yards on NFS lands. Other impacts would be the same as those discussed under Effects Common to all Alternatives.

The PUG Plant, WRF, and portions of the haul road would be situated in flooded Cordeston loam soils that support riparian habitat. Salvage and stockpile storage of these wet soils with high organic matter content

would almost certainly alter their steady state oxidation levels and organic matter decomposition rates. Storage time would directly impact soil productivity as stored soil dries and unfavorable conditions develop to maintain native in-situ soil biological components. Separating riparian soils from upland soils for stockpiling would help support pre-disturbance soil by reducing dilution of the pre-mine soil components diversity. The effectiveness and timing of restoring soil function are unknown however, and site specific.

Table 30.
Alternative C Disturbed Acres and Soil Salvage Volumes on NFS Lands

Affected Soil Map Unit	Acres	Soil Salvage Cubic Yards
Cordeston loam, 1 to 6 percent slopes	1.7	3,434
Disturbed Land or Unknown	20.6	0
Grizzly-Virkula complex, 6 to 15 percent slopes	245.4	494,876
Grizzly-Virkula complex, 15 to 60 percent slopes	0.3	523
Larkson loamy coarse sand	1.2	2,117
Lyxn loam	2.8	5,650
Vanocker gravelly silt loam	82.3	165,894
NFS Total	**354.3**	**672,494**

Reclamation

Under this alternative, Mineable Pit highwalls would not be reduced and soil related impacts in the Mineable Pit area would be permanent, and reclamation activities would concentrate on the WRF and road systems. No reclamation is planned in the Mineable Pit area in this alternative and no soil ecosystem function would be restored. On NFS lands, this would result in a permanent change of 232 acres to the soil map unit Q0702F, except any area that results in a pit lake, which would be water. Roads and the PUG Plant location would result in 118 acres permanently changing to soil map unit Pits and Quarries Q0702.

Alternative D

Alternative D disturbs more acres overall (NFS lands and other ownership) than Alternative C. On NFS lands, the increase is largely a result of the additional areas disturbed for the pit reclamation and modified road routes.

Table 31.
Alternative D Disturbed Acres and Soil Salvage Volumes on NFS Lands

Affected Soil Map Unit	Acres	Soil Salvage Cubic Yards
Disturbed Land	7.6	-
Grizzly Virkula complex	298.8	602,580
Grizzly-Virkula complex, 15 to 60 percent slopes	7.0	14,117
Larkson-Lakoa loams, 10 to 60 percent slopes	8.4	16,940
Larkson-Lakoa loams, 3 to 10 percent slopes	1.1	2,218
Lyxn loam	0.6	1,210
Peso-Paunsaugunt	10.1	20,368
Pesowyo-Rockerville complex, moist, 10 to 60 perc*	0.1	202
Rock outcrop, limestone	1.8	-
Rock outcrop-Vanocker complex, 50 to 75 percent slopes	14.1	-
St. Onge loam, 1 to 6 percent slopes	0.2	403
Suglo-Nihill complex, 3 to 10 percent slopes	0.8	1,613
Vanocker gravelly silt loam	86.9	175,248
NFS Total*	**437.5**	**834,900**

* Does not include pit reclamation.

Construction

Total soil stockpiles and subsequent impacts on quality and quantity would be increased compared to Alternative C, primarily due to the larger reclamation footprint required to reduce pit highwalls and to expand the WRF.

Total acreage of affected soil types on NFS lands and

the estimated salvage volumes of each affected soil type under Alternative D are summarized in **Table 31**.

The WRF would be expanded and require stockpiling 122,246 cubic yards of soil from NFS lands of the total 874,277 cubic yards (including private lands). The WRF would not affect wetland/riparian soils along both Beaver and Whitelaw Creeks.

The new Warren Peak Road construction would affect more NFS and private lands than Alternative C. Access road new construction would require stockpiling 66,240 cubic yards on NFS lands. Other impacts would be the same as those discussed under Effects Common to all Alternatives.

The PUG Plant and haul road in Alternative D would not affect the Cordeston loam soil map unit that supports wetlands and riparian habitat.

Soils on the power line ROW would be subject to short-term construction impacts with temporary disruption of the soil ecosystem and the potential of increased compaction from long-term maintenance and repairs during the mine operation phase. Under Alternative D there would be no impacts on soils on state land from power line construction. Other soil impacts would be the same as those discussed under the Effects Common to all Alternatives.

Reclamation

Reclamation of the Mineable Pit would result in the need to store 191,136 cubic yards of topsoil for 18 years longer than with Alternative C, due to the pit slope layback to 3:1 and shaping. Reclamation of the WRF would be delayed until final contouring of WRF slopes, and would similarly increase soil storage times, decreasing the quality of stockpiled soils and requiring additional maintenance. In the long-term, reclamation would bring some level of soil ecosystem function to the Mineable Pit area, which would not occur in Alternative C. The reclamation soil would promote revegetation and address water quality; however it would not be at the naturally occurring ecosystem functioning level. This alternative would increase the length of soil storage time and diminish natural soil ecosystem function during the life of the Mineable Pit (45 years).

On NFS lands, reclamation would result in a permanent change to 548 acres of Pits and Quarries soil map unit Q0702 for the pit reclamation area, roads, the PUG Plant, and WRF.

Alternative E

Construction

Under Alternative E, the total WRF soil stockpile size and subsequent impacts on quality and quantity would be similar to Alternative C.

Acreages of affected soil types on NFS lands and estimated salvage volumes of each affected soil type under this alternative are summarized in **Table 32**.

In Alternative E, the PUG Plant would be off NFS lands and would avoid the riparian areas affected in Alternative C. Other long-term soil impacts would be the same as those discussed under Effects Common to all Alternatives.

No power lines would be constructed under Alternative E, therefore there would be no impacts to soil from power lines.

The new NFS Road 879.1 construction would require stockpiling of approximately 61,017 cubic yards of topsoil from NFS lands.

Other impacts would be the same as those discussed under the Effects Common to all Alternatives.

The WRF footprint would require stockpiling 6,327 cubic yards from NFS lands of the total 742,708 cubic yards (including private lands).The WRF and haul road would avoid the Cordeston loam soil map unit that supports riparian/wetland soils associated with Beaver Creek unlike Alternative C.

Operations

Use of the generators for the entire mine life would require the diesel fuel to be transported to the Mine Area and refilled more frequently that the other alternatives, increasing the risk of a diesel fuel spill, as described in the Effects Common to All Alternatives. Spill Containment and Countermeasures (see Appendix A) would minimize the hazard be requiring secondary containment for fuel storage areas and a response plan if spills occur anywhere along the transportation route.

Table 32.
Alternative E Disturbed Acres and Soil Salvage Volumes on NFS Lands

Affected Soil Map Unit	Acres	Soil Salvage Cubic Yards
Disturbed Land	8.5	-
Grizzly-Virkula complex, 6 to 15 percent slopes	180.5	364,008
Grizzly-Virkula complex, 15 to 60 percent slopes	2.2	4,437
Lyxn loam	2.0	4,033
Pesowyo-Rockerville complex, moist, 10 to 60 percent slopes	0.1	202
Vanocker gravelly silt loam	82.3	165,972
Larkson-Lakoa loams, 3 to 10 percent slopes	1.1	2,218
Larkson-Lakoa loams, 10 to 60 percent slopes	5.8	11,697
Peso-Paunsaugunt	9.8	19,763
NFS Total*	**292.3**	**572,330**

* Does not include pit reclamation

Reclamation

The Mineable Pit highwalls would be reduced to 3:1 slopes in this alternative, which would increase the Mineable Pit disturbance footprint and require long-term storage of approximately 207,381 cubic yards of topsoil derived from NFS lands. This alternative includes reclamation of the Mineable Pit except for the portion subject to inundation in the post mine lake. Soil reclamation would increase soil ecosystem function in the Mineable Pit disturbance area from the disturbed state. This alternative would also increase the length of soil storage time and diminish natural soil ecosystem function during the life of the Mineable Pit (45 years).

On NFS lands, reclamation would result in a permanent change to 400 acres of the Pits and Quarries Q0702 soil map unit for the pit reclamation area, roads, PUG Plant, and WRF, except for any area that results in a pit lake, which would be water.

Alternative F

Construction

Alternative F includes the most soil disturbance of any of the alternatives and results in the most acres with moderate water erosion susceptibility, for both NFS and private lands. This additional disturbance is due to the footprint of the WRF on NFS lands.

Acres on NFS lands tabulated by soil type and the estimated salvage volumes for each affected soil type under Alternative F are summarized in **Table 33**. Alternative F incorporates the greatest acreage of soil disturbance and therefore produces the greatest volume of topsoil to store. This is primarily due to the increased WRF configuration.

Under Alternative F, additional acres of soil disturbance and exposure to wind and water erosion from new power line construction would occur on NFS and private lands.

The WRF disturbance footprint under Alternative F would be expanded onto private and NFS lands. Reclamation would be delayed until final contouring of WRF slopes and new stream channel construction, likely increasing soil storage times.

Table 33. Alternative F Disturbed Acres and Soil Salvage Volumes on NFS Lands		
Affected Soil Map Unit	**Acres**	**Soil Salvage Cubic Yards**
Disturbed Land	11.8	-
Grizzly-Virkula complex, 6 to 15 percent slopes	407.8	822,397
Grizzly-Virkula complex, 15 to 60 percent slopes	5.9	11,898
Lyxn loam	2.0	4,033
Peso very cobbly clay loam	4.6	9,277
Rock outcrop Vanocker, dry complex, 50 to 75 percent slopes	0.1	13,153
Suglo-Nihill complex, 3 to 10 percent slopes	0.6	1,210
Vanocker gravelly silt loam	82.3	165,972
Peso-Paunsaugunt complex 6 to 10 percent slopes	10.4	20,973
NFS Total*	**525.5**	**1,035,760**

* Does not include pit reclamation.

Cordeston loam soil map unit that support riparian and wetland soils associated with Beaver Creek would be avoided.

Reclamation

The impacts on topsoil to be used for reclamation would be the similar to Alternative D, however additional pit reclamation disturbance would be reduced by avoiding the mineral withdrawal area. Reclamation of the Mineable Pit would result in the need to store 84,095 cubic yards. On NFS lands, reclamation would result in a permanent change for 580 acres to soil map unit Pits and Quarries Q0702 for the pit reclamation area, roads and the PUG Plant location, except any area that results in a pit lake, which would be water.

Alternative G

The acreages of affected soil types on NFS lands and the estimated salvage volumes for each affected soil type under this alternative are summarized in **Table 34.**

Under this alternative, the disturbance footprint of the Mineable Pit and its reclamation would be reduced and reclamation delayed until total backfill. This would decrease soil salvage volumes but increase storage time in stockpiles by up to 30 years, negatively impacting some components of the soil ecosystem. Other soil related impacts would be the same as those presented in the Effects Common to All Alternatives.

The same access road would be used as in Alternative C; however the road would be narrower so there would be fewer acres of disturbance required with 17,550 cubic yards of topsoil stockpiled from NFS lands.

The WRF disturbance footprint in Alternative G may be expanded onto additional NFS lands. This would increase the total WRF disturbance footprint and require soil salvage and storage volumes located on NFS lands of approximately 122,246 cubic yards as part of the total 874,277 cubic yards, including private lands.

The PUG Plant and portions of the haul road would be situated in flooded Cordeston loam soils that support riparian habitat. Salvage and stockpile

Table 34. Alternative G Disturbed Acres and Soil Salvage Volumes on NFS Lands		
Affected Soil Map Unit	**Acres**	**Soil Salvage Cubic Yards**
Cordeston loam, 1 to 6 percent slopes	1.2	2,420
Disturbed Land	7.2	-
Grizzly Verkula complex	288.1	581,002
Grizzly-Virkula complex, 6 to 15 percent slopes	0.8	1,613
Grizzly-Virkula complex, 15 to 60 percent slopes	0.2	403
Larkson loamy coarse sand	1.0	2,017
Lyxn loam	0.6	1,210
Vanocker gravelly silt loam	86.9	175,248
NFS TOTAL	**386.1**	**763,913**

storage of these wet soils with high organic matter content would almost certainly alter their steady state oxidation levels and organic matter decomposition rates. Storage time would directly impact soil productivity as stored soil dries and unfavorable conditions develop to maintain native in-situ soil biological components. Separating riparian soils from upland soils for stockpiling would help support pre-disturbance soil by reducing dilution of the pre-mine soil components diversity. The effectiveness and timing of restoring soil function are unknown however, and site specific. The Cordeston loam soil map unit that support riparian/wetland soils associated with Beaver Creek would be avoided in this alternative.

Reclamation

Reclamation of the Mineable Pit would be accomplished by complete backfilling and covering it with topsoil. No additional topsoil would be disturbed and stockpiled as a result of this pit reclamation, and therefore the effects on topsoil would be the same as for Alternative C. On NFS lands, reclamation would result in a permanent change of 379 acres for the pit reclamation area, roads and the PUG Plant location to soil map unit Pits and Quarries Q0702.

Reclamation of the WRF would be delayed by an estimated 31 years until final removal of material from the WRF for pit backfill.

Alternative H

The acreages of affected soil types on NFS lands and the estimated salvage volumes for each affected soil type under this alternative are summarized in **Table 35.**

Impacts on soils would be the same as those presented in the Effects Common to All Alternatives.

The same access road would be used as in Alternative C; however the road would be narrower so there would be fewer acres of disturbance required with 17,550 cubic yards of topsoil stockpiled from NFS lands.

The WRF disturbance footprint in Alternative H is the same as Alternative E.

The PUG Plant and portions of the haul road would be situated in flooded Cordeston loam soils that support riparian habitat. Salvage and stockpile storage of these wet soils with high organic matter content would almost certainly alter their steady state oxidation levels and organic matter decomposition rates. Storage time would directly impact soil productivity as stored soil dries and unfavorable conditions develop to maintain native in-situ soil biological components. Separating riparian soils from upland soils for stockpiling would help support pre-disturbance soil by reducing dilution of the pre-mine soil components diversity. The effectiveness and timing of restoring soil function are unknown however, and site specific. The Cordeston loam soil map unit that support riparian/wetland soils associated with Beaver Creek would be avoided in this alternative.

Table 35.
Alternative H Disturbed Acres and Soil Salvage Volumes on NFS Lands

Affected Soil Map Unit	Acres	Soil Salvage Cubic Yards
Cordeston loam, 1 to 6 percent slopes	1.2	2,420
Disturbed Land	13.6	-
Grizzly Verkula complex	244.7	493,398
Grizzly-Virkula complex, 6 to 15 percent slopes	0.9	1,740
Grizzly-Virkula complex, 15 to 60 percent slopes	0.2	403
Larkson loamy coarse sand	1.0	2,017
Lyxn loam	0.3	599
Vanocker gravelly silt loam	97.4	196,441
NFS TOTAL	**359.3**	**697,176**

Reclamation

The impacts on topsoil to be used for reclamation would be the similar to Alternative F. On NFS lands, reclamation would result in a permanent change for 580 acres to soil map unit Pits and Quarries Q0702 for the pit reclamation area, roads and the PUG Plant location, except any

area that results in a pit lake, which would be water.

Reclamation of the WRF would be the same as Alternative E.

3.8.3.2 Cumulative Effects

The analysis area for cumulative effects to soil resources is the Project Area. Impacts on soils do not extend beyond the local disturbance area.

Alternative A

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects.

Cumulative Effects Common to All Action Alternatives

Past, present, and reasonably foreseeable future actions that have affected or would affect soils include exploration and mineral resources development, road maintenance and improvement, grazing, and recreational activities. Cumulative impacts that may occur associated with surface disturbance include soil erosion, compaction, and loss of productivity to a limited extent. The greatest potential for cumulative effects due to these processes is during construction, and to a lesser degree, during operations due to road use and maintenance. Effects from a loss in productivity may continue following reclamation and closure. Reclaimed or second-growth vegetation communities tend to be less diverse, have an altered soil profile and associated soil processes, and may be less productive then pre-mine or pre-harvest conditions.

Cumulative Effects by Alternative

The magnitude of cumulative effects to soils would differ by alternative at levels that may be inferred by the direct and indirect analysis. Alternatives D, E, F, G, and H include design features to minimize soil erosion and impacts to soil productivity of riparian soils. Inclusion or placement of project components such as power poles, roads, and facility footprints vary by alternative. Alternative E would result in the least acreage of disturbed soils and amount of stockpiled soil, and would not include placement of utility poles, thus having the least potential for cumulative effects of erosion and compaction. However, the soil would be stockpiled for a longer time during reclamation, which may result in a greater potential for cumulative effects to productivity. Alternative F has the greatest potential for erosion based on the increased acreage of disturbance being exposed to water and wind forces, and thus has the greatest potential for cumulative effects.

3.8.3.3 Irretrievable and Irreversible Consequences

Irretrievable and Irreversible impacts identified above include:

- Long-term loss of soil productivity from all soil salvage operations under all action alternatives.
- Leaving the Mineable Pit footprint open would irretrievably and irreversibly reduce suitable topographic acreage for developing and supporting soil resources in Alternative C.

3.9 Geology, Minerals, and Stability

3.9.1 Area of Analysis and Methods

The analysis area for Geology, Minerals, and Stability is the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes.

3.9.2 Affected Environment

The Bear Lodge Mountains are part of the Black Hills Uplift formed during the latter stages of the Laramide orogeny during the late Cretaceous-Early Tertiary (approximately 50 million year ago (Wyoming School Facilities Department, 2014). This period involved the uplift and eventual exposure of basement rocks which consists of Precambrian schist, gneiss, and granite overlain by Paleozoic and Mesozoic clastic and carbonate

rocks (Roche Engineering, Inc., 2014) with the subsequent erosion of overlying sedimentary units from higher elevations. Cenozoic volcanism and intrusive activity along with associated dikes, diatremic breccia pipes, and feeder tubes cut through the region. The Cenozoic alkaline igneous activity appears to be mainly restricted to the northern portion of the Black Hills and consists of multiple intrusions of phonolite, trachyte, and other alkaline igneous rocks. The alkaline igneous complex has surface dimensions of approximately 2.8 by 6 miles and is elongated in the northwest-southeast directions (Roche Engineering, Inc., 2014). Associated with this activity was the emplacement of carbonatite and silico-carbonatite dikes which are often enriched with concentrations of rare earth bearing minerals in the north central core area of the regional uplift The structural complexity and uniqueness of the local geology can be attributed to the stresses placed upon these rocks due to tectonic uplift during the Laramide orogeny, the subsequent emplacement of igneous intrusions, and the formation of exfoliation joints after uplift due to erosional removal of the overlying sedimentary formations. Detailed mapping of the different lithologies and their juxtapositions has shed light on the genesis and orientation of the joints and fractures within the complex and the subsequent emplacement of the unique mineralization in the area.

Figure 16 shows a generalized overview of the regional geology of the northern Black Hills area. A central core of Precambrian rocks is surrounded by outward dipping Paleozoic and Mesozoic strata draped over the limbs of the uplifted areas and eroded away over the highest central region of the uplift.

Figure 17 shows the locations of these Cenozoic alkaline igneous features in the northern Black Hills. Several features are associated with important economic mineral deposits. Among these are the Tinton Dome which produced tin, niobium, tantalum, and gold, the Lead-Deadwood Complex noted for its gold deposits, and the rare earth, gold, and thorium mineralization associated with the Bear Lodge Mountain features.

As evidenced by the breccia pipes present in the igneous features of the area, emplacement was likely rapid and highly energetic. Commonly this emplacement occurs along zones of weakness that utilized existing faults and fractures as well as propagating new structures associated with the injection of these magmas. In the northern Black Hills the alkaline igneous bodies often contain xenoliths of Paleozoic and Mesozoic rock fragments suggesting a rapid, perhaps even pneumatolytic (gas charged explosive) emplacement. Similar emplacement mechanisms are noted in other alkaline-carbonatite rocks in the Arkansas Alkaline Province (Eby & Vasconcelos, 2009) and elsewhere around the world. Had the magma been introduced more slowly, one would surmise that these foreign fragments would have been assimilated into the magma by anatectic (partial melting) processes. Rapid emplacement would therefore exacerbate existing fracture sets and most likely introduce new ones into the intruded strata.

The rare earth mineralization at Bear Lodge occurs in an area of approximately 6.2 square miles in the southern portion of the Bear Lodge Mountains (Staatz, 1983) near the axis of a northwest trending elongated alkaline intrusive dome comprised of carbonatite and silicocarbonatite dikes, veins, and stockworks hosted in the Bull Hill and Whitetail diatremes. **Figure 18** shows the geology. The diatremes, which are the primary ore target, are part of a Tertiary alkaline intrusive belt (red features on **Figure 16**) that trends about N75W and extends from the east from Bear Butte, South Dakota through the Bear Lodge Mountains to the west at Devils Tower and the Missouri Buttes in northeastern Wyoming (Roche Engineering, Inc., 2014).

The rare-earth and thorium deposits occur principally in large multiple intrusive bodies of trachyte and phonolite (Staatz, 1983). These mineralized deposits primarily occur either as disseminated stockworks or as veins. The rare earth elements in the Bear Lodge occurrence include the rare elements neodymium, praseodymium, europium, cerium, lanthanum, dysprosium, terbium, gadolinium, samarium, yttrium, erbium with relatively small amounts of ytterbium, thulium, lutetium, and holmium (Roche Engineering, Inc., 2014).

Figure 18 shows how the lower right-hand lobe of the proposed mine encompasses the Bull Hill diatremes and how the upper left-hand lobe encompasses the smaller White Tail diatremes. The approximate proposed open pit location is superimposed as a green outline onto the map over the denoted geology.

Figure 16. Regional Geology

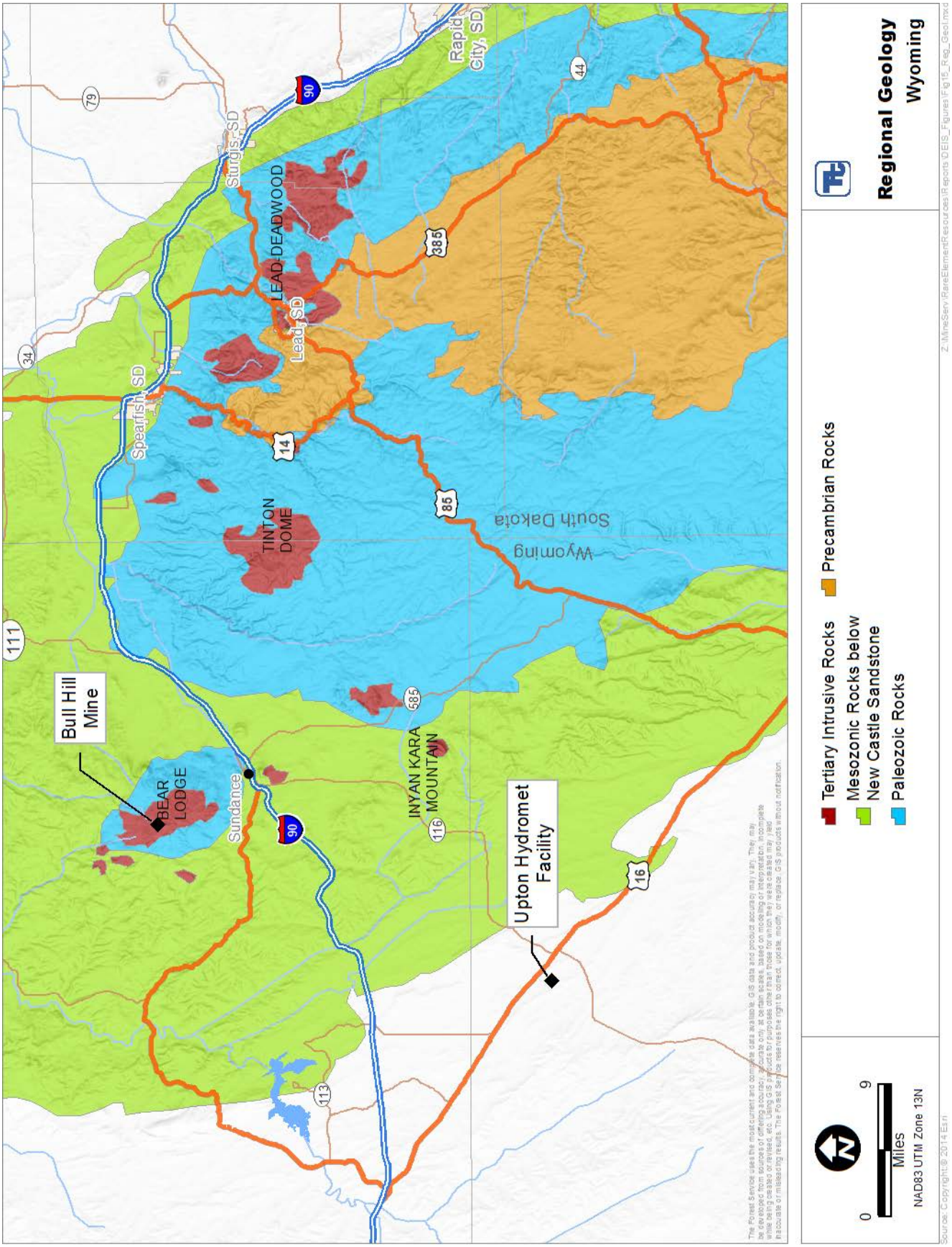


Figure 17. Location of Notable Alkaline Igneous Features in the Northern Black Hills

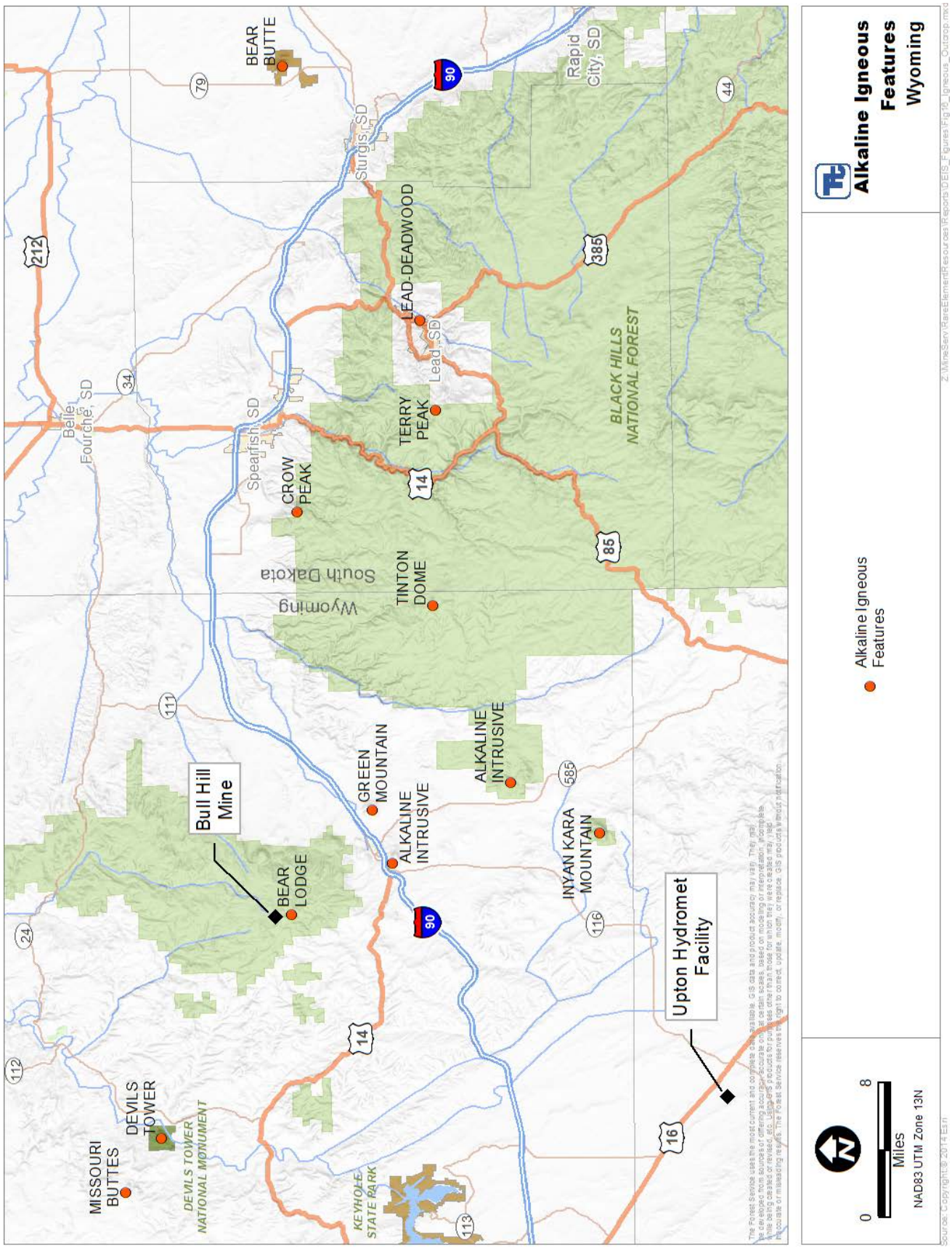
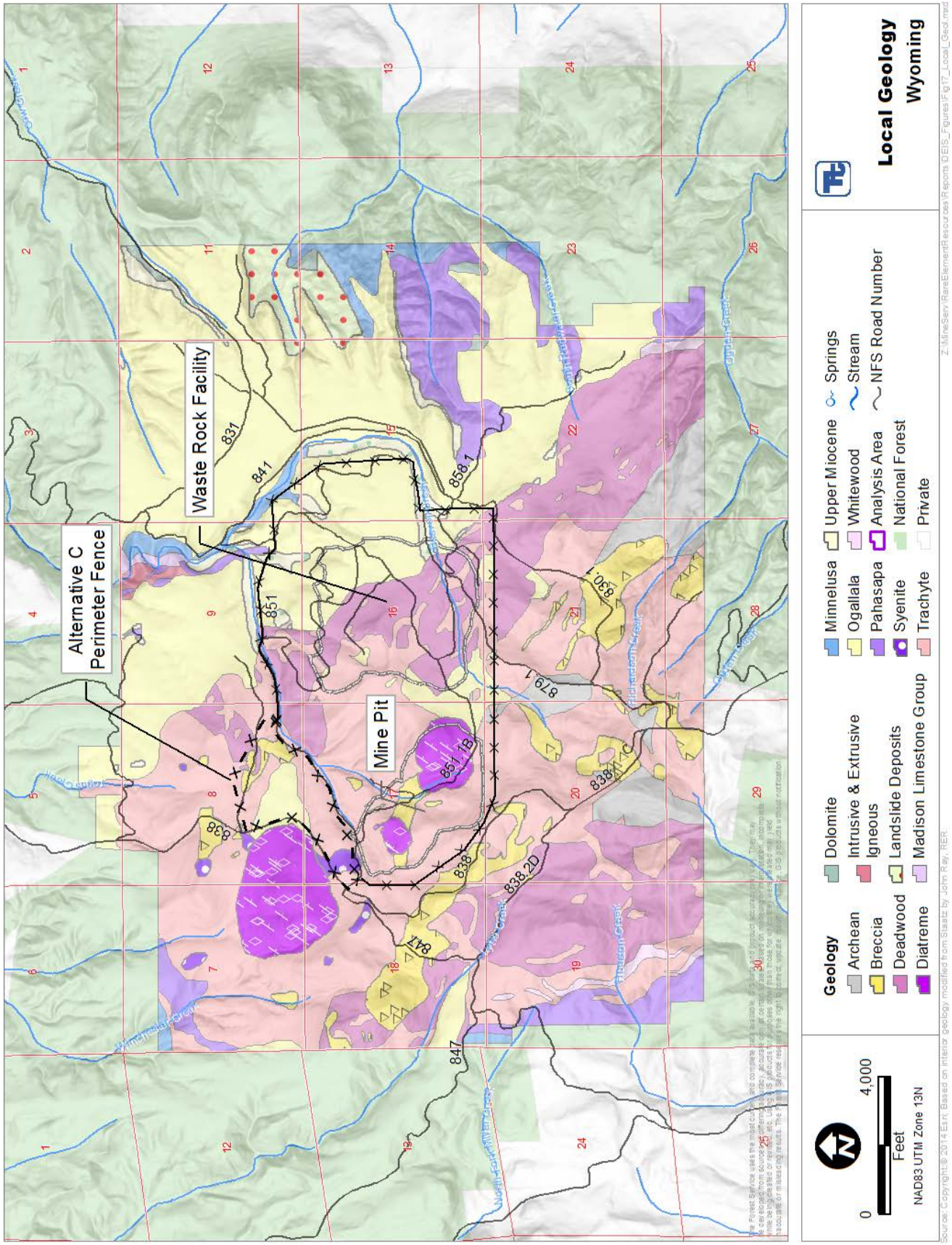


Figure 18. Close-up View of the Geology



Rare earth deposits of the region appear to exhibit a pronounced zonation with the lighter rare earth elements being dominantly found in the Bull Hill deposit while the heavier rare earth elements and yttrium are preferentially located within the Whitetail, Carbon, and Taylor targets to the northwest. The central portion of the dome appears to be highly altered whereas outlying igneous intrusions show little to no alteration. Localized intrusive brecciation of the Bull Hill and Whitetail diatreme bodies are noted and are interpreted to indicate that the forces associated with the emplacement of these intrusions were high. As such, fractures would develop within the igneous complex and surrounding strata during the time of igneous emplacement.

Tuffs and breccias are still visible in some locales (Roche Engineering, Inc., 2014). **Figure 19** and **Figure 20** (RER, 2014a) show the east-west and north-south geologic cross sections across the proposed Mineable Pit, respectively. There is a central core of Precambrian basement rock (depicted as gray) that has overlapping Paleozoic and Mesozoic sedimentary material that was uplifted during the later stages of the Laramide orogeny. This resulted in layers of sedimentary rocks that dip away from and drape over the central uplifted area. These sedimentary units along the margins of the uplift are important recharge zones for many of the aquifers exploited for their water resources further down dip. As shown, the phonolite and trachyte igneous bodies (depicted as pink) were emplaced during the Cenozoic. These materials cut across or occur along the contacts of the other lithologies within the core (Precambrian granitic and metamorphic assemblages) and are locally intruded within the sediments that are draped over the flanks of the uplift In addition, highly fractured breccia pipes are present within the central domed portion of the complex. Major fracture orientations are predominantly northwest and northeast with a lesser developed fracture set oriented north-south (Wicks, et al., 1999). The strongest fracture orientation represented is the aforementioned northeastern set.

In addition to the stratigraphically controlled groundwater mentioned above, shallow and generally perched zones of groundwater are known to occur in some locations in the area where facilities may be constructed.

3.9.3 Environmental Consequences

3.9.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, if no mine development occurs, the current conditions of the area with regard to the geology would remain the same. Normal natural erosional processes that could release metals into groundwater and surface streams would occur but only over long geologic time scales. Short of natural catastrophic processes occurring, which are not likely (such as increased seismic or tectonic activity), the presence of materials associated with rare earth deposits should pose no additional risks over those that currently exist for the area.

Effects Common to All Action Alternatives

Exploration

Exploration would include drilling and excavation of trenches but not blasting. Therefore, it would not affect the PM-1 repository.

Construction

Impacts to geology and mineral resources are the same for all action alternatives, other than those described for specific alternatives later in this section. Impacts to geology and mineral resources are associated with the excavation and relocation of geological materials from the mine pit and those related to mineral processing and mine waste disposal.

The Department of Defense maintains a site (PM-1 repository) in Section 20 that formerly housed a nuclear power plant for a radar station in the 1960s. The reactor has since been dismantled and “entombed”. A concern was raised that blasting in the area would damage the site and cause radiation to be emitted into the

Figure 19. East-West Geologic Cross-Section of the Bear Lodge Area

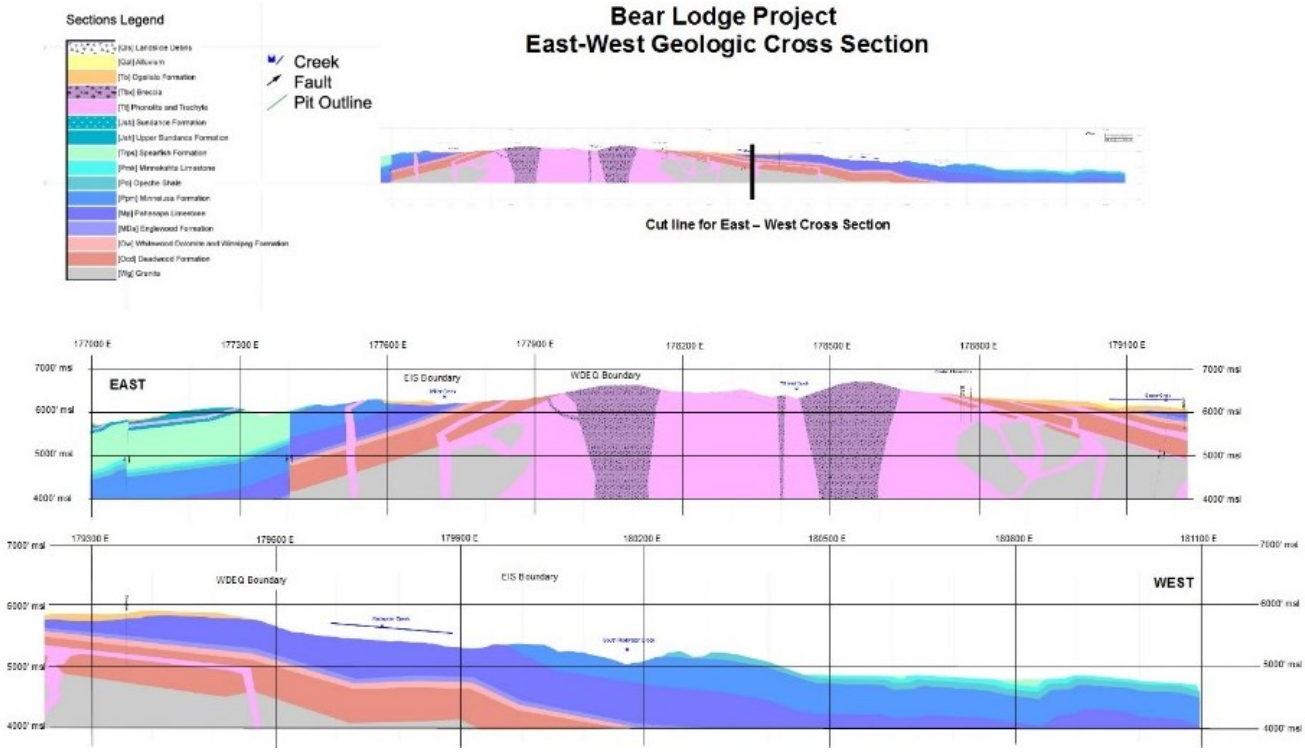
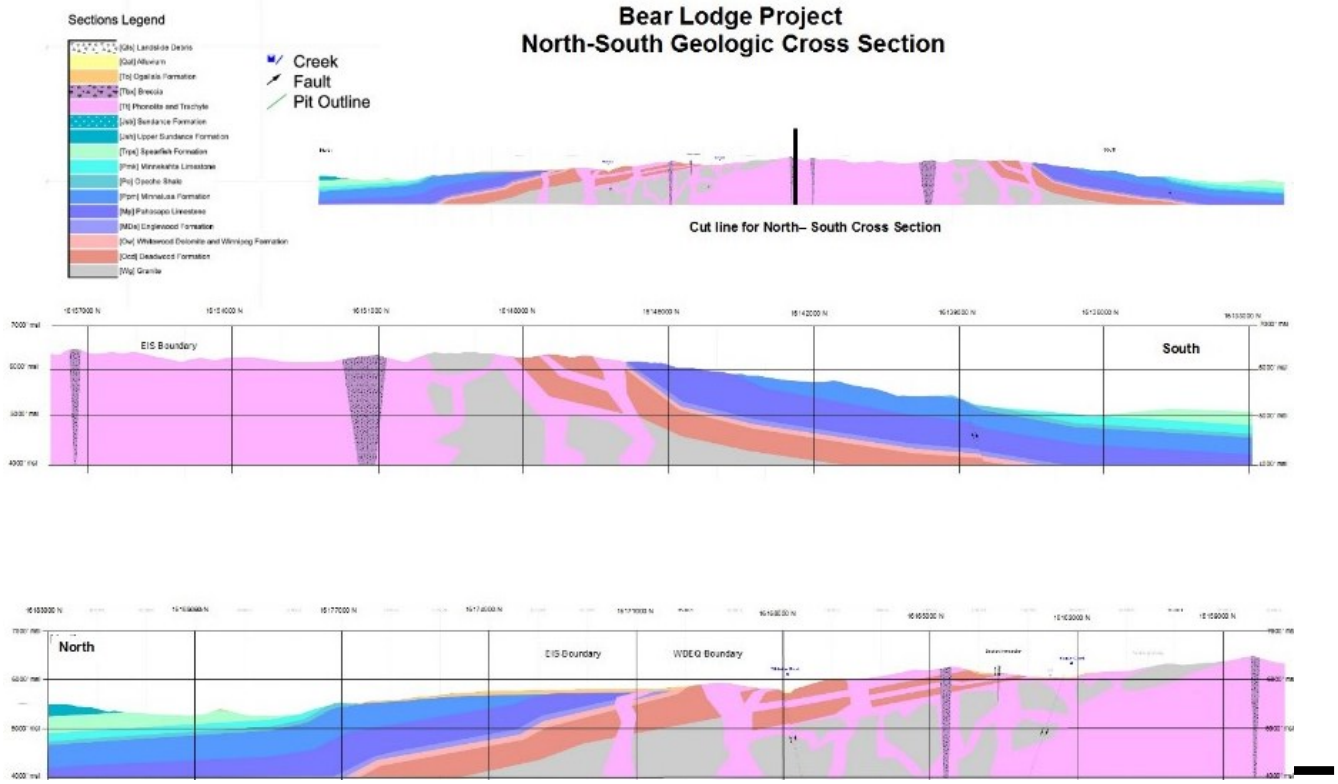


Figure 20. North-South Geologic Cross-section of the Bear Lodge Area



environment. There is one-half mile buffer established by the Air Force which exists around the former PM-1 site that withdraws the land from mineral claims as a precaution to prevent the release of any nuclear materials (see Section 3.16.2). This promulgated one half mile distance was deemed safe by the Air Force. In addition to this mineral withdrawal, the U.S. Forest Service in 1979 established a special closure under an executive order (36 CFR 261.50) prohibiting the use of explosives near the PM-1 site.

The mining operation would excavate and relocate approximately 151 million tons of geological material (including overburden (waste rock) and pre-concentrate) (Roche Engineering, Inc., 2014).

Because of the buffer distance, blasting would not affect stability of the PM-1 repository site. Vibration monitoring is required (see Section 2.9.4) so that adjustments, if necessary, can be made to avoid adversely affecting the repository. Regular excavation in the Mineable Pit with conventional proposed mining equipment would not create vibration of significant intensity to affect the PM-1 repository.

While blasting may cause low intensity vibrations that may be detectable off-site, blasting within the Mineable Pit would not cause vibrations strong enough to affect landslide areas in or near the Project Area. The blasting is highly controlled and engineered, and much like the explosives techniques used in building demolition, the process is designed to loosen rock locally and not to damage the structural integrity of the rock behind or below the targeted blast zone.

The Miller Creek Road crosses an area mapped as landslide in the center portion of Section 18, T52N R63W. The landslide is a slump type failure with multiple blocks of debris. Approximately 4,500 feet of road occurs within the landslide area. Roadway improvements on this segment of Miller Creek Road should consider the slide and plan contingency mitigation through periodic maintenance or possible drainage improvements.

Operation

Mining (including blasting) in the Mineable Pit and construction of the WRF as the project progresses are analyzed as part of the construction activity. There would be no additional impacts on geology and minerals and stability from mine operations, such as processing and hauling ore, and dewatering.

Reclamation/Closure

Effects from reclamation are discussed under each alternative.

Alternative C

Construction

Shallow groundwater occurs where the PUG Plant would be located which could have an effect on the below grade conventional foundations being considered for the PUG Plant and under certain circumstance, may create difficult mobility issues for rubber-tired construction equipment. Groundwater impacts on design and construction can be mitigated by accommodating for shallow water in the design of foundation elements, by changing the selected foundation type to a deep foundation style of implementation, and/or by raising the site grade by filling.

Stability modeling completed for the WRF in Section 16 considered a subsurface profile below the WRF comprised of overburden soil with clay rich zones, fractured bedrock overlying bedrock. Based on the completed stability analysis the WRF under ultimate build-out met acceptable Factors of Safety for static and pseudo-static loading conditions (Golder Associates, 2014a).

The analysis completed for Alternative C indicates that it is highly probable that there would be suitable foundation subgrade soils for the WRF under that design. Alternative D may or may not require additional engineering or construction costs for the WRF, although these costs would not be prohibitive.

Reclamation/Closure

As part of the application to mine, an investigation and evaluation of the stability of the Mineable Pit at closure was completed (Sierra Geotechnical, 2014). Tetra Tech conducted an independent review of the report, evaluating whether the study used appropriate information and modeling techniques and accurately reported the conclusions. Six individual cross sections of the pit at closure were analyzed. Slope stability was assessed immediately following cessation of pit dewatering and when the pit lake had reached the expected maximum elevation of 5,945 feet amsl in up to 100 years. The safety factors of the cross sections ranged from 1.24 to 1.64. The analysis showed that all the cross sections would have slope stability factors of greater than 1.2, which is considered acceptable for low consequence of failure.

Naturally occurring degradation of the exposed bedrock would prevail on the final post closure slopes after mining due to exposure effects from weathering processes. In consideration of the rock quality noted in the geotechnical studies completed (Roche Engineering, Inc., 2014; Sierra Geotechnical, 2014), it is expected that some raveling of the bench faces and possible development of minor sloughs of rockfall between ramps over the long term. Rounding of rock surface angularities and hard points on slope faces would be on-going with the passage of time but because of final pit slope geometries, expansion beyond minor surface irregularities to deep seated failures is not anticipated. Growth of revegetation would be isolated to those locations of preferable accumulation of moisture and the deposition of soil fines from weathered bedrock. Vegetation in these locations would likely consist of a random patchwork of trees, native shrubs and grasses intermixed with exposed rock down to the water level of the pit lake.

The WRF reclamation would include regrading and recontouring operational side slopes to an overall 3H:1V slop, designed to reflect existing topography as much as practical (RER, 2014a). The regrading and revegetation would maintain stable slopes. As the WRF would be constructed in 50-foot lifts, concurrent reclamation would generally reclaim each lift as it is completed.

Alternative D

Construction

The PUG Plant location in Alternative D would have similar conventional shallow foundation and construction mobility issues affected by shallow groundwater as described in Alternative C.

It is possible that a geotechnical investigation for stability analysis would be needed for any areas of the WRF which extend outside of Tract 42 (Roche Engineering, Inc., 2014). Additional geotechnical analysis and design would be necessary to evaluate steeper proposed WRF repository slopes and higher repository elevation at final construction, including geotechnical exploration, laboratory testing and analysis to confirm that the stability of the foundation area of the WRF; the foundation north of Beaver Creek to confirm the proposed WRF layout; the foundation and abutment areas of the sediment control structures, borrow source material and spillway alignment; and the waste rock toe area for stability should water levels rise below the WRF due to groundwater or storm events filling the diversion channels.

Alternative D may require additional engineering or construction to investigate areas outside the footprint tested for Alternative C.

Reclamation/Closure

The lithologies intercepted in the north, south, east, and immediate west of the pit during highwass reduction would be the same as Alternative C (and other action alternatives), however pit boundaries would intersect a highly brecciated area in the southwest and the pit margins would be a little closer to poorly consolidated, highly porous and permeable Ogallala formation in the southeast. The interception with the brecciated zone could affect groundwater (see Section 3.9.2).

Partial backfill of the Mineable Pit would reduce the overall size of the WRF but not enough to affect the stability, so reclamation stability of the WRF at closure would be similar to Alternative C. Concurrent

reclamation may be feasible on the lower lifts of the WRF, but the top lifts would be the ones that are removed and placed into the Mineable Pit, delaying their reclamation somewhat.

Naturally occurring degradation of the bedrock exposed by the highwall reduction would prevail on the final 3H: 1V layback slopes following final grading due to exposure effects from weathering processes. In consideration of the rock quality noted in the geotechnical studies (Roche Engineering, Inc., 2014; Sierra Geotechnical, 2014), it is expected that some raveling of the bench faces and possible development of minor sloughs of rockfall between ramps in approximately 65 years. Rounding of rock surface angularities and hard points on slope faces would be on-going with the passage of time but because of final pit slope geometries, expansion beyond minor surface irregularities to deep seated failures is not anticipated. Growth of revegetation outside of topsoiled and reseeded areas would be isolated to those locations of preferable accumulation of moisture and the deposition of soil fines from weathered bedrock.

Except for these possible concerns on intersecting potential areas of higher permeability, the overall geology of the project should not pose any significant detrimental effects to the environment.

The proponent has identified rare element resources adjacent to and below the bottom of the Mineable Pit. Partially filling the Mineable Pit with layback material or waste rock in Alternative D would bury the resource outside the lower sides of the pit. In their report evaluating the impacts of partial backfilling of the pit, Golder evaluated the impacts related to impairing access to potential mineral resources adjacent to the Mineable Pit (Golder Associates, 2014c). **Table 36** shows the estimate they derived. It should be noted that this evaluation is for the gross value, and does not account for the cost of mining, either with or without the backfilling.

Table 36.
Mineral Resources Recovery Impaired Under Alternative D, E, F, and H

Category	Average Grade (% rare elements)	Ore Mass	Rare Elements	Gross Value
Oxides (measured resources)	3.43	0.30 million tons	21 million pounds	$233 million
Oxides (indicated resources)	2.87	4.22 million tons	242 million pounds	$2.7 billion
Oxides (inferred resources)	2.33	15.40 million tons	715 million pounds	$8.0 billion
Total	8.63	19.92 million	978 million pounds	$10.93 billion

Source: Table 3 (Golder Associates, 2014c).

Alternative E

Construction

Based on the final groundwater modeling report (Petrotek Engineering Corp, 2015a), the PUG Plant location in Alternative E would avoid shallow groundwater areas. Therefore, there would be no need for additional design or engineering to address impacts associated with shallow groundwater during construction of the PUG Plant.

As in Alternative D, additional geotechnical design may be needed for the WRF because the final elevation would be higher and slopes would possibly be of steeper inclination. The WRF footprint is not entirely within the area already investigated for subsurface conditions, so additional geotechnical investigation would probably be needed for stability.

Reclamation/Closure

Reclamation of the Mineable Pit would have the similar impacts on geology and minerals as described for Alternative D. Filling the Mineable Pit with material removed for the 3:1 layback would impair the removal of additional mineral reserves as shown in **Table 36**.

Additional geotechnical investigation and design for the reclamation of the WRF in Alternative E would need to be completed because the proposed footprint extends outside the area where foundation stability was assessed, because the overall height would be increased above Alternative C, causing steeper proposed repository slopes and higher repository elevation. Based on the information and methods presented in the closure stability report discussed in Alternative C (Roche Engineering, Inc., 2014), it is probable that a final closure WRF can be designed to be stable.

Naturally occurring degradation of the exposed bedrock would prevail on the final 3H: 1V layback slopes in the pit highwalls following final grading due to exposure effects from weathering processes. In consideration of the rock quality noted in the geotechnical studies completed (Roche Engineering, Inc., 2014; Sierra Geotechnical, 2014), one should expect some raveling of the bench faces and possible development of minor sloughs of rockfall between ramps after reclamation is complete in over 65 years. Rounding of rock surface angularities and hard points on slope faces would be on-going with the passage of time but because of final pit slope geometries, expansion beyond minor surface irregularities to deep seated failures is not anticipated. Growth of revegetation outside of topsoiled and reseeded areas would be isolated to those locations of preferable accumulation of moisture and the deposition of soil fines from weathered bedrock. Vegetation in these locations would likely consist of a random patchwork of trees, native shrubs and grasses intermixed with exposed rock down to the water level of the pit lake.

Alternative F

Construction

Impacts from construction of the PUG Plant would be the same as Alternative E.

The footprint of the WRF would be greatly expanded in this alternative, and consequently there is more cumulative area that has not been investigated for foundation subgrade support beneath the proposed facility. Therefore, additional geotechnical drilling, analysis, and design would be required, particularly on the part of the WRF that extends into Section 15 on the east boundary of the WRF.

Reclamation/Closure

Reclamation in Alternative F would avoid the mineral withdrawal completely.

Reclamation of the Mineable Pit would have the same impacts on geology and minerals as described for Alternative D. Post reclamation stability of the Mineable Pit would be similar to Alternative E. Filling the Mineable Pit with material removed for the 3:1 layback and placing material in the pit would impair the removal of additional mineral reserves similar to that shown in **Table 36**.

The WRF in this alternative would be engineered to follow natural topography and drainage. Because the WRF in this alternative covers more area and has a lower top elevation, it should present similar stability characteristics to that analyzed for the WRF evaluated in Alternative D. See the Alternative D discussion for the types of questions that would be answered with additional geotechnical investigation. Additional engineering, design, and construction costs are certain to be incurred, but probably not of a magnitude to make it economically unfeasible.

Alternative G

Construction

Shallow groundwater could be present which would require special PUG Plant design and construction similar to those as described in Alternatives C and D.

Impacts on stability from Alternative G WRF construction would be similar to Alternative C.

Reclamation/Closure

Alternative G would not increase the size of the Mineable Pit, as would happen in Alternatives D, E, and F, however it would bury the resource as described in the Reclamation discussion under Alternative D, E, and F. Golder evaluated this proposal and concluded that the value made inaccessible (Golder Associates, 2014d). **Table 37** shows their estimate.

Table 37. Mineral Resources Recovery Impaired Under Alternative G

Category	Average Grade (% rare elements)	Ore Mass	Rare Elements	Gross Value
Oxides (measured resources)	3.41	0.31 million tons	21 million pounds	$239 million
Oxides (indicated resources)	2.84	4.36 million tons	248 million pounds	$2.8 billion
Oxides (inferred resources)	2.26	19.70 million tons	891 million pounds	$9.9 billion
Total	8.51	24.37 million	1,160 million pounds	$12.94 billion

Source: Table 3 (Golder Associates, 2014d).

Stability analysis of Alternative G cap construction would be required looking at the interface shear forces between cap layers and final safety factors for the slope inclinations on the pit cap and the WRF.

Alternative H

Construction

Shallow groundwater could be present which would require special PUG Plant design and construction similar to those as described in Alternatives C and D.

Impacts on stability from Alternative H WRF construction would be similar to Alternative E.

Reclamation/Closure

Reclamation of the Mineable Pit would have the same impacts on geology and minerals as described for Alternative F. Based on the information and methods presented in the closure stability report discussed in Alternative C (Roche Engineering, Inc., 2014), it is probable that a final closure WRF can be designed to be stable.

3.9.3.2 Cumulative Effects

The analysis area for cumulative effects on geology and minerals includes the Mine Area plus a 5-mile buffer.

Alternative A

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects.

Cumulative Effects Common to All Action Alternatives

Past and present exploration activities removed small amounts of rock from drill holes and trenches. This activity did not impact the mineral resources or stability of the area (US Forest Service, 2009a). Cumulative disturbance to geologic resources caused by past and existing gravel extraction facilities would be minimal. The pits extract surface gravels, are relatively small and located over a mile away. Considering the other past, present, and reasonably foreseeable future actions identified for the project, impacts have not occurred or would not occur to minerals resources or stability and would not combine with project effects to result in cumulative impacts on geology, minerals, and stability.

3.9.3.3 Irretrievable and Irreversible Consequences

Irretrievable and irreversible impacts on geology, minerals, and stability include:

- Removal of mineral resources under any of the action alternatives.

3.10 Water

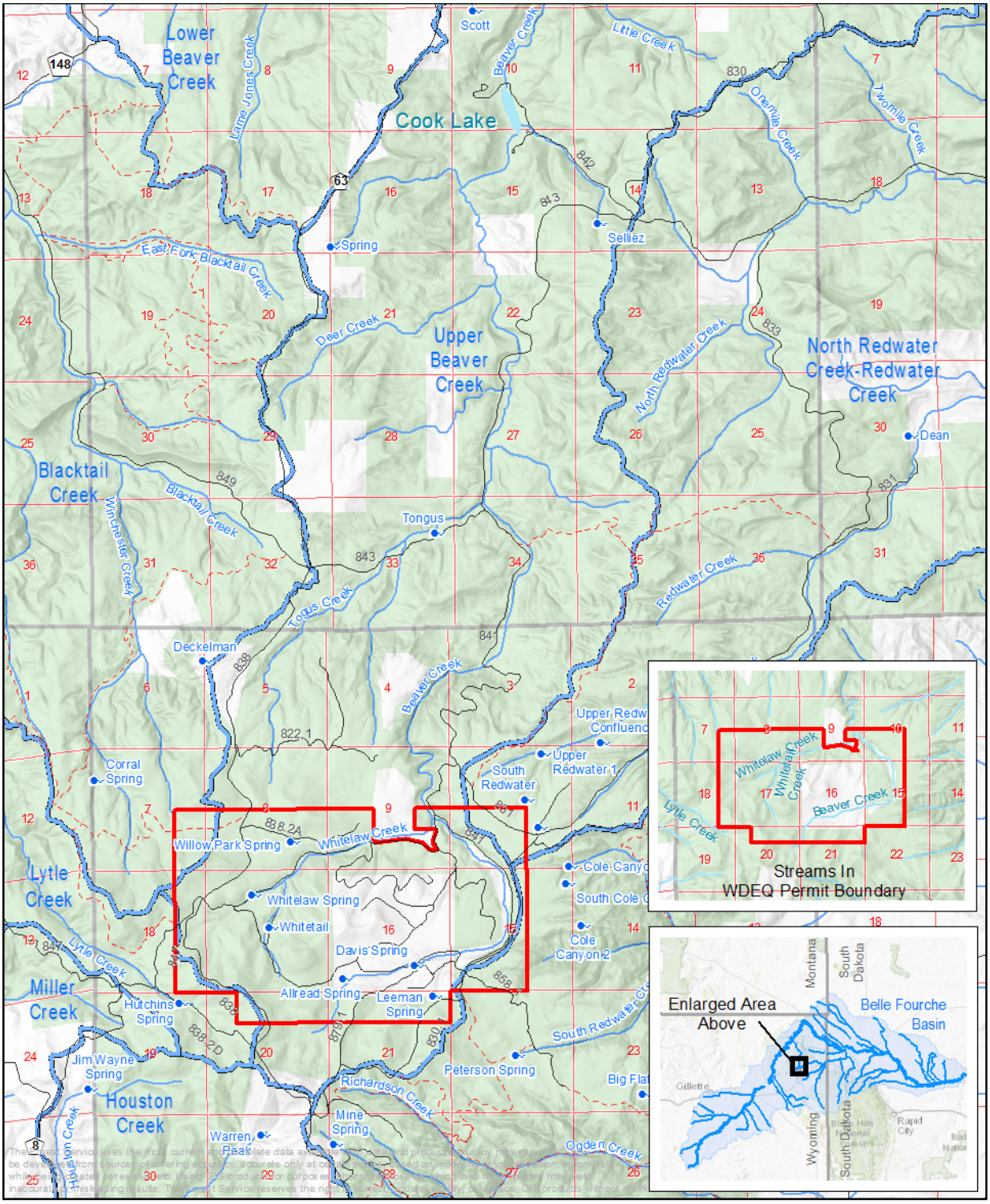
This section includes surface water (springs and streams) and groundwater (water in the saturated zone below the water table). Impacts may include water quantity and water quality. Effects on humans, wildlife, and livestock from potential water contamination are discussed in Section 3.18.

3.10.1 Analysis Area and Methods

The analysis area includes surface water in the Beaver Creek drainage upstream from its confluence with Whitelaw Creek and downstream areas where stream flow or water quality may be affected. The analysis area includes groundwater where groundwater levels or groundwater quality may be affected. In both cases, the analysis area extends beyond the WDEQ Permit boundary.

Methods and data used in the analysis include the following:

- Surveys of stream geometry at seven transects at or adjacent to surface water monitoring station locations on Beaver, Whitetail and Whitelaw creeks in 2011 (WWC Engineering, 2013) (**Figure 21**).
- Surface water flow and water quality monitoring at seven locations on Beaver Creek, Whitetail Creek, Whitelaw Creek and Lytle Creek (**Figure 21**) starting in November 2010 and continuing through August 2014 (WWC Engineering, 2015).
- Surveys and monitoring of flow rates and water quality at area springs and seeps (**Figure 22)** starting in May 2011 and continuing through August 2014 (WWC Engineering, 2015). Some of the spring sample locations may be duplicated or sampled adjacent to other nearby sample locations; for example Mine Spring_FR-SW and Mine Spring and OgdenSCynWall_BS-SW and OgdenSCynWall_P-SW.
- Groundwater monitoring, monthly, September 2011 through December 2014, including measurement of water levels and analysis of water quality (WWC Engineering, 2014a; WWC Engineering, 2015).
- Performance of 31 aquifer tests in 2012 and 2013 (Petrotek Engineering Corp, 2015b)
- Developing and operating a groundwater flow model to simulate the existing groundwater system and the mine pits (Petrotek Engineering Corp, 2015c).
- Geochemical characterization of rock for water quality modeling (Golder Associates, 2014e).
- Developing seepage, water balance, and water quality models for the WRF and the Mineable Pit (Golder Associates, 2014f; Golder Associates, 2015b).



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Miles
NAD83 UTM Zone 13N

6th Code Hydrologic Unit Boundary
WDEQPermitBoundary
National Forest
Private
Springs
Lake/Pond
Stream
NFS Road Number
Trails

Water Resources Study Area Wyoming

Source: Copyright:© 2014 Esri

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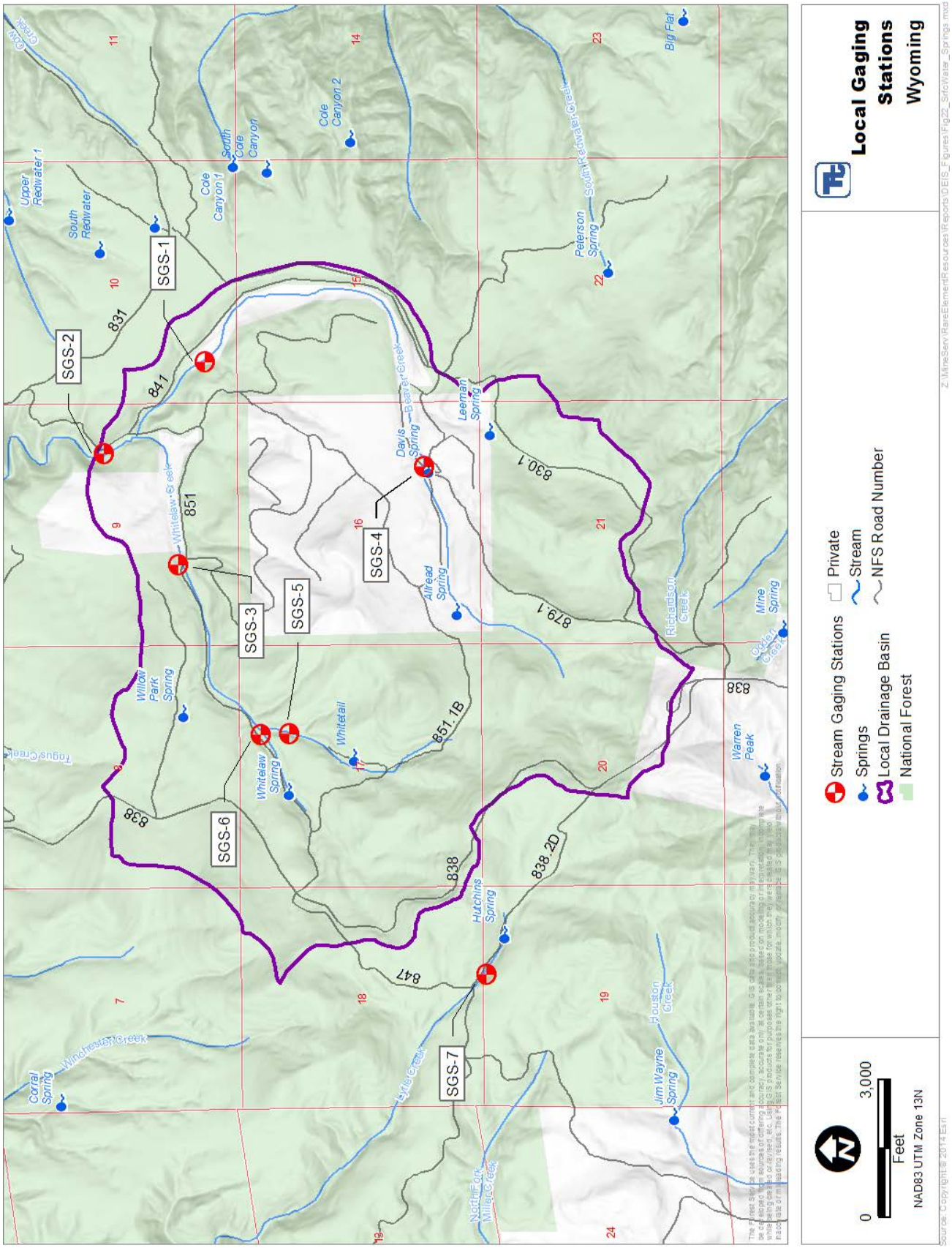
Figure 22. Gaging Station



Designated Uses and Water Rights

The Belle Fourche River basin has a multi-state water right compact between South Dakota and Wyoming intended to provide for the "*most efficient use of the waters of the Belle Fourche River Basin*" (Wyoming Water Development Office, 1943). The compact provides supplemental water storage for the river's reservoir and flood control to residents who live near the river in both states.

Surface water uses in the Beaver and Whitelaw creeks and other nearby watersheds include domestic supply, irrigation, mining/industrial, stock water use, recreation, and wildlife (WWC Engineering, 2014b). The SEO describes designated uses for spring water rights as stock, domestic, milling and mining (SEO, 2015). **Figure 22** shows the locations of existing surface water rights in the area. Perennial streams and intermittent reaches north and south of the Mineable Pit are classified Class 2AB. Class 2AB waters are known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Class 2AB waters can be either “cold water” or “warm water” depending upon the predominance of cold water or warm water species present. Class 2AB waters are designated as cold water game fisheries unless identified as a warm water game fishery by a “ww” notation in the Wyoming Surface Water Classification List. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, and aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value uses [Wyoming Surface Water Quality Standards, Section 4(b)(i)].

Surface Water Flow Characterization

The Black Hills region is semi-arid. Annual evaporation (approximately 45 inches) exceeds annual precipitation (WWC Engineering, 2014b). Runoff occurs mostly during spring snow melt. Precipitation data are presented in **Table 38**. The streams in the Mine Area are ephemeral (only flow in direct response to snow melt and precipitation), intermittent (cease flowing for weeks or months), or perennial (flow year-round).

Table 38.
Monthly and Annual Precipitation Summary

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot.
Bull Hill Mine													
2011*	1.85	1.0	1.9	2.6	6.5	2.3	3.2	1.3	1.2	0.7	0.4	0.4	23.3
2012	1.0	0.8	0.2	1.4	2.0	0.4	2.9	1.0	0.0	2.2	0.4	0.6	12.8
2013	0.3	1.3	0.8	2.4	9.3	2.2	3.9	1.6	3.7	7.8	1.1	0.7	35.1
Sundance													
2011	1.5	0.8	1.6	2.1	5.4	1.9	2.6	1.1	1.0	0.5	0.3	0.3	19.2
2012	0.8	1.5	0.5	2.0	1.6	1.0	3.9	1.3	0.0	0.9	0.3	0.5	14.3
2013	0.5	0.8	0.4	2.1	6.7	1.6	2.8	1.4	2.1	3.4	0.5	0.8	23.0
2014	1.7	1.7	3.5	1.3	2.1	5.0	1.0	1.2	2.8	1.8	1.9	1.7	27.5
Average Total Precipitation**	0.7	0.7	1.1	1.9	2.7	3.3	2.0	1.4	1.4	1.3	0.9	0.7	18.1

Source: (WWC Engineering, 2014b).
Notes: Precipitation values are in inches.
*2011 Bull Hill precipitation was estimated using the data from Sundance. A monthly adjustment factor of 1.21 was used.
**Average total precipitation data (5/1/1915 through 12/31/2005) (Western Regional Climate Center, 2015)

Table 39 provides a summary of the surface water flows measured by the proponent from 2011 to 2013. Hydrographs of each SGS are provided in the project file. **Figure 23** shows the monitoring locations. Gain and loss determinations (WWC Engineering, 2014b) were made by comparing average flow data between upstream and downstream gaging stations.

Table 39.
Surface Water Flow Summary

Stream Gage Station		Type	Year	Average (cfs)	Maximum (cfs)	Minimum (cfs)	Annual Runoff (ac-ft)	No-Flow Days
SGS-1	Beaver Ck. upstream of confluence with Whitelaw Ck.	Perennial stream, losing between SGS-1 & SGS-2	2011	4.3	67.9	0.1	3109.7	0
			2012	1.3	27.2	0.01	974.6	0
			2013	4	322.5	0.0	2904.1	7
			2014	6.4	538.5	0.0	3959	59
			2011-2014	3.9	538.5	0.0	10957	66
SGS-2	Beaver Ck. Below confluence with Whitelaw Ck.	Perennial stream	2011	6.4	117.3	1.07	4621.9	0
			2012	4.4	177.3	0	3203.8	2
			2013	8.1	383.9	0	5874.5	33
			2014	4.6	65.0	0.49	3127.3	0
			2011-2014	5.9	383.9	0.00	13700.2	35
SGS-3	Whitelaw Ck. Above confluence with Beaver Ck.	Perennial stream, losing between SGS-3 and SGS-2	2011	3.2	61.2	0.35	2317.3	0
			2012	2.3	26.1	0.13	1694.6	0
			2013	9.7	1486.6	0.2	7010.7	0
			2014	2.5	30.1	0.45	1702.6	0
			2011-2014	4.5	1486.6	0.13	12725.2	0
SGS-4	Beaver Ck. Just downstream from Davis Spring	Intermittent stream, losing between SGS-4 & SGS-1	2012	0.9	128.7	0	657.4	187
			2013	8.1	965.7	0	5875.7	23
			2014	8.4	234.0	0	5737.6	44
			2012-2014	5.8	965.7	0	12270.7	254
SGS-5	Whitetail Ck. above confluence with Whitelaw Ck.	Intermittent stream,	2012	0.4	1.7	0.01	268.3	0
			2013	0.4	16.4	0	318.1	30
			2014	0.9	19.9	0.38	634.4	0
			2013-2014	0.6	18.2	0	1220.8	30
SGS-6	Whitelaw Ck. Upstream of confluence with Whitetail Ck.	Perennial stream, gaining between SGS-6 & SGS-3	2012	0.5	10.2	0.08	391.0	0
			2013	3.7	343.3	0.16	2652.7	0
			2014			0	2822.4	1
			2012-2014	2.7	343.3	0.08	5866.1	1
SGS-7	Lytle Ck. Below Hutchins Spring	Intermittent	2012	0.6	12.5	0	418.9	80
			2013	1.1	68.2	0	820.5	192
			2014	1.0	278.1	0	713.9	277
			2012-2014	0.9	278.1	0	1953.3	549

Source: Draft PHC (WWC Engineering, 2014b)
Note: Flow data from SGS-5 for December 20, 2012 thru December 26, 2012 was considered faulty and was therefore substituted with a value of 0.4 cfs based on averages of 5 days before and after the deficient data. CFS- cubic feet per second.

Surface Water Quality

Surface waters have been broadly defined as all perennial, intermittent, and ephemeral defined drainages, springs, seeps, lakes, reservoirs, and wetlands which are not man-made retention ponds used for the treatment

of municipal, agricultural, or industrial waste; and all other bodies of surface water, either public or private, which are wholly or partially within the boundaries of the state.

Wyoming water quality regulations include an anti-degradation clause (WDEQ, Chapter 1 Wyoming Surface Water Quality Standards). The state of Wyoming when issuing a permit to mine would outline any anti-degradation requirements:

> *Water uses in existence on or after November 28, 1975 and the level of water quality necessary to protect those uses shall be maintained and protected. Those surface waters not designated as Class 1, but whose quality is better than the standards contained in these regulations, shall be maintained at that higher quality. However, after full intergovernmental coordination and public participation, the department may issue a permit for or allow any project or development which would constitute a new source of pollution, or an increased source of pollution, to these waters as long as the following conditions are met:*
> *(i) The quality is not lowered below these standards;*
> *(ii) All existing water uses are fully maintained and protected;*
> *(iii) The highest statutory and regulatory requirements for all new and existing point sources and all cost effective and reasonable best management practices for nonpoint sources have been achieved; and*
> *(iv)The lowered water quality is necessary to accommodate important economic or social development in the area in which the waters are located.*

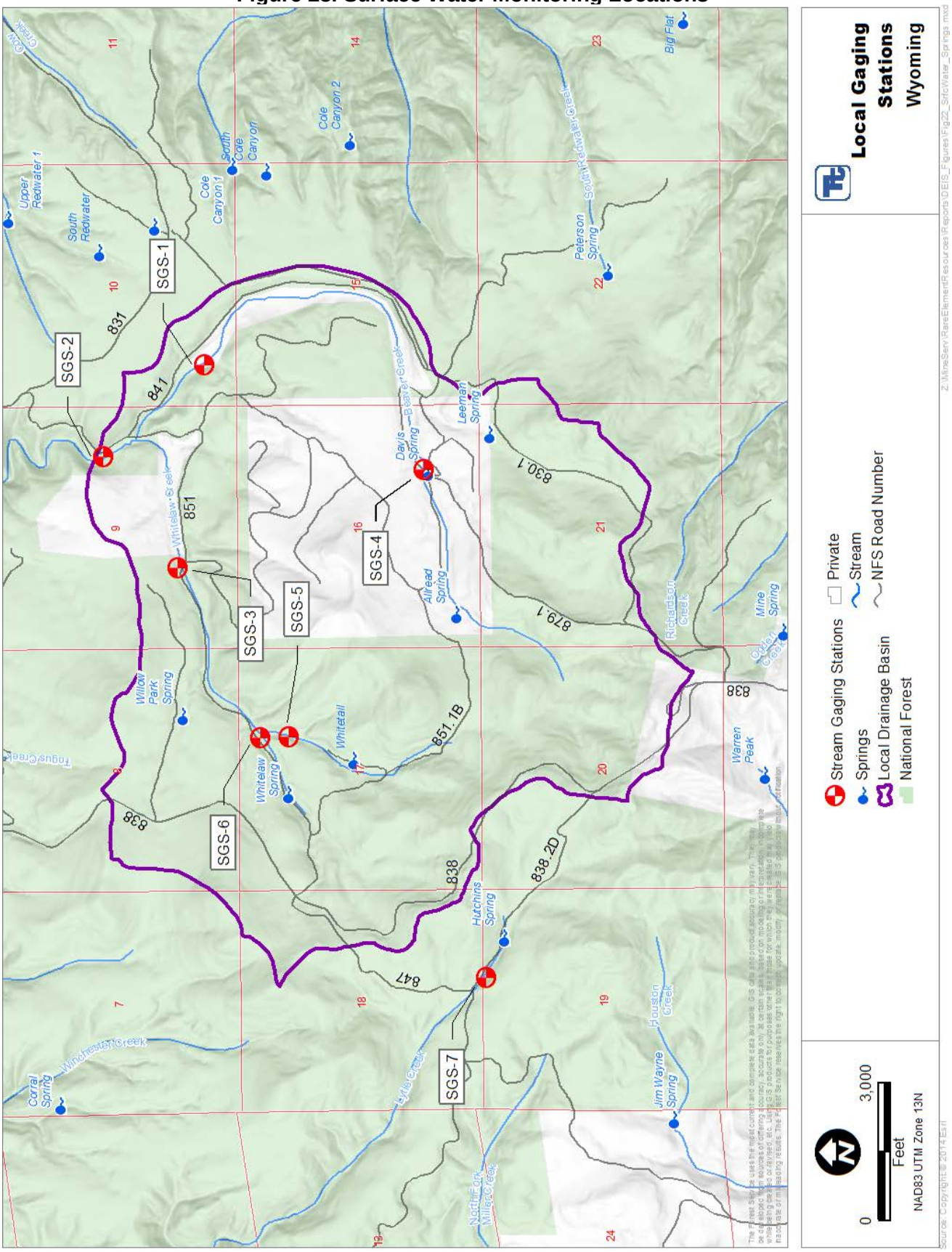
Baseline surface water quality monitoring was performed at the seven stream gaging locations shown on (**Figure 23**) since November 2010 and 82 specific spring locations from approximately 26 area springs ongoing since June 2011 (WWC Engineering, 2014a). Some spring sample locations may be duplicated with slight variation in naming of the samples. Water quality monitoring consisted of measuring:

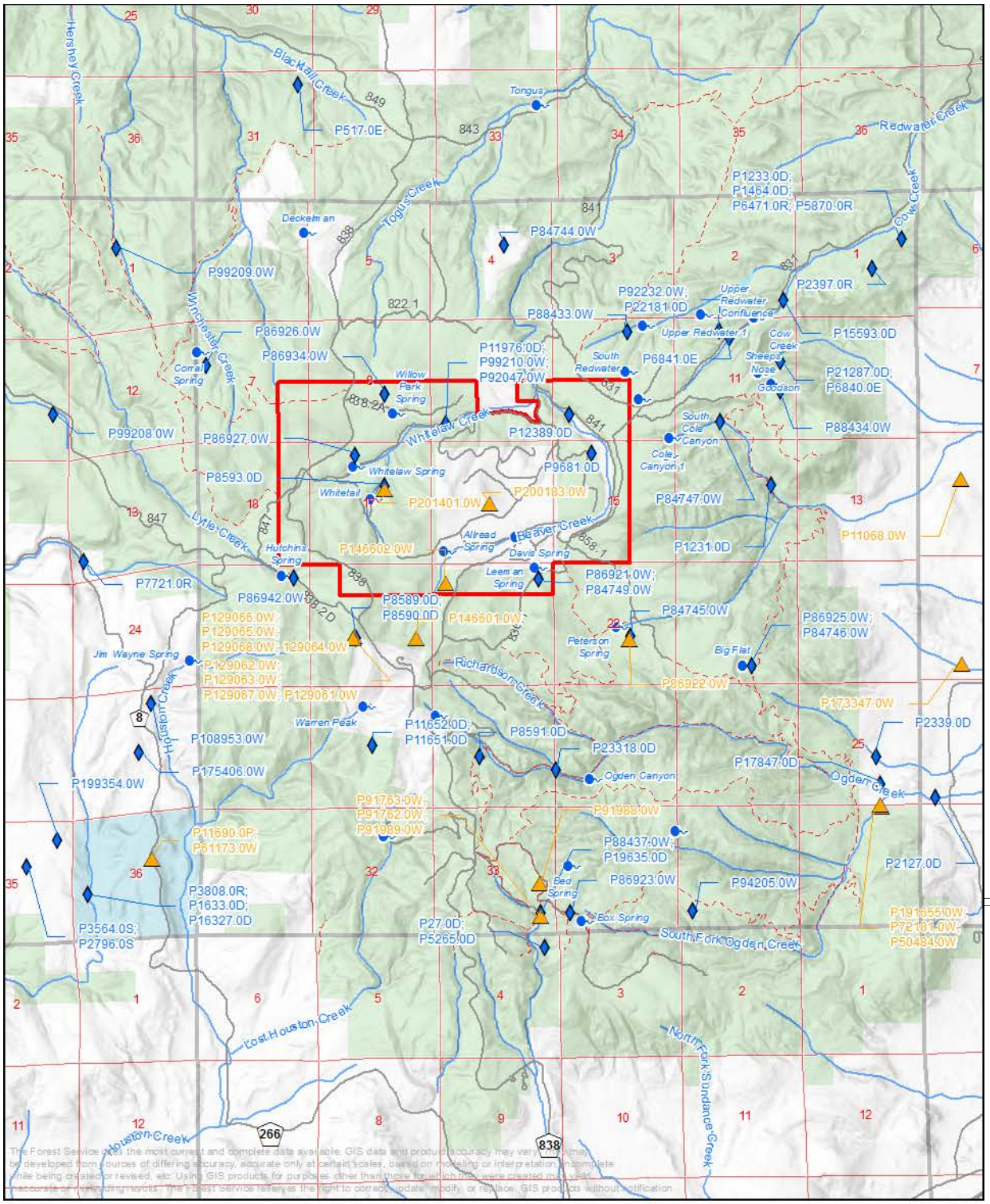
- pH
- conductivity
- salinity
- temperature
- total dissolved solids
- general ions and nutrients (acidity, alkalinity, ammonia, bicarbonate, carbonate, cyanide, hardness, iodine, conductivity, pH, nitrate, nitrate+nitrite, nitrite, sodium adsorption ratio, sulphide, total dissolved solids, total suspended solids)
- organics (coliform bacteria, oil and grease)
- dissolved major ions (bromide, and sulphate)
- total recoverable metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, cerium, chromium, cobalt, copper, iron, lanthanum, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, thorium, uranium, vanadium, and zinc), and
- radionuclides (gross alpha, gross beta, radium 226 & 228, radon 222, strontium 90, and thorium 230

WDEQ would establish the water quality standards the proponent must meet as part of their permitting, which would apply to the operations and post-mine reclamation and closure. The standards would be set depending on the likely designated use of the water and consider the current water quality. The current water quality was determined through surface water quality samples collected by baseline monitoring (available in the project file).

Aquatic life water quality limits for Class 2AB waters (WDEQ, 2013) for the metals cadmium, chromium (III), copper, lead nickel, silver, and zinc are based on the dissolved metals detected and depend on the hardness of the water (WDEQ, 2013)(harder water will contain less dissolved metals than softer water). The baseline surface water quality sampling (WWC Engineering, 2015) analyzed total recoverable metals instead of dissolved amounts for these analytes. Total recoverable metals includes the total dissolved and the total suspended. A comparison of the total suspended solids to the total dissolved solids indicates that the ratio of

Figure 23. Surface Water Monitoring Locations




Hershey Creek
Blackfall Creek
Tongus
Redwater Creek
Cow Creek
Togus Creek
Deckelman
Winchester Creek
Corral Spring
Willow Park Spring
Whitelaw Creek
Whitelaw Spring
Whitetail
Lytle Creek
Hutchins Spring
Allread Spring
Beaver Creek
Davis Spring
Leeman Spring
Upper Redwater
Upper Redwater Confluence
Upper Redwater 1
South Redwater
Cow Creek
Sheeps Nose
Goodson
South Cole Canyon
Cole Canyon 1
Jim Wayne Spring
Houston Creek
Richardson Creek
Peterson Spring
Big Flat
Warren Peak
Ogden Canyon
Ogden Creek
Bed Spring
Box Spring
South Fork Ogden Creek
Lost Houston Creek
North Fork Sundance Creek
P517.0E
P99209.0W
P86926.0W
P86934.0W
P99208.0W
P86927.0W
P8593.0D
P7721.0R
P86942.0W
P108953.0W
P175406.0W
P199354.0W
P3808.0R; P1633.0D; P16327.0D
P3564.0S; P2796.0S
P11690.0P; P61173.0W
P84744.0W
P88433.0W
P92232.0W; P22181.0D
P1233.0D; P1464.0D; P6471.0R; P5870.0R
P2397.0R
P15593.0D
P6841.0E
P21287.0D; P6840.0E
P88434.0W
P11976.0D; P99210.0W; P92047.0W
P12389.0D
P9681.0D
P200183.0W
P201401.0W
P146602.0W
P146601.0W
P8589.0D; P8590.0D
P86921.0W; P84749.0W
P84747.0W
P1231.0D
P11068.0W
P84745.0W
P86925.0W; P84746.0W
P86922.0W
P173347.0W
P2339.0D
P129066.0W; P129065.0W; P129068.0W; 129064.0W; P129062.0W; P129063.0W; P129067.0W; P129061.0W
P11652.0D; P11651.0D
P8591.0D
P23318.0D
P17847.0D
P91763.0W; P91762.0W; P91989.0W
P91988.0W
P88437.0W; P19635.0D
P86923.0W
P94205.0W
P2127.0D
P27.0D; P52651.0D
P191555.0W; P72181.0W; P50484.0W
Surface Right
Groundwater Right
WDEQPermitBoundary
National Forest
State Land
Private
Springs
Lake/Pond
Stream
NFS Road Number
Trails
0
1.25
Miles
NAD83 UTM Zone 13N
Water Rights Wyoming
Source: Copyright:© 2014 Esri
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total suspended solids to total dissolved solids is mostly dissolved solids in almost all surface water samples. Therefore the total recoverable metals analysis should mostly reflect the dissolved fraction. Other metals (besides cadmium, chromium (III), copper, lead nickel, silver, and zinc) aquatic life criteria are based on total recoverable metals.

An additional analysis was to compare the measured total recoverable metals to the dissolved aquatic life criteria by converting the dissolved aquatic life criteria to total recoverable criteria[8]. Water samples measured as total recoverable (which are essentially a reflection of the dissolved concentration) that failed aquatic life criteria calculated as dissolved also failed aquatic life criteria calculated as total recoverable; with one exception: surface sample SGS-6 collected on July 2, 2012 failed lead chronic life standard calculated as dissolved but not calculated as total recoverable.

Baseline surface water quality monitoring at 26 spring locations has been ongoing since June 2011 (WWC Engineering, 2015). Water quality monitoring measured or analyzed the same parameters as the surface water suite of parameters. Because springs are directly tied to surface water or contribute to surface water, results from baseline spring water quality sampling were compared to surface water quality standards for Class 2AB waters.

Overall surface water and spring water quality is good; however some parameters were exceeded (**Table 40**) in one or more WDEQ Class 2AB standards (for cold water fisheries). Current water quality is compared to operational and post-mining classifications because the effects on water quality will consider the current condition, including where standard of future classifications are exceeded in pre-mining water quality.

Spring Flow Characterization

Springs and seeps are considered a sub-category of surface water and groundwater. There are approximately 30 named springs within three miles of the Mine Area. Key springs in the vicinity of the Bull Hill Mine are shown on **Figure 22**. Approximately 26 of these spring locations were sampled. Some of the named springs represent multiple seep or spring discharge points. An inventory of area springs is provided in the Probable Hydrologic Consequences Report (WWC Engineering, 2014b) located in the project file. Spring flows range from 0 to 25 gallons per minute (gpm).

3.10.1.1 Groundwater

Groundwater uses for the 27 permitted water wells listed in the SEO database (WWC Engineering, 2014b) are domestic, stock, municipal, and miscellaneous. Thirteen of the wells are permitted for monitoring use, which allows water withdrawal only for testing purposes. **Figure 22** shows the locations of existing groundwater rights in the area.

A network of 41 groundwater monitoring wells identified the occurrence, flow, and quality of groundwater near the Project Area (**Figure 25**).

Table 40.
Surface Water Sample Stations and Springs where Water Quality Standard was Exceeded

Parameter	Surface Water Sample Location
Coliform Bacteria*	SGS-1 through SGS-6 (Escherichia coli [E. coli] >126 organisms/1000 mL)

…….

[8] The conversion is based on the guidance procedures outlined in Appendix F of Chapter 1 (WDEQ, 2013), which were modified by removing the conversion factor (CF); thereby providing aquatic life criteria adjusted for hardness expressed as a total recoverable metal concentration rather than the dissolved criteria. The EPA provides discussion for converting criteria in guidance documents (US EPA 1993) regarding aquatic life criteria for hardness dependent metals when limited to a particular type of data or when necessary to comply with discharge regulations (for example TMDL standards reported as total recoverable). The modification to hardness dependent aquatic life criteria calculation resulted in minor changes to the aquatic life criteria.

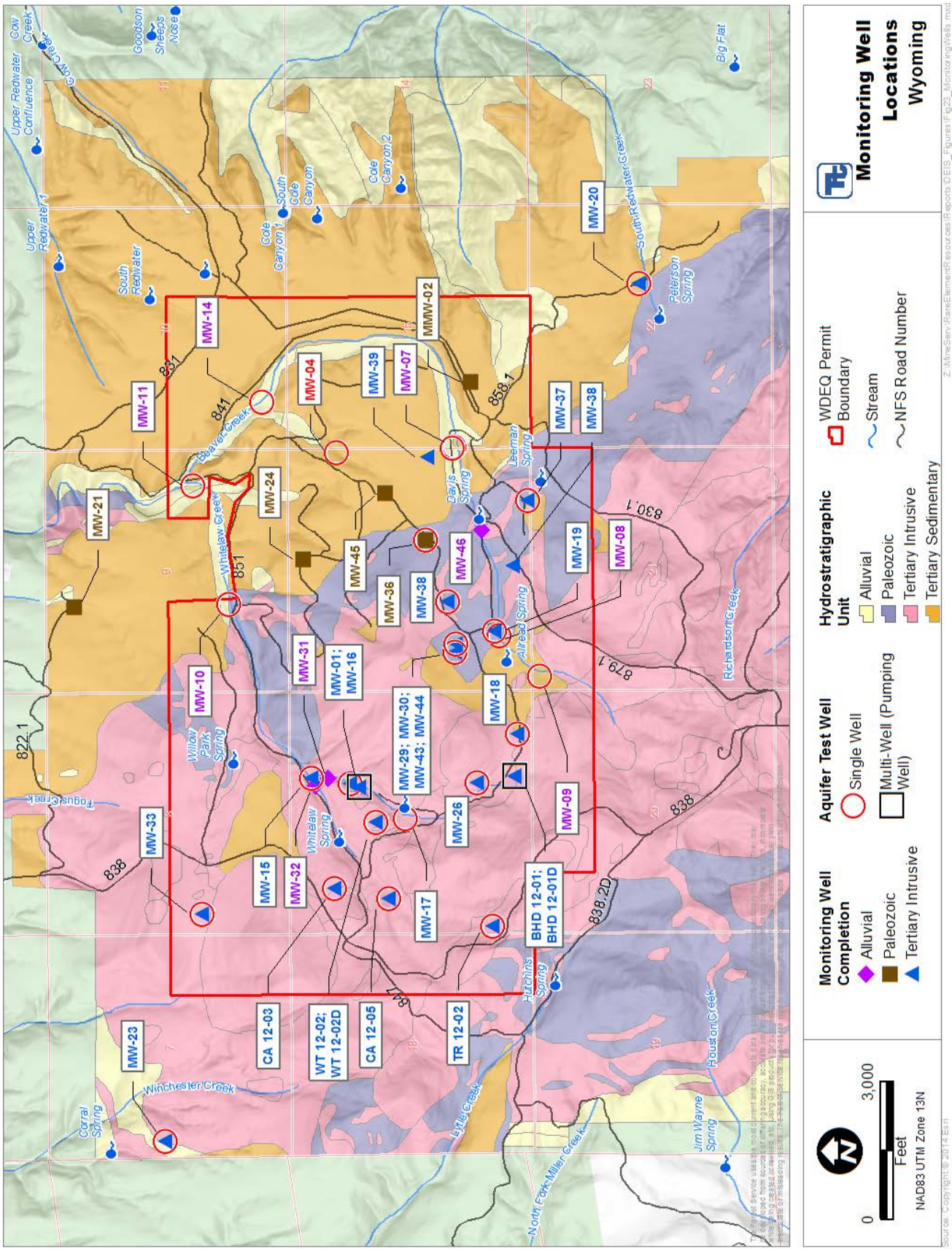
Table 40. Surface Water Sample Stations and Springs where Water Quality Standard was Exceeded	
Parameter	**Surface Water Sample Location**
Aluminum	SGS-1 through SGS-6: aluminum acute and chronic aquatic life standards (0.75 mg/L and 0.087 mg/L, respectively)
Cadmium	SGS-3: cadmium acute and chronic aquatic life standards (0.002 mg/L and 0.00025 mg/L, respectively ; corrected for hardness)
Iron	SGS-1 through SGS-6: iron chronic aquatic life standard and/or human health secondary maximum contaminant level (1.0 mg/L and 0.300 mg/L, respectively; human health criterion only apply where drinking water is an actual use)
Lead	SGS-1 through SGS-6: lead chronic aquatic life standard (0.0025 mg/L; corrected for hardness)
Manganese	SGS-6: manganese chronic aquatic life standard (1.46 mg/L; corrected for hardness)
Gross Alpha	SGS-1, -5 and -6: gross alpha (15 pCi/L, excluding radon and uranium).
	Spring and Seep Sample Locations
pH	Allread, Davis, Hutchins, Whitelaw, Whitetail
Coliform Bacteria	Allread, Cole Canyon, Corral, Cow Creek, Hutchins, Jim Wayne, Leeman, Peterson, Sandpit, South Redwater, Upper Redwater, Warren Peak, Whitelaw, Whitetail Springs, Willow Park
Aluminum	Allread, Bed, Box, Corral, Cow Creek, Davis, Deckelman, Hutchins, Jim Wayne, Leeman, Mine, Ogden, Peterson, Sandpit, South Redwater, Upper Redwater, Warren Peak, Whitelaw, Whitetail, Willow Park
Cadmium	Upper Redwater
Copper	Hutchins
Iron	Allread, Bed, Box, Cole Canyon, Corral, Cow Creek, Davis, Deckelman, Hutchins, Jim Wayne, Leeman, Peterson, Sandpit, South Redwater, Upper Redwater, Warren Peak, Whitelaw, Whitetail, Willow Park
Lead	Davis, Hutchins, Leeman, South Redwater, Whitelaw
Manganese	Corral, Cow Creek, Deckelman, Hutchins, Jim Wayne, Leeman, Peterson, Upper Redwater, Whitelaw, Whitetail
Gross Alpha	Bed, Whitelaw
Radium	Whitelaw

Source: (WWC Engineering, 2014c).

* Baseline water quality sampled total coliform as the test for the sanitary condition of a water supply. WDEQ water quality standards for E.coli for surface waters designated for primary and secondary contact recreation usage. E. coli is the major species in the fecal coliform group. Of the five general groups of bacteria that comprise the total coliforms, only E. coli is generally not found in the environment. Consequently, E. coli is considered to be the species of coliform bacteria that is the best indicator of fecal pollution and the possible presence of pathogens.

WDEQ is seeking to reclassify all waterways that flow at less than an annual daily average of 6 cubic feet per second (cfs) from the higher “primary recreation” to the lower, “secondary” standard. It is unknown if reclassification will be approved. Based on the average flow, Beaver Creek below SGS-4 and Whitelaw Creek below SGS-3 exceeds 6 cfs flow and would remain classified as primary contract recreation streams. It is assume that all surface waters designated as Class 2AB are also designated as primary contact recreation streams. It is also assumed that total coliform bacteria counts from baseline sampling can be compared to the E. coli water quality standard.

Figure 25. Hydrostratigraphic Units and Monitoring Well Locations



Groundwater is found in the consolidated bedrock and in the overlying unconsolidated alluvial and colluvial materials present in the stream valleys that form a discontinuous but generally thin mantle on top of the bedrock. Water is present in fractures in the igneous bedrock, and in the pore spaces between grains in the sedimentary bedrock, as well as in unconsolidated alluvium and colluvium. Water is found in the unsaturated zone above the water table and in the saturated zone below the water table.

For purposes of hydrogeologic characterization and analysis of groundwater resources, the geologic units described in Section 3.9.2 were grouped into hydrostratigraphic units (HSUs) on the basis of their occurrence and hydrologic characteristics (**Figure 25**). All of the HSUs contain groundwater.

Alluvial HSU

The youngest geologic materials in the area are the Quaternary-age alluvium along the stream valleys and the colluvial materials that interfinger with alluvium along the valley margins. These materials comprise the Alluvial HSU. The Alluvial HSU was investigated (WWC Engineering, 2013) with 43 borings drilled in transects across the Beaver, Whitelaw and Whitetail Creek valleys at the locations of the surface water gaging stations (**Figure 23**). Nine monitoring wells were completed in the Alluvial HSU. The alluvium is composed of sediments most commonly consisting of a clay matrix containing varying amounts of cobbles, gravel, sand, and silt. Clean sand and gravel were noted only in borings drilled along upper Beaver Creek. The alluvial borings terminated in the alluvium and therefore did not determine the total thickness of the alluvium. Deriving from well logs, most areas contained at least 29 feet of alluvium, and at least 70 feet of alluvium was logged at well MW-07 along Beaver Creek (**Figure 25**).

Although groundwater was present at each of the transect locations, not all of the borings encountered water, indicating that the Alluvial HSU is not continuously saturated along its length and width. Measured depths to groundwater in Alluvial HSU monitoring wells ranged from less than 0.1 foot to approximately 23 feet below ground surface. Monitoring data (Petrotek Engineering Corp, 2015b) show water level fluctuations ranging from about 1.5 feet to 21.9 feet. Water levels are shown to rise in response to precipitation events and during spring and fall months (Petrotek Engineering, Corp, 2014). Water levels generally decline during the summer months. The water table in the Alluvial HSU generally mimics the land surface, sloping downstream along the drainages.

Tertiary Sedimentary HSU

Tertiary-age sedimentary rocks of the Oligocene White River Formation and Miocene-Pliocene Ogallala Formation comprise the Tertiary Sedimentary HSU. They are up to several hundred feet thick (Siskind, et al., 1993). The Tertiary Sedimentary HSU covers substantial areas of the older sedimentary formations in the eastern part of the proposed mine site and to the north, east and southeast. This HSU is also found mantling smaller areas of the older sedimentary formations to the northwest, west and southwest (Staatz, 1983). Staaz (1983) describes the White River Formation as siltstone and the Ogallala Formation as mainly gravels and coarse, poorly-sorted conglomerate that lap up onto the periphery of the Bear Lodge dome and thicken with distance away from the central dome.

One monitoring well (MW-04) (**Figure 25**) was completed in the Tertiary Sedimentary HSU (Petrotek Engineering Corp, 2015b). It measured depths to water ranging from approximately 50 to 65 feet below ground surface (bgs), with a general rise in the spring followed by a gradual decline through the remainder of the year. Pump testing at MW-04 indicated a transmissivity of 20 ft^2/d and a hydraulic conductivity of 0.27 feet per day.

Tertiary Intrusive HSU

The Tertiary-age igneous intrusive rocks that host the ore deposit and which are exposed in the core of the Bear Lodge Mountains comprise the Tertiary Intrusive HSU. Also grouped into the Tertiary Intrusive HSU, because of their similar makeup (igneous) and hydrologic function, are the Precambrian-age igneous rocks, primarily granite, that are found in restricted zones within the outcrop area of the Tertiary Intrusive rocks. The

Tertiary HSU is massive igneous rock with little to no primary porosity or permeability; secondary permeability is provided by fractures in the rock. The number of fractures, the width of individual fractures, and the interconnectivity governs the ability of these rocks to allow water to flow through.

Twenty-six monitoring wells were installed in the Tertiary Intrusive HSU (**Figure 25**). Depths to water in these wells ranged from zero (two wells flowed at the land surface) to 342 feet bgs. One well in this HSU (MW-05) was reported to be dry to its total depth of 270 feet. Annual fluctuations of measured water levels ranged from less than one foot to slightly over 20 feet between the 26 wells.

Paleozoic HSU

The Paleozoic HSU is comprised of Paleozoic-age sedimentary rocks from the Deadwood Formation, Whitewood Limestone, Pahasapa Limestone (equivalent to Madison Limestone), Minnelusa Sandstone, Opeche Formation, and Minnekahta Limestone. These rocks are exposed around the outer margins of the Bear Lodge dome's Tertiary intrusive rocks and dip radially away (Staatz, 1983). In the immediate vicinity of the Tertiary intrusive outcrops, the Paleozoic rocks are intruded by roughly conformable sills of the Tertiary intrusive body. The Paleozoic HSU is present throughout the region and has been studied extensively (Bartos & Ogle, 2002), (Kyllonen & Peter, 1987), (Hodson & Druse, 1973). It extends well beyond the project vicinity and, particularly with respect to the Minnelusa Sandstones and Pahasapa Limestones, these sedimentary lithologies serve as important water sources to the community water systems for Sundance and the Vista West subdivision (SEO, 2015). Yields from water supply wells in the Paleozoic HSU, at least where it has been developed on and beyond the flanks of the Bear Lodge Mountains, can be several hundred gpm.

Five monitoring wells were constructed in the Paleozoic HSU or interfingered rocks of the Paleozoic HSU and the Tertiary Intrusive HSU (**Figure 25**). Reported depths to water in the Paleozoic HSU ranged from approximately 111 feet to 472 feet bgs. However; Wells MW-21 and MMW-02, which are respectively about a mile northeast and southeast of the proposed mine site, have been reported to be dry (Petrotek Engineering Corp, 2015b) to their respective total depths of 465 feet and 858 feet. These two wells appear to represent anomalous conditions, indicating groundwater elevations far lower than those observed in the other Paleozoic HSU wells and those observed in non-Paleozoic HSU wells between these two dry wells. Depths to water reported for water-supply wells in the vicinity ranged from 8 feet to 450 feet bgs subdivision (SEO, 2015). Water-level fluctuations in the wells were reported to range from 1.9 feet to 16.6 feet, with a seasonal pattern similar to that of the other HSUs (Bartos & Ogle, 2002; Petrotek Engineering Corp, 2015b).

Hydraulic Properties of HSUs

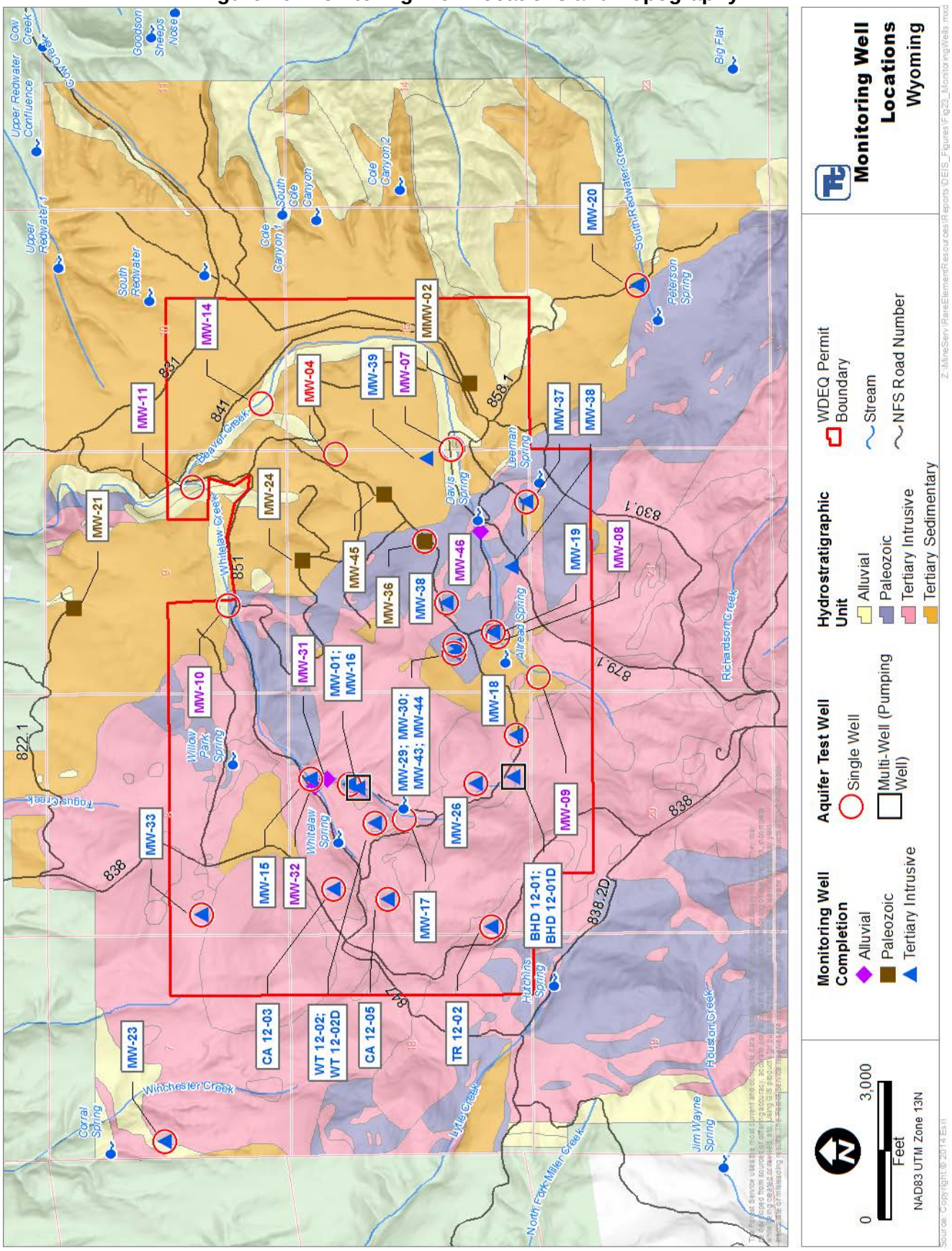
Pumping tests were conducted in 29 monitoring wells to determine the hydraulic properties of the various HSUs at the proposed project site (Petrotek Engineering Corp, 2015a). The test results are summarized in **Table 41** and the locations of the tested wells are shown in **Figure 25** and **Figure 26**.

Transmissivity and hydraulic conductivity represent the ability of the aquifer to transmit water. Hydraulic conductivity is calculated as transmissivity divided by the saturated thickness of the aquifer. Specific yield and storage coefficient, properties related to water storage and water level change in an aquifer, were not determined in these single-well aquifer tests.

Table 41.
Summary of Aquifer Test Results

HSU	Number of Tests	Transmissivity (ft^2/d)			Hydraulic Conductivity (ft/d)		
		Min	Max	Median	Min	Max	Median
Alluvial	6	6	1,765	20	0.32	239	1.13
Tertiary Sedimentary	1	20			0.27		
Tertiary Intrusive	23	3	3,960	197	0.03	43	1.74
Paleozoic	1	43			0.25		

Figure 26. Monitoring Well Locations and Topography



3.10.1.2 Groundwater Flow

Recharge to the groundwater system originates as precipitation that falls, infiltrates into the subsurface, and percolates downward to the water table. In the project vicinity, recharge is generally dependent on elevation, with more recharge occurring in higher elevations and less in lower elevations. Studies by the U.S. Geological Survey (Edridge, et al., Western South Dakota Hydrology Meeting) estimated that recharge to the saturated zone in the vicinity ranges from approximately 0.77 inches per year along Lytle Creek about 6 miles northwest of the Mine Area to approximately 7.62 inches per year near Warren Peaks about ¾ mile south of the Mine Area. The average infiltration rate over the Mine Area is between about 5 and 7.6 inches per year, based on U.S. Geological Survey data (Edridge, et al., Western South Dakota Hydrology Meeting).

The general pattern of groundwater flow in the Bear Lodge Mountains is outward from the higher-elevation areas that receive the most recharge to regional aquifer discharge areas in lower elevation valleys. **Figure 27** shows the potentiometric surface elevation, based on water levels measured in monitoring wells in October and November 2013, water level elevations estimated for wells in the SEO database, and surveyed or estimated spring elevations. Groundwater flow is approximately perpendicular to the potentiometric surface contour lines. Groundwater flow in the bedrock HSUs (Tertiary Intrusive HSU, Tertiary Sedimentary HSU, and Paleozoic Sedimentary HSU) is generally from the Warren Peaks area toward the northeast, with local variations. The Alluvial HSU conducts groundwater generally down-valley and thus in approximately the same directions as groundwater flow in the bedrock HSUs.

Within the area underlain by the Tertiary Intrusive HSU, fracturing of the bedrock exerts strong control on groundwater movement. Highly fractured breccia pipes and fractures could provide avenues for preferential groundwater flow. Where present, such zones could provide avenues of preferential flow which may have an impact on both surface and groundwater quality associated with mining and mine closure activities. The major fracture orientations in the Black Hills are predominantly northwest and northeast, and a lesser-developed fracture set is oriented north-south (Wicks, et al., 1999). Within the northern portion of the Black Hills, the strongest orientation represented is the northeastern set. These would parallel general stream orientations. Northeast-trending faults aligned with Whitelaw Creek and upper Beaver Creek are thought to be present at the project site (Siskind, et al., 1993), but their role relative to groundwater flow has not been determined.

Groundwater and Surface Water Interaction

Groundwater and surface water closely interact, transferring water quantity and quality from one flow system into the other. Streams receiving flow from groundwater are termed gaining streams, and streams that recharge groundwater are termed losing streams. Gaining and losing reaches of streams are strongly influenced by topography, relative elevation and streambed permeability. Flow monitoring data indicate that Beaver Creek is a losing stream from SGS-4 to SGS-1, likely losing between SGS-1 and SGS-2, and that Whitelaw Creek is a gaining stream from the confluence of Whitetail Creek to SGS-3 and a losing stream from SGS-3 to SGS- 2 (WWC Engineering, 2014b). **Table 39** presents the surface water gaging data used to determine the relative gain/loss sections of streams within the Mine Area.

Groundwater Quality

Groundwater samples were collected from 39 monitoring wells (**Figure 26**) between November 2010 and December 2014 for groundwater quality (Petrotek Engineering, Corp, 2014). **Table 42** summarizes water quality classification and use criteria provided to the proponent by WDEQ (WDEQ, 2015b). Groundwater within the Mine Area is classified as Class III Livestock.

Figure 27. Potentiometric Surface

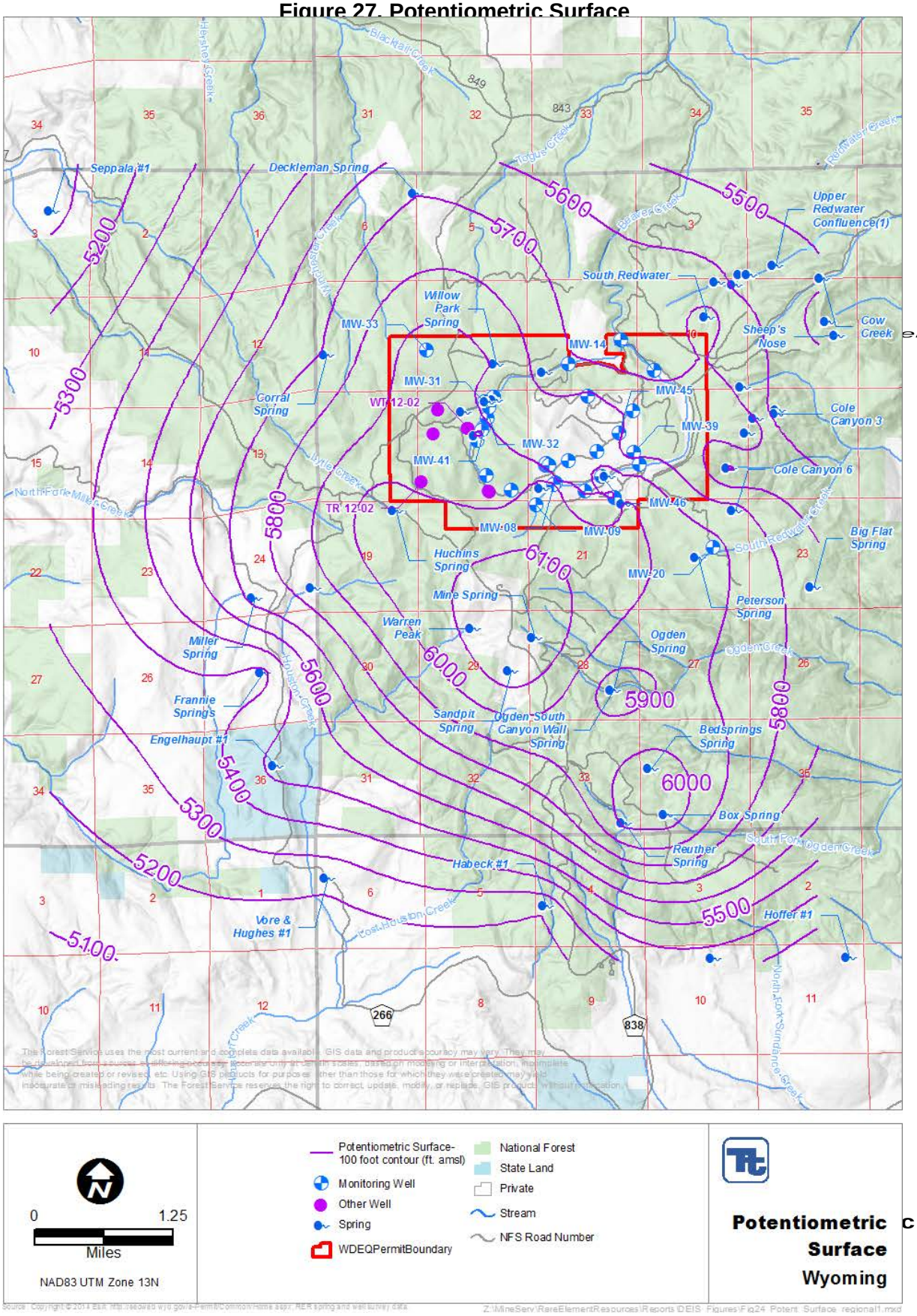


Table 42. Summary of Groundwater Quality Exceedances				
Parameter	**Alluvial HSU**	**Tertiary Intrusive HSU**	**Tertiary Sedimentary HSU**	**Paleozoic HSU**
pH	X	X		X
Chromium	X			
Copper		X		
Oil & Grease		X		
Gross Alpha	X	X		X
Radium 226 + Radium 228	X		X	X

Note: X indicates a groundwater quality exceedance.

3.10.2 Environmental Consequences

3.10.2.1 Direct and Indirect Effects

Alternative A- No Action

Under Alternative A- No Action, the proposed mining activities would not happen. Therefore; there would be no effects on groundwater, springs, stream channels, or stream flows. Reclamation of previously completed exploration will minimize erosion from exposed soils as pads and roads are recontoured and revegetated.

Effects Common to All Action Alternatives

Hazardous material releases, including fuels and process materials, have the potential to affect surface water and groundwater resources during project construction, operation, and closure. A Spill Prevention, Control, and Countermeasures Plan (see Appendix A) would be required for the project and would specify potential sources, plans, and procedures to be employed for preventing releases, and the means by which releases would be controlled and cleaned up. Proper implementation of the Spill Prevention, Control, and Countermeasures Plan would protect water resources from avoidable impacts related to material spills.

Exploration

Surface Water

Exploration drilling, trenching, and road and pad construction include measures that would minimize sedimentation in surface water (see Appendix A). No surface water impacts are expected during exploration activities.

Groundwater

Mineral exploration effects on groundwater levels (and associated surface flows) and quality would be minimized through proper borehole plugging required in the Wyoming Water Quality Rules and Regulations (see Appendix A). These practices would prevent creation of a hydraulic interconnection along exploration borings with groundwater or surface water.

Construction

Surface Water

Surface waters found within the Mineable Pit area, which includes the headwaters of Whitetail Creek and Whitetail Spring, would be modified by pit construction to the extent that the essential character would change from a drainage to a water retention area (WDEQ, 2015b).

Water quality impacts are tied to designated usage under the water body classification. Water body classification for the Mine Permit area during the mine construction, operation, and reclamation phases have

been provided by WDEQ. All live streams and intermittent reaches during construction phase (first 4 to 5 years) would remain Class 2AB.

Discharges of pollutants to areas such as fields or roads, which are not considered surface waters of the state, are not regulated under the WYPDES program; however, these discharges may fall under the jurisdiction of another program, such as the Water/Wastewater Program (WDEQ, 2015b).

Mine components that would directly disturb surface water include surface water diversions, sediment control measures, the Mineable Pit, and the WRF. Vegetation removal, construction of stream crossings, and encroachment on springs could alter the area's ability to control sediment runoff, attenuate low flows or peak flows, or facilitate surface water flow. The extent varies by alternative.

Sediment control measures (e.g., sediment ponds, silt fences, traps, check dams, water bars, etc.) would be employed to minimize the potential for increased sediment loads from disturbed areas, primarily the Mineable Pit, PUG Plant, WRF and roads and power line construction. Where possible, diversions would be constructed to route flow from upstream in undisturbed areas around the mining activities. A berm around the up-gradient side of the Mineable Pit highwall would divert storm water from running into the Mineable Pit (Figure 4).

Overall, because of measures to eliminate sediment entering streams from during construction, it is expected the impact to area water quality from sediment runoff would be less than existing land disturbances from stock use along riparian corridors. Additionally, construction discharge would be monitored and permitted under WYPDES. WDEQ would determine if additional controls are needed.

Consumptive use of water during the construction phase of mining operations, estimated to be 25 gallons per minute (gpm) (RER, 2014d)) would result in minor reduction to groundwater recharge from Beaver Creek and Whitelaw Creek surface water flows. The proponent would be required to apply for a water right for use of water. The SEO could issue a permit and any senior water rights that are downstream and are hydraulically connected could potentially make a call for regulation of water on the junior water right; requiring consultation and mitigation to offset impacts.

Groundwater

Effects on groundwater during construction would minimally lower water levels in the vicinity of the water supply well if water from that source is required for construction purposes. Lowering of water levels in springs and seeps near the water supply well would not occur during construction. No existing groundwater rights would be affected.

Groundwater designated use during the construction phase of the mine would remain as is; underground water classification III for livestock usage. No impacts to groundwater quality are expected during the construction.

Operation

Surface Water

Water diverted around mine operation areas would flow through sediment ponds designed to reduce sediment loads and attenuate peak flows. All discharge from sediment ponds and dewatering operations would be permitted through the WDEQ WQD and would be required to meet permit discharge criteria. Approximately nine percent of the Beaver Creek upstream of Cook Lake, and two percent of the entire watershed downstream would be under the influence of sediment controls during the construction phase of mining (WWC Engineering, 2014b). The overall impact to surface water flow due to temporary storage in sediment control structures such as sediment ponds is minor relative to the drainage area to the receiving waters. As vegetation is restored and the need for sediment controls diminishes, this percentage would be reduced.

Most of the temporary stored water in sediment control ponds will be released downstream once it meets water quality standards; however a portion may be used for dust suppression or utilized at the PUG facility during the initial stages of mine operations (prior to significant groundwater dewatering withdrawals). If the

sediment control water is discharged, it will be discharged under a Wyoming Department of Environmental Quality, Water Quality Division (WDEQ/WQD) permit under an Industrial Storm Water Permit for a Metallic Mining Facility. This permit will incorporate effluent limits and will require monitoring for Chemical Oxygen Demand, total suspended sediment, nitrate plus nitrite nitrogen, and potentially other parameters of concern. Under WYPDES rules discharges from the mine site cannot result in exceedances of any applicable water quality standard; therefore sediment control storm water will be treated if necessary. This should minimize any impact to surface water quality.

Whitelaw and Beaver creeks would continue to be classified as Class 2AB. Surface waters in the Mineable Pit would be changed from a drainage to a water retention area (WDEQ, 2015b) and no longer qualified as Class 2AB waters. Therefore, surface water quality standards would not apply during operation. Pit dewatering discharged to Whitetail Creek would alter the quality of the water in the creek because the groundwater quality is different from surface water quality. The water quality sample results from groundwater and spring water quality sampling during baseline do not suggest that the combined discharge plus stream flow would exceed any surface water quality standards at the monitoring stations on Whitetail Creek and Whitelaw Creek.

Hutchins Ditch (P8593.OD) is a nearby surface water right (although not associated with the Whitetail Spring) that may also be affected by the pit expansion. The Hutchins Ditch is related to the historic mining in the area. The ditch is permitted to supply water to a cyanide plant in Section 17. It appears that this facility is no longer (or never was) in operation and the diversion/conveyance structure(s) are no longer present (WWC Engineering, 2014b); therefore no adverse effect from the loss of this water right is expected.

Streamflow reduction may result from the use of a portion of the water temporarily stored in sediment ponds for mine operations or at the PUG Plant during the initial stages of mine operations, prior to significant pumping of groundwater for dewatering of the Mineable Pit. During later mining operations the majority of the consumptive use of water for dust suppression and mine operations would be supplied by the dewatering well. The estimated daily consumptive use of water during mining operation is approximately 75 gpm (RER, 2014d). As with the surface water rights, any senior water rights that are downstream and are hydraulically connected could potentially make a call for regulation of water on the junior groundwater right, requiring consultation and mitigation to offset its impacts.

Fracturing of the rock around a hole from blasting has been shown to extend out to approximately 26 times the diameter of the charge in the blast hole (Siskind, et al., 1993), which would typically be no more than 27 feet, given that blast holes are typically 4 to 10 inches in diameter. Other than Whitetail Spring, which would be physically removed by mining, no springs or wells are close enough to the mine pit blasting area to be affected by blast-induced fracturing. Vibration caused by blasting would extend farther from the blast site but would be of low energy and small displacement and could cause existing fractures to shift and either enhance or diminish the ability of individual fractures to transmit water. This could increase or diminishment fracture-fed spring and seep flows. These potential effects are expected to be minor due to the distance between the blasting and the springs and seeps. Although unlikely, water with higher concentrations of contaminants could be introduced into the spring flow if fractures that communicate with deeper metal-rich, sulfide-bearing strata or other less-than-desirable lithologies were to become hydraulically connected to springs.

Dewatering of the Mineable Pit and discharge of the water pumped from the Mineable Pit would increase gradually with deepening of the pit, reaching a predicted 625 gpm (1.4 cfs) near the end of mining operations (year 38). The discharge would be routed into Whitetail Creek through a pit dewatering pond, which will increase the average flow from the current 0.4 cfs by an additional 1.4 cfs. The additional flow could result in channel scour and alteration of the channel geometry. Channel scour and change in geometery would produce increased sediment load and alter aquatic habitat. Discharge from the dewatering pond would be regulated by WDEQ, including channel scour that would be regulated by the discharge permit. Turbidity or TSS would be monitored and exceedances would require mitigation (Section 2.8).

Springs and seeps whose flow is sourced more directly by precipitation would not experience diminished flows because of mine dewatering. The effect on specific seeps and springs is not available, because the

sources of flow have not been definitively determined for each. In the gaining reaches of the streams, where stream flows pick up water from seeps and springs or groundwater could be diminished by decreased contribution due to pit dewatering.

Groundwater

Based on the analysis that follows, neither groundwater level changes nor groundwater quality changes during operations are expected to affect existing groundwater rights.

Pit dewatering would result in withdrawal of groundwater, primarily from the Tertiary Intrusive HSU and possibly from the other three HSUs hydraulically connected to the Tertiary Intrusive HSU. A groundwater flow model was developed to simulate existing conditions, mine dewatering, and the effects the Mineable Pit on the groundwater system. The model development, calibration, operation, and results are described in detail by Petrotek Engineering Corp (Petrotek Engineering Corp, 2015b).

Modeled scenarios predicted water-level drawdown at the end of mine operation is shown on **Figure 28**. The flow of seeps and springs from the Tertiary Intrusive HSU or other hydrologically-connected HSUs encompassed by the mine-induced drawdown may diminish or cease if drawdown causes the water table to drop to an elevation below that of the land surface at the seep or spring locations.

Water-balance and geochemical modeling of the WRF was conducted to assess the quantity and quality of water that may seep from that facility during and following mine operations (Golder Associates, 2015a). Although the WRF location and development would be slightly different for some of the alternatives, the potential effects of seepage would not differ between alternatives except Alternative G (described later).

Precipitation falling on the WRF would infiltrate and percolate through, then seep out the base. The seepage would intercept the groundwater below the facility and flow out the toe of the WRF. The average predicted seepage rate was 4 inches per year (13 inches in the wettest year). An average groundwater recharge rate of 4.8 inches currently estimated by the U.S. Geological Survey (Edridge, et al., Western South Dakota Hydrology Meeting) is within the range of recharge predicted.

The chemical quality of seepage would be affected by contact with the waste rock. The mixing of the seepage water with groundwater flowing beneath the WRF would affect groundwater quality. **Table 43** (Golder Associates, 2015a) summarizes the estimated WRF seepage water quality and provides water quality standards for comparison. Comparing the predicted seepage water quality to baseline groundwater quality for the Tertiary Intrusive HSU, groundwater parameters could increase from WRF seepage. Parameters with the potential to increase are: TDS, chloride, sodium, sulfate, potassium, fluoride, calcium, molybdenum, arsenic, and uranium. Of those, TDS, chloride, arsenic and aluminum could exceed the respective water quality standards. Upon reaching groundwater, the WRF seepage would mix with the groundwater as it flows down-gradient (northeast). Mixing and additional recharge to the groundwater system down-gradient would result in dilution of the WRF seepage, and seepage-affected groundwater quality would approach the natural groundwater quality with time and distance.

Comparing the predicted seepage water quality to baseline surface water quality, from monitoring stations SGS-1, SGS-2 and SGS-3 on Whitelaw and Beaver creeks, show surface water parameters could increase from WRF seepage to be TDS, chloride, sodium, sulfate, potassium, fluoride, calcium, magnesium, aluminum, cadmium, manganese, molybdenum, arsenic, and uranium. Of those, TDS, chloride, arsenic, cadmium and aluminum could exceed the respective water quality standards. This approach is conservative because it does not allow for groundwater mixing, sorption or dilution effects. For “use protection” anti-degradation as per WDEQ regulations, the exceedances of standards would not meet the anti-degradation standard. As stated in Section 2.9, discharged water would be monitored as required by the WYPDES permits and treatment required if necessary to meet permit requirements.

Figure 28. Predicted Drawdown at End of Mining

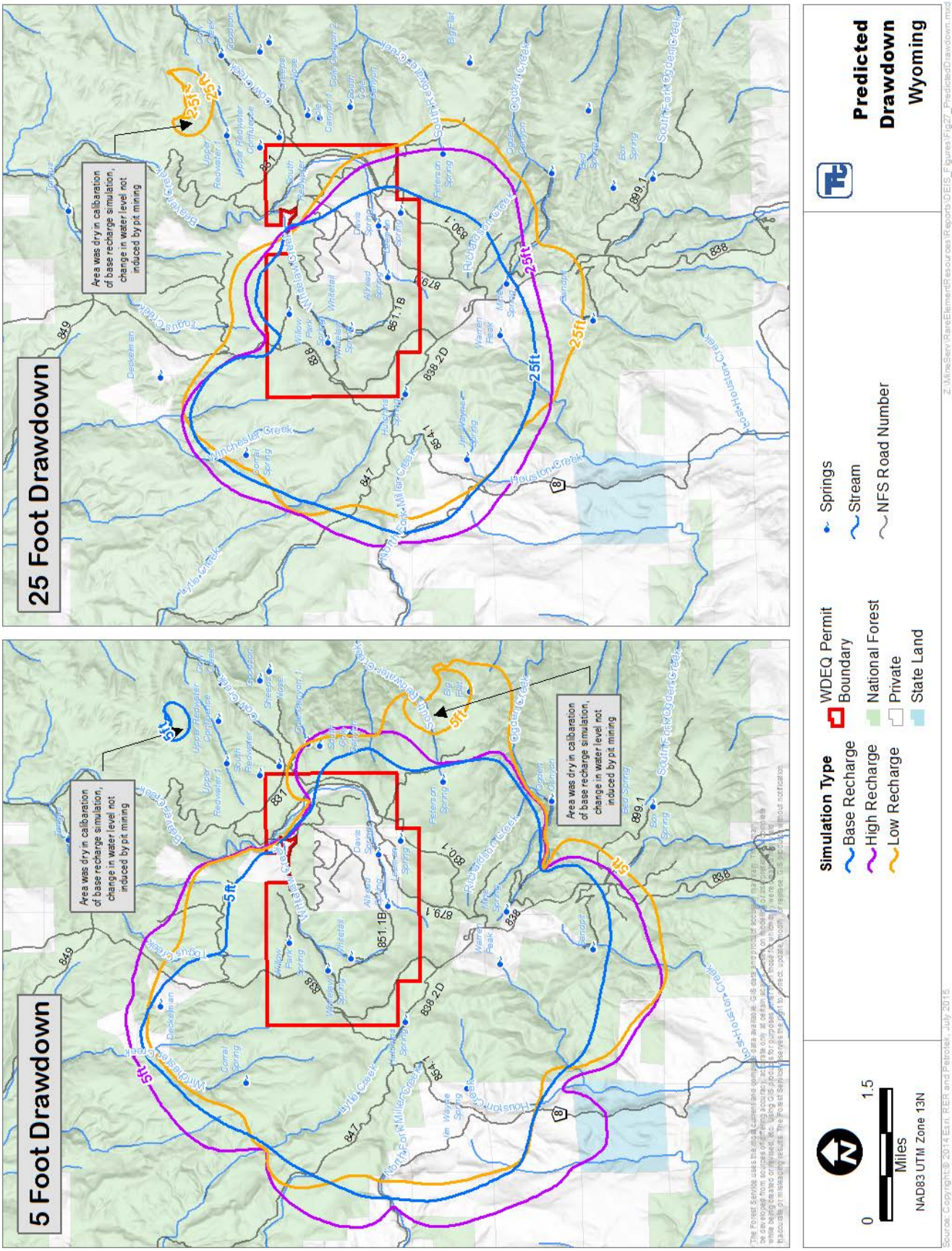


Table 43. Predicted Long-Term WRF Seepage Water Quality						
Parameter	**Concentration Range**				**WDEQ Water Quality Standard**	
	Lower Level	**Upper Level**	**WRF Area Tertiary Intrusive HSU Groundwater (mg/L)**	**WRF Area Streams (SGS-1, SGS-2 and SGS-3) (mg/L)**	**Class III GW (mg/L)**	**Class 2AB SW (mg/L)**
TDS		≥1000 mg/L +GWS	77 – 473	50 - 230	5000	--
Chloride	100-999 mg/L +SWS	≥1000 mg/L +GWS, +SWS	1 – 2	<1 - 1	2000	230
Sodium	100-999 mg/L	≥1000 mg/L	3 – 71	1 - 4	--	--
Sulfate		100-999 mg/L	10 - 225	1 - 12	3000	--
Potassium	10-99 mg/L	100-999 mg/L	1 – 13	<1 - 3	--	--
Fluoride	1-9 mg/L	10-99 mg/L	0.3 – 1.6	0.2 – 1.2	--	--
Calcium	100-999 µg/L	1-9 mg/L	12 – 77	4 - 62	--	--
Magnesium	100-999 µg/L	1-9 mg/L	2 – 14	<1 - 10	--	--
Aluminum		10-99 µg/L +SWS	0.05 – 0.25	0.03 – 2.45	5	0.087
Barium		>10 µg/L	0.05 – 0.43	0.09 – 0.26	--	--
Iron		>10 µg/L	0.04 – 0.52	0.07 – 1.91	--	1
Molybdenum		100-999 µg/L	0.001 – 0.016	<0.001 – 0.009	--	--
Arsenic	10-99 µg/L	100-999 µg/L +GWS, +SWS	0.001 – 0.01	0.001 – 0.007	0.2	0.15
Uranium		10-99 µg/L	0.0002 – 0.0233	0.0003 – 0.0025	--	--
Cadmium		>10 µg/L	<0.001	<0.001 – 0.002	0.05	0.00025
Manganese		>10 µg/L	0.001 – 0.531	0.009 – 0.23	--	1.462

Shaded cells: estimated upper range for constituents constrained by mineral precipitation if equilibrium is not reached.
Tertiary Intrusive HSU range for wells MW-19, MW-29, MW-30, MW-38, MW-40, MW-43 and MW-44.
+GWS indicates potential exceedance of groundwater quality standard.
+SWS indicates potential exceedance of surface water quality standard.

Reclamation/Closure

Surface Water

All live and intermittent surface water streams and stream reaches would return to their pre-mining designation as Class 2AB; though portions of Whitetail Creek and upper Whitelaw Creek would be considered physical and functional losses where the stream bed was excavated for pit construction. Surface water quality impacts are not anticipated from reclamation and closure. The post-mining vegetation and land use would be similar to pre-mining and the post-mining slopes, except for the Mineable Pit, would be similar to pre-mining slopes. Under those conditions, post-mining sediment yields should be similar to existing sediment yields. Within the Mineable Pit area, the absence of topsoil and vegetation should not impact the downstream environment, because pit slope sediment deposition would collect in the pit.

Perimeter ditches would carry storm water flows along the toe of the WRF and terminate in one or more sediment ponds (number of ponds varies between alternatives); a sediment pond would also be constructed

downstream of the PUG Plant. The sediment ponds would capture and temporarily store the disturbed area runoff, reducing the peak discharge and extending the flow times of the natural discharge hydrograph. Reduction in peak discharge could result in sediment deposition and buildup in stream channels downstream of the sediment ponds, and extended flow times could result in channel scour. The pit would remain, intercepting and reducing the amount of surface water draining into Whitetail Creek, Whitelaw Creek, and Beaver Creek (WWC Engineering, 2014b). Runoff from the Mineable Pit and the areas uphill would report to the reclaimed pit instead of to the streams, diminishing stream flow in these creeks. The total post-mining flow reduction predicted at monitoring station SGS-2 just downstream from the confluence of Whitelaw Creek and Beaver Creek was estimated to be 14 percent. This could affect downstream senior surface water rights and the SEO would determine if there are adverse impacts to existing rights requiring negotiation and mitigation by the proponent.

The WRF would create a permanent change in the drainage areas of Whitelaw Creek and Beaver Creek (loss of riparian habitat and stream channel morphology and loss of Whitetail Spring). The final configuration of the WRF would not decrease the overall drainage area but would result in a slight reduction (approximately 25 acres) in the area that drains into upper Beaver Creek and an equal increase in the area that drains into Whitelaw Creek. These minor changes in runoff area would not affect existing downstream water rights that are hydrologically connected.

At the end of mine operation, Whitetail Creek would then return to its pre-mining designation of Class 2AB.

Groundwater

Cessation of dewatering the pit would allow groundwater levels to rebound. Groundwater levels are predicted (Golder Associates, 2015b) to continue to rise for up to 100 years until reaching a water level of 5,933 feet amsl, slightly lower than the pre-mining water table elevation in the area (Petrotek Engineering Corp, 2015b). **Table 44** compares the water modeled water quality of the pit lake in Alternative C and the groundwater quality with partial or complete backfill in Alternatives D, F, and G. Average, minimum and maximum estimates are displayed. Alternatives E and H were not modelled as the pit reclamation is similar to Alternative F by utilizing only rock material from the pit walls.

Table 44.
Comparison of Water Quality Standards after Closure

Parameter	Alt. C Ave. (Min-Max)	Alt. D Ave. (Min-Max)	Alt. F Ave. (Min-Max)	Alt. G Ave. (Min-Max)	Current Pit Area Tertiary Intrusive GW[1] (mg/L)	Class III GW (mg/L)	Class 2AB SW (mg/L)
pH (s.u.)	8.5 (8.4-9.2)	9.1 (9-9.3)	8.8 (8.6-9.1)	9.0 (8.8-9.1)			
TDS	320 (210-1800)	2,040 (1,720-2,650)	622 (380-1,000)	1,470 (1,080-1,910)	35 – 1140	5000	--
Alkalinity (mg/L as $CaCO_3$)	120 (81-640)	510 (410-760)	210 (130-380)	410 (290-530)	20 - 198	--	--
Calcium (mg/L)	15 (15-21)	3 (3-2)	19 (18-19)	3 (4-3)	6 – 66	--	--
Chloride (mg/L)	8 (4-65)	530 (460-600)	110 (50-140)	330 (230-430)	1 – 4	2000	230
Fluoride (mg/L)	2 (1-9)	17 (14-22)	4 (2-7)	9 (8-13)	0.2 – 3	--	--
Magnesium (mg/L)	3 (3-5)	8 (9-7)	6 (5-6)	10 (10-10)	1 – 20	--	--

Table 44. Comparison of Water Quality Standards after Closure							
Parameter	**Alt. C Ave. (Min-Max)**	**Alt. D Ave. (Min-Max)**	**Alt. F Ave. (Min-Max)**	**Alt. G Ave. (Min-Max)**	**Current Pit Area Tertiary Intrusive GW[1] (mg/L)**	**Class III GW (mg/L)**	**Class 2AB SW (mg/L)**
Potassium (mg/L)	5 (3-40)	80 (70-110)	17 (9-30)	45 (35-70)	1 – 11	--	--
Sodium (mg/L)	70 (40-450)	640 (540-820)	170 (95-280)	450 (320-590)	1 – 265	--	--
Sulfate (mg/L)	45 (60-490)	240 (210-310)	80 (60-130)	190 (170-250)	3 – 666	3000	--
Metals							
Aluminum (mg/L)	5 (2-28)	0.2 (0.1-0.3)	0.07 (0.04-0.1)	0.1 (0.08-0.2)	<0.05	5	0.087
Antimony (mg/L)	0.006 (0.003-0.04)	0.09 (0.08-0.1)	0.02 (0.01-0.03)	0.05 (0.04-0.07)	<0.001 – 0.002	--	--
Arsenic (mg/L)	0.006 (0.004-0.04)	0.08 (0.07-0.1)	0.02 (0.01-0.04)	0.05 (0.04-0.07)	<0.001 – 0.005	0.2	0.15
Barium (mg/L)	0.001 (0.001-0.003)	0.00003 (0.00004-0.00003)	0.0003 (0.0003-0.0002)	0.000039 (0.000055-0.000042)	0.007 – 1.49	--	--
Boron (mg/L)	0.4 (0.2-3)	6 (5-8)	1 (1-2)	3 (3-5)	<0.1	--	--
Cadmium (mg/L)	0.0009 (0.0006-0.003)	0.004 (0.004-0.004)	0.002 (0.002-0.003)	0.004 (0.004-0.005)	<0.001	0.05	0.00025
Cobalt (mg/L)	0.01 (0.006-0.08)	0.2 (0.2-0.2)	0.03 (0.02-0.07)	0.1 (0.08-0.1)	<0.001 - 0.001	--	1
Copper (mg/L)	0.01 (0.006-0.09)	0.3 (0.2-0.3)	0.04 (0.02-0.07)	0.1 (0.08-0.1)	0.006 – 0.014	0.5	0.009
Iron (mg/L)	0.2 (0.2-0.5)	0.3 (0.3-0.3)	0.7 (0.7-0.7)	0.4 (0.4-0.4)	<0.03 – 2.12	--	1
Lead (mg/L)	0.003 (0.002-0.007)	0.06 (0.06-0.05)	0.01 (0.008-0.02)	0.02 (0.01-0.02)	<0.001	0.1	0.0025
Lithium (mg/L)	0.1 (0.06-0.8)	2 (2-2)	0.3 (0.2-0.7)	0.9 (0.8-1)	<0.1	--	--
Manganese (mg/L)	0.2 (0.2-0.3)	0.1 (0.1-0.1)	0.3 (0.2-0.3)	0.1 (0.1-0.1)	0.001 – 7.83	--	1.462
Molybdenum (mg/L)	0.03 (0.01-0.2)	0.4 (0.4-1)	0.08 (0.04-0.2)	0.2 (0.2-0.3)	<0.001 – 0.28	--	--
Nickel (mg/L)	0.01 (0.008-0.09)	0.2 (0.2-0.2)	0.04 (0.02-0.07)	0.1 (0.08-0.1)	0.006 – 0.047	--	0.052

Table 44. Comparison of Water Quality Standards after Closure							
Parameter	**Alt. C Ave. (Min-Max)**	**Alt. D Ave. (Min-Max)**	**Alt. F Ave. (Min-Max)**	**Alt. G Ave. (Min-Max)**	**Current Pit Area Tertiary Intrusive GW[1] (mg/L)**	**Class III GW (mg/L)**	**Class 2AB SW (mg/L)**
Selenium (mg/L)	0.007 (0.003-0.04)	0.09 (0.08-0.1)	0.02 (0.01-0.04)	0.05 (0.04-0.07)	<0.001 - 0.005	0.05	0.005
Silver (mg/L)	0.004 (0.002-0.03)	0.06 (0.05-0.07)	0.01 (0.006-0.02)	0.03 (0.02-0.04)	<0.001	--	--
Vanadium (mg/L)	0.03 (0.01-0.2)	0.4 (0.3-0.5)	0.07 (0.04-0.1)	0.2 (0.2-0.3)	<0.01	--	--
Radionuclides							
Radium (pCi/)	3 (1.5-20)	35 (30-49)	9 (5-18)	15 (10-25)			
Uranium (mg/L)	0.002 (0.0009-0.01)	0.03 (0.02-0.04)	0.006 (0.003-0.01)	0.01 (0.01-0.02)	0.0001 – 0.115	--	--

1 Pit area groundwater quality is from monitoring wells BHD12-02, BHD12-02D, CA12-02, MW-17, MW-18, MW-26, TR12-02, WT12-02 and WT12-02D.

2 (Golder Associates, 2015c), Tables 8-10, 8-11, and 8-12.

+GWS potential exceedance of groundwater quality standard. +SWS potential exceedance of surface water quality standard.

Alternative C- Proposed Action

Construction

Surface Water

The WRF and diversion channel would eliminate the segment of Beaver Creek buried by the WRF and reduce or eliminate flow in a short segment between the WRF and the reentry point of the Beaver Creek channel. This effect would continue through reclamation and closure.

The haul road from the Mineable Pit to the PUG Plant would pass over a spring on Whitelaw Creek. The road construction would cover the spring. The spring could diminish, cease, or emerge adjacent to the fill. This effect would continue through reclamation and closure.

An estimated 18,371 linear feet of stream would be disturbed during construction (NFS and private lands). On NFS lands, 1.2 acres of perennial and 10.7 acres of intermittent water influence zones would be disturbed.

Ground water

Impacts on groundwater from construction in Alternative C would be as described under Effects Common to All Action Alternatives.

Operation

Surface Water

In-stream flow in Whitetail Creek and the lower portion of Whitelaw due to discharge from the dewatering pond would increase in years 7 through 45. This increased flow could result in more erosion and sediment in Whitetail Creek during the dewatering period. The WRF would be expanded to cover Allread Spring and Davis Spring (see **Figure 4**). Although the springs themselves would be covered, a designed channel beneath

the WRF would discharge water from the springs to Beaver Creek. The quality of water discharged from the springs may be affected by seepage from the WRF. This change would be permanent, continuing through reclamation and closure. As stated in Section 2.9, discharged water (springs or dewatering pond) would be monitored as required by the WYPDES permits and treatment required if necessary to meet permit requirements. Discharged water would not be allowed to degrade water quality.

Groundwater

Impacts on groundwater from operations in Alternative C would be as described under Effects Common to All Action Alternatives.

Reclamation/Closure

Surface Water

Portions of Whitetail Creek and upper Whitelaw Creek would be considered physical and functional losses where the stream bed is excavated for pit construction.

Whitetail Creek could be reclassified as a drainage after dewatering discharge ceases. In that case it would be classified as Class 2AB and therefore, unless it is shown otherwise, these waters would be presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, and aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value uses.

Pit Lake

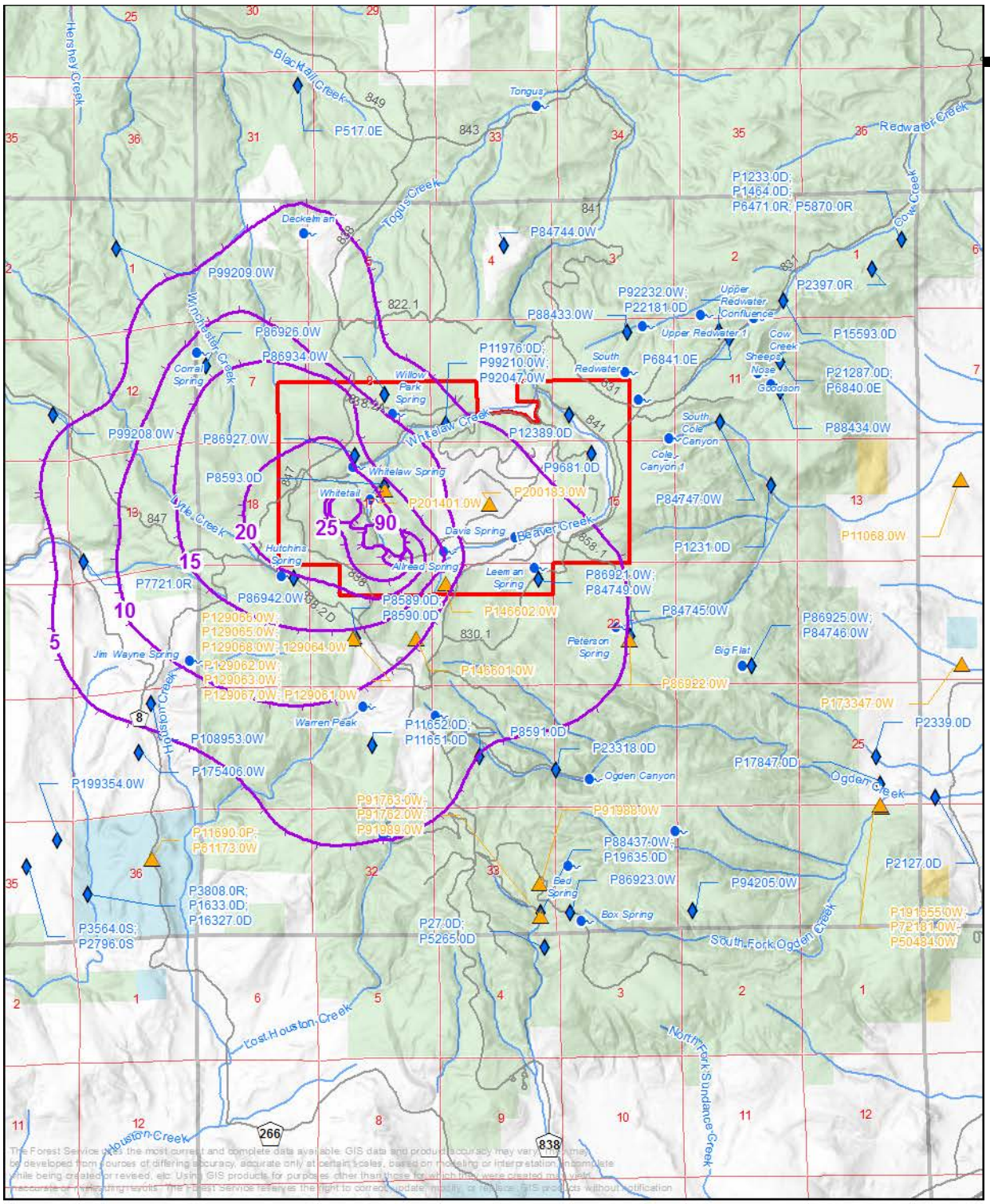
After mining, a combination of groundwater inflow, precipitation and surface water runoff would cause the water level in the Mineable Pit to rise until reaching equilibrium with prevailing hydrologic conditions. The resulting pit lake would be permanent. Water-balance and geochemical modeling predict that a pit lake would start developing after dewatering ceases. The water-balance model (Golder Associates, 2015b) predicts that the pit lake water level would continue to rise for up to 100 years until reaching a water level of 5,933 feet amsl, slightly lower than the pre-mining water table elevation in the area (Petrotek Engineering Corp, 2015b).

The long-term average water balance for the pit lake was predicted (Golder Associates, 2015b) to include:

- Groundwater inflow of 112 gpm;
- Runoff and direct precipitation inflow of 166 gpm;
- Subflow through the pit walls (inflow) of 45 gpm;
- Evaporative losses of 230 gpm; and
- Groundwater outflow of 93 gpm.

Water evaporating from the pit lake would cause permanent drawdown of the water table around the pit lake. The groundwater flow model (Petrotek Engineering Corp, 2015b) was used to predict the long-term steady-state drawdown that would result (**Figure 29**). The flow of seeps and springs from the Tertiary Intrusive HSU or other hydrologically-connected HSUs within the drawdown area may remain permanently diminished or stopped if the water table were to remain below the land surface at the seep or spring locations. The water balance modeling predicted that the pit lake would be a flow-through feature. Consequently, the groundwater down-gradient of the pit lake could be affected by water that would flow out of the pit lake.

Geochemical reactions would occur between water flowing into the pit lake and the rock on the walls of the mine pit and in the adjacent blasting-affected fractured zone adjacent to the pit walls. The pit lake water quality that would result from those reactions was estimated by geochemical modeling (Golder Associates, 2015c). The results are summarized in **Table 44**. The table also lists the range of current baseline


Hershey Creek
Black Hall Creek
Tongue
Redwater Creek
Cow Creek
Togus Creek
Deckelman
Winchester Creek
Corral Spring
Willow Park Spring
Whitelaw Creek
Whitelaw Spring
Whitetail
Davis Spring
Beaver Creek
Alfred Spring
Hutchins Spring
Leeman Spring
Peterson Spring
Big Flat
Jim Wayne Spring
Warren Peak
Houston Creek
Ogden Creek
Ogden Canyon
South Fork Ogden Creek
Bed Spring
Box Spring
North Fork Sundance Creek
Upper Redwater Confluence
Upper Redwater 1
South Redwater
Sheeps Nose
Goodson
South Cole Canyon
Cole Canyon 1
5
10
15
20
25
90
P517.0E
P99209.0W
P86926.0W
P86934.0W
P99208.0W
P86927.0W
P8593.0D
P7721.0R
P86942.0W
P108953.0W
P175406.0W
P199354.0W
P11690.0P;
P61173.0W
P3808.0R;
P1633.0D;
P16327.0D
P3564.0S;
P2796.0S
P84744.0W
P88433.0W
P11976.0D;
P99210.0W;
P92047.0W
P12389.0D
P9681.0D
P201401.0W
P200183.0W
P8589.0D;
P8590.0D
P146602.0W
P146601.0W
P11652.0D;
P11651.0D
P85910.0D
P23318.0D
P91763.0W;
P91762.0W;
P91989.0W
P27.0D;
P52650D
P92232.0W;
P22181.0D
P6841.0E
P1233.0D;
P1464.0D;
P6471.0R; P5870.0R
P2397.0R
P15593.0D
P21287.0D;
P6840.0E
P88434.0W
P84747.0W
P1231.0D
P11068.0W
P86921.0W;
P84749.0W
P84745.0W
P86925.0W;
P84746.0W
P86922.0W
P173347.0W
P2339.0D
P17847.0D
P2127.0D
P94205.0W
P191655.0W;
P72181.0W;
P50484.0W
Lost Houston Creek
266
838
This Forest Service GIS data is the most current and complete data available. GIS data and product accuracy may vary but are generally developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being created or revised, etc. Using GIS products for purposes other than those for which they were created may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify, or replace GIS products without notification.
0
1.25
Miles
NAD83 UTM Zone 13N
Surface Right
Groundwater Right
Simulated Drawdown Contour (10 ft. amsl contour interval)
WDEQPermitBoundary
Bureau of Land Management
National Forest
State Land
Private
Springs
Stream
NFS Road Number
Long-Term
Post-Mining
Drawdown
Wyoming
Source: Copyright:© 2014 Esri, Tetra Tech simulation with 2X recharge to year 250.
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concentrations observed in groundwater samples collected from monitoring wells indicating that flow from the pit lake into the groundwater system may degrade groundwater quality for all listed parameters except barium, iron, magnesium, manganese, and uranium. The increases may cause exceedance of the applicable water quality standards for TDS, aluminum and selenium for groundwater and chloride, aluminum, copper, nickel, lead, selenium and cadmium for surface water. The effect of such exceedances would mean that the water is no longer suitable for the uses to which the water quality classes apply, that is, livestock use (Class III) for groundwater and fisheries and drinking water (Class 2AB) for surface water. As stated in Section 2.9, discharged water would be monitored as required by the WYPDES permits and treatment required if necessary to meet permit requirements. Discharged water would not be allowed to degrade water quality.

Because groundwater from the Tertiary Intrusive HSU discharges to springs along lower Whitetail Creek, the surface water quality standards, in addition to groundwater standards, may be appropriate. However, water in the pit lake would be classified differently, and the Class 2AB standards would not apply to the pit lake.

The geochemical model that was used to predict pit lake water quality (Golder Associates, 2015b) assumes that no preferential pathways exist for water movement and that only strongly oxidized rock devoid of sulfides is part of the hydrologic circuit. Mining could expose fractures and joints that communicate with waters not otherwise connected to the pit area. If fractures communicate with deeper metal-rich, sulfide-bearing strata or other undesirable lithologies, then water with higher concentrations of contaminants could be introduced into the pit lake.

Groundwater

Groundwater levels in the Tertiary Intrusive HSU would experience permanent declines as described in the previous section and illustrated in **Figure 29**. The declines would be due to evaporation losses from the pit lake. Groundwater levels near the pit lake would remain 30 to 45 feet lower than before mining, and groundwater levels up to three miles away from the reclaimed pits would remain 5 feet or more lower than before mining. Along the upper reaches of Whitetail, Whitelaw and Beaver creeks, water levels in the Alluvial HSU would likely also be lowered, although the degree of lowering has not been quantified.

Groundwater quality northeast of the mine pit would be affected by seepage of pit lake water out of the pit, as described in Effects Common to All Action Alternatives. The effects of the WRF on groundwater quality during post-mining/closure would be as described for the operational period.

Changes to groundwater levels and quality are not anticipated to affect any existing groundwater rights.

Alternative D

Construction

Surface Water

Under Alternative D, the WRF footprint would remain at least 100 feet from Beaver Creek, and Beaver Creek would not be diverted. With that setback from Beaver Creek, the WRF would not cover Allread Spring or Davis Spring, so the springs would remain undisturbed.

The haul road between the Mineable Pit and the PUG would be re-routed to cross Whitelaw Creek farther upstream and avoid disturbance of the spring along Whitelaw Creek and its tributary. Consequently, construction impacts to those features would be avoided. Construction impacts are reduced over Alternative C, E, and F.

An estimated 8,310 linear feet of stream would be disturbed during construction (NFS and private lands). On NFS lands, approximately 27.3 acres of intermittent water influence zones would be disturbed during construction.

Groundwater

Impacts on groundwater from construction in Alternative D would be as described under Effects Common to All Action Alternatives.

Operation

Surface Water

Effects to water resources during operation would be similar to those in Alternative C. However, in-stream flow in Whitetail Creek would not be affected because the dewatering pond would not be located in the Whitetail Creek drainage.

Groundwater

Impacts on groundwater from construction in Alternative D would be as described under Effects Common to All Action Alternatives.

Reclamation/Closure

Surface Water

Under Alternative D, a pit lake would not develop, the potential loss of surface water due to a permanent drawdown of groundwater levels from evaporation off the pit lake would be avoided, and groundwater levels would ultimately recover to near the pre-mining levels.

Groundwater

The Mineable Pit would have highwalls regraded and overburden placed in the pit along with enough waste rock backfill to eliminate the pit lake. After backfilling, as groundwater levels recover, groundwater would begin to flow through the rock overburden and backfill in the Mineable Pit. This fill material would be broken up and a smaller size than the original material removed from the pit or the layback area which would create additional surface area that has not been exposed to groundwater or rain and snowmelt water previously. The material would also be exposed to water continually. These conditions would lead to additional leaching of chemicals from the rock into the groundwater within and down-gradient (northeast) of the partially backfilled pit. This leaching would reduce water quality (**Table 44**). This table also indicates the existing groundwater quality in the pit area. Model results are reported for the average, minimum, and maximum likely concentrations. The results of the modeling did not identify any potential exceedances of Wyoming Class III groundwater quality standards, however, parameters are exceeded when compared to the existing condition for the tertiary intrusive groundwater quality (Golder Associates, 2015c). Any water quality effects would be carried down-gradient with the groundwater flow.

Alternative E

Construction

Surface Water

The WRF footprint under Alternative E would be similar to Alternative D, as would the related effects. The PUG Plant would be constructed south of the WRF and at least 100 feet south of Beaver Creek, and the haul road from the pit to the PUG Plant would avoid the Whitelaw Creek spring area. The relocated haul road would be constructed along upper Beaver Creek, and a haul road crossing would be constructed across Beaver Creek near Allread Spring. Increased sediment loading to Beaver Creek is possible, but appropriate implementation of sediment control measures would mitigate potential impacts to surface water.

The dewatering pond would be constructed in lower Whitetail Creek resulting in impacts that would be similar to Alternative C.

An estimated 8,7401 linear feet of stream would be disturbed during construction (NFS and private lands). On NFS land, approximately 18.5 acres of intermittent of water influence zones would be disturbed.

Groundwater

Impacts on groundwater from construction in Alternative E would be as described under Effects Common to All Action Alternatives.

Operation

Surface Water

Effects to water resources during operation would be similar to those in Alternative C.

Groundwater

Impacts on groundwater from operations in Alternative E would be as described under Effects Common to All Action Alternatives.

Reclamation/Closure

Surface Water

Under Alternative E, the Mineable Pit would be mostly filled with rock derived from reducing the slope of the pit walls. A shallow pit lake would develop with anticipate water quality similar to Alternative C.

Groundwater

The effects of the reclaimed pit and pit lake formation on groundwater would be as described for Alternative F. While no specific modelling was completed for Alternative E pit reclamation, it is similar to Alternative F pit reclamation by using the same type of material modelled in Alternative F. It is reasonable to expect similar water quality results. The effect the WRF would have on groundwater would be as described under Effects Common to All Action Alternatives.

Alternative F

Construction

Surface Water

Under Alternative F, the WRF natural drainage and contour and PUG Plant location would be similar to Alternative E.

An estimated 13,897 linear feet of stream would be disturbed during construction (NFS and private lands). On NFS lands, approximately29.0 acres of intermittent water influence zones would be disturbed. Ephemeral and intermittent tributaries to Whitelaw and Beaver creeks would not be filled in construction of the WRF. However, this alternative effects the second highest linear feet and acres of stream and influence zone due to the expanded WRF size.

Groundwater

Impacts on groundwater from construction in Alternative F would be as described under Effects Common to All Action Alternatives.

Operation

Surface and Groundwater

In-stream flow impacts would be similar to Alternative C. Effects on groundwater during operation would be similar to those in Alternative E.

Reclamation/Closure

Surface Water

Under Alternative F, the Mineable Pit reclamation would be similar to Alternative E, except that a portion of the pit would not be recontoured to avoid the mineral withdrawal area. The effects on surface water would be similar to those described for Alternative E, however a deeper pit lake would form in Alternative F.

Groundwater

The effects of the reclaimed pit and pit lake formation on groundwater would be as described for Alternative C. Groundwater quality was modeled (Golder Associates, 2015c) and result are shown in **Table 44**. This table also indicates the existing groundwater quality in the pit area. Model results are reported for the average, minimum, and maximum likely concentrations. The results of the modeling did not identify any potential exceedances of Wyoming Class III groundwater quality standards.

Alternative G

Construction

Surface Water

The WRF would not cover Allread Spring or Davis Spring, so the springs would remain. Seepage from the WRF could increase concentrations of some parameters listed in **Table 40,** affecting spring water quality.

The WRF would be constructed with a cap to prevent infiltration of surface waters (i.e., rainfall and snowmelt); a liner intended to provide isolation from the groundwater regime, and a system to capture any seepage within the WRF. During construction, the liner could increase runoff to the perimeter runoff collection system and reduce recharge to the groundwater system beneath the areas covered by the liner. Appropriate use of sediment control measures would minimize potential impacts to surface water resources in the additional disturbed area. EPA requires that liner assessments assume that all liners (even High-density polyethylene) will leak because of pinhole defects from construction and installation, typically one hole for every one to two acres, even with good installation practices. A smaller volume of waste rock in the WRF (about 2/3 less) at closure and less groundwater would be in contact with infiltrating water compared to the other action alternatives. This could improve the WRF seepage quality compared to other action alternatives, which would reduce the degree and/or areal extent of water quality effects, but the nature of the effects would be the same as the other action alternatives.

The PUG Plant and haul road would be located as described for Alternative D, and the related effects would be as described for Alternative D.

Alternative G would disturb an estimated 8,297 linear feet of stream during construction (NFS and private lands). On NFS lands, approximately 11.0 acres of water influence zones disturbed during construction, which includes 1.0 acres of perennial and 10.0 acres of intermittent.

Groundwater

Impacts on groundwater from construction in Alternative G would be as described under Effects Common to All Action Alternatives.

Operation

Surface Water

Effects on surface water would be similar to Alternative D, except the increased WRF setback (to 300 feet) from Beaver Creek would reduce the potential for effects on Beaver Creek.

Groundwater

The WRF liner would increase as the WRF grows and would cut off recharge to the groundwater system over a larger area. This would reduce the quantity of groundwater flow through the area. The WRF would not affect groundwater quality, because there would be reduced seepage from the WRF to the groundwater.

Reclamation/Closure

Surface Water

The placement of a liner and geomembrane on the WRF would eliminate most risks associated with seepage to springs, or seeps. Surface water flows from the area and the water quality of those flows would be comparable to pre-mining flows and quality. No pit lake would form, so there would be no stream flow loss to evaporation from the pit lake.

Groundwater

Groundwater levels would recover over time to approximately pre-mining levels. Flows from springs affected by dewatering-induced drawdown may reappear when water levels recover sufficiently. Groundwater quality was modeled (Golder Associates, 2015c) and result are shown in **Table 44**. This table also indicates the existing groundwater quality in the pit area. Model results are reported for the average, minimum, and maximum likely concentrations. Selenium has a potential exceedance of groundwater quality standards which would likely require treatment. As stated in Section 2.9, discharged water would be monitored as required by the WYPDES permits and treatment required if necessary to meet permit requirements. Discharged water would not be allowed to degrade water quality.

The placement of an impermeable cap on the WRF would eliminate most water quality risks associated with seepage to groundwater from the WRF. Recharge to the groundwater system beneath the WRF footprint would be eliminated. However, if the water that runs off the WRF were allowed to infiltrate around the perimeter of the WRF, the overall natural water balance would not be affected because the runoff water would recharge the groundwater system.

Alternative H

Construction

Surface Water

The WRF footprint under Alternative H would be similar to Alternative E, as would the related effects. The WRF would not cover Allread Spring or Davis Spring, so the springs would remain. Seepage from the WRF could increase concentrations of some parameters listed in **Table 40,** affecting spring water quality.

The PUG Plant and haul road would be located as described for Alternative D, and the related effects would be as described for Alternative D.

Alternative H would disturb the least stream channel and water influence zones. An estimated 7,762 linear feet of stream would be disturbed during construction (NFS and private lands). On NFS lands, approximately 8.2 acres of water influence zones disturbed during construction, which includes 1.0 acres of perennial and 7.2 acres of intermittent.

Groundwater

Impacts on groundwater from construction in Alternative H would be as described under Effects Common to All Action Alternatives.

Operation

Surface Water

Effects on surface water would be similar to Alternative D.

Groundwater

Impacts on groundwater from operations in Alternative H would be as described under Effects Common to All Action Alternatives.

Reclamation/Closure

Surface Water

Under Alternative H, the Mineable Pit reclamation would be similar to Alternative E, except that a portion of the pit would not be recontoured to avoid the mineral withdrawal area. The effects on water resources would be similar to those described for Alternative F; however a deeper pit lake would form in Alternative H.

Groundwater

The effects of the reclaimed pit and pit lake formation on groundwater would be as described for Alternative F because Alternative H has the same design as Alternative F pit reclamation. The effect the WRF would have on groundwater would be as described under Effects Common to All Action Alternatives.

3.10.2.2 Cumulative Effects

The cumulative analysis area for water resources is the same as defined for the direct and indirect analysis. The analysis area includes surface water in the Beaver Creek drainage upstream from its confluence with Whitelaw Creek and downstream areas where stream flow or water quality may be affected. The analysis area includes groundwater where groundwater levels or groundwater quality may be affected. In both cases, the analysis area extends beyond the WDEQ Permit boundary. Cumulative effects to surface water quality are considered through the life of mine (45 years) and reclamation. Groundwater cumulative impacts are considered following reclamation and formation of a pit lake.

Alternative A – No Action

Cumulative effects would not occur under Alternative A - No Action, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Past and current forest management and resource development activities located within the drainage areas of the proposed project have likely affected water quality to varying degrees. Erosion and sedimentation resulting from timber harvesting and other forest and vegetation treatments, exploration and mineral resources development, and road use and maintenance would result in cumulative effects to water quality. BMPs to control sediment and spills, and federal policies and management guidance that prevent direct impacts to water, wetlands and riparian areas have minimized these effects. Past and current activities in the analysis area have not affected groundwater levels or water use/rights.

Water use by livestock developments is minimal. Potential effects from mineral exploration on groundwater levels and quality would be ameliorated through sediment control and proper borehole plugging practices.

Past and present activities have not affected water resources in terms of quantity and quality as compared to the direct and indirect effects analysis for the project. Future activities in the analysis area would affect water resources similar to past and current activities, as the existing management guidance, use of BMPs, and federal policy and regulations would remain in place.

Reasonably foreseeable actions are not expected to have cumulative effects on groundwater beyond the direct and indirect effects described in each alternative.

3.10.2.3 Irretrievable and Irreversible Consequences

Based on the analysis described above, the irretrievable and irreversible consequences by alternative include:

- Permanent loss of the headwaters of Whitetail Creek, and headwaters of Beaver Creek in the Mineable Pit in Alternatives C, D, E, F, and H.
- Permanent loss of Whitetail Spring and ephemeral headwaters of Whitelaw in the Mineable Pit in all alternatives.
- Permanent loss of spring areas (Allread and Davis Springs) where the WRF would be in all action alternatives except Alternatives D , G, and H and wetlands where the WRF would be in all action alternatives except Alternative G.
- Permanent loss of the reach of Beaver Creek covered by the WRF in Alternative C.
- Permanent diminishment of the quantity of groundwater flow due to evaporative losses from a pit lake in Alternatives C, E, F, and H.

3.11 Vegetation

This section discusses the general vegetation and sensitive plants found in the analysis area. Other EIS sections specifically discuss the impacts on Wetlands (Section 3.12.3) and Timber (Section 3.14.3) in more detail. This section provides the foundation for the wildlife discussed in Wildlife (Section 3.13) and primary grazing forage in Livestock Grazing (Section 3.15).

3.11.1 Area of Analysis and Methods

The analysis area for vegetation consists of the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes and the WDEQ Permit boundary. Vegetation data used in this analysis were taken from the vegetation baseline report which covered a larger area, completed for the Bull Hill Mine (BKS, 2014b). Quantitative vegetation sampling was completed for the Mine Area, exploration boundary, and WDEQ Permit boundary. Where field surveys were not conducted, the US Farm Service Agency, National Agricultural Imagery Project data (NAIP, 2012) and Forest Service GIS data was used (generally for access routes, power lines, weeds, and sensitive plants). GIS was used to calculate acres of disturbance.

3.11.2 Affected Environment

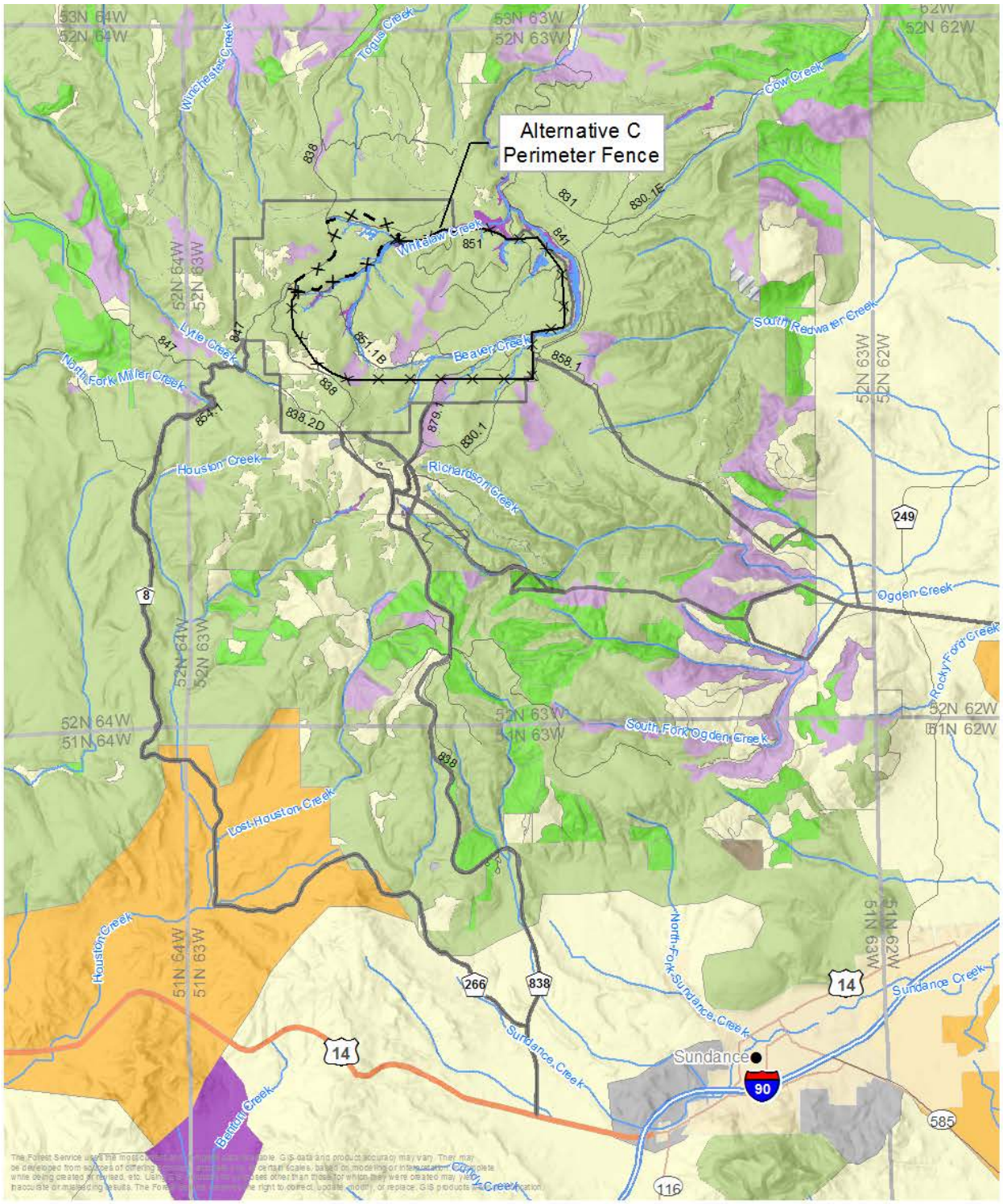
Vegetation Cover Types

Vegetation types are used to characterize the vegetation found in the analysis area. Vegetation communities were mapped using 2011 NAIP imagery and field verified (BKS, 2014b). Percent cover, shrub density, and tree density parameters were estimated to determine vegetation community composition. **Table 45** lists the dominant vegetation types. **Figure 30** shows the location of these plant community types.

Table 45.
Acres of Vegetation Types in Project Area

Vegetation Type	NFS	Private	State	Total	Percent of Project Area
Disturbed	52.5	44.1	4.0	100.6	3.2
Riparian	35.0	3.8	0.2	39.0	1.3
Hardwood Forest	103.4	64.7	0	168.1	5.4
Grassland	237.0	64.2	2.8	304.0	9.8
Ponderosa Pine Forest	1,891.0	561.8	4.6	2,457.4	79.2
Wetland	24.1	2.5	0	26.7	0.9
Crop/Hayland	0.8	6.9	0	7.7	0.2

* Stream channels accounted for roughly 6.3 acres of the project area and were not included in vegetation type acreage calculations.



Source: Copyright:© 2014 Esri

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Ponderosa Pine Forest

The ponderosa pine forest is the predominant forest cover type, comprising 78.7 percent of the Project Area. It also is the dominant vegetation type in the fenced Mine Area. This tree dominated community type occurs on well drained, upland sites on the slopes and mesas of the area.

Aspen

Quaking aspen is the dominant species in this plant community, intermixed with ponderosa pine and paper birch. This community type occurs on moderate to steep slopes often surrounded by ponderosa pine forests.

Grasslands

The dominant types of the mapped grasslands are mixed grass prairie and montane grasslands. Grasslands consist of forbs (with no woody stems) and some shrubs (with woody stems). Forbs include native perennial grasses and non-native perennial grasses and other plants such as western yarrow and arrowleaf balsamroot. Shrubs include western snowberry, common snowberry, silver sagebrush and chokecherry among others.

Montane grasslands account for 8.6 percent of the 9.8 percent of the grasslands in the Project Area. Montane grasslands are characterized by gradual to moderately sloped rolling hills with limited shrub cover. Dominant species were Sandberg bluegrass (*Poa secunda*), timothy, and western yarrow (*Achillea millefolium*).

Mixed grass prairie is a blend of the vegetation of the tallgrass and shortgrass prairies. It has the richest floristic complexity of all the central plains region grasslands. This type is mixed with tall grasses in wetter areas and with shorter grasses in drier sites.

Riparian and Wetlands

The riparian vegetation type occurs along streams, springs and seeps. Riparian vegetation tolerates or is dependent on either saturated soils, moist soils, or a water table near the surface. There is 1.2 percent of the Project Area that is classified as riparian. The main riparian corridors in the vegetation analysis area are Beaver Creek, Whitelaw Creek, Whitetail Creek and smaller tributaries to these streams. Riparian areas were characterized during the baseline vegetation inventory as grass dominated communities along ephemeral, intermittent, and perennial drainages. Shrubs and trees were typically found on the drainage edge and included ponderosa pine, quaking aspen and Oregon grape (*Mahonia repens*) (BKS, 2014b). Other species by lifeform found include: *Carex* and *Juncus* species, hazelnut, chokecherry, and snowberry, and bur oak (*Quercus macrocarpa*) and Bebb's willow (*Salix bebbiana*). See Section 3.12 for detailed Wetlands discussion.

Disturbed

This type is defined as lands previously disturbed by human activities (BKS, 2014b).

Cropland

This type was identified during baseline studies as occurring along the Miller Creek Road. No prime farmland or agricultural land of state importance is documented in the analysis area (BKS, 2014b).

Special Status Plant Species

Special status plants are species listed as threatened or endangered under the ESA, on the Regional Forester's sensitive species list (US Forest Service, 2013) or identified in the Forest Plan as Species of Local Concern, and Target Plant Species.

ESA Listed Threatened and Endangered Plants

The Ute ladies'-tresses is the only federally listed plant with potential habitat in the analysis area (BKS, 2014b).

Ute ladies'-tresses' habitat is typically moist and seasonally flooded meadow terraces, ox bows and gravel bars of streams fed predominately by groundwater (Fertig, W., Heidel, B., 2007). Potential habitat was identified along perennial streams, so surveys for individuals, populations, and habitat suitability were completed on the following streams that occur in the analysis area:

- South Redwater Creek and associated tributaries;
- Whitelaw Creek and associated tributaries;
- Beaver Creek and associated tributaries; and
- Cow Creek.

No individuals or populations of Ute ladies'-tresses were found during field surveys in 2011 or 2012. Of 83 sites investigated for habitat suitability, the majority were classified as marginal or non-existent habitat and thirteen were classified as poor habitat. Thus, the analysis area contains some potentially suitable habitat for Ute ladies'-tresses, classified as marginal to poor in quality.

Although some marginal to poor suitable habitat was identified, occurrence of this species is unlikely because the known population is not near the analysis area (BKS, 2014b). Two locations classified as poor-quality suitable habitat occur within the WRF and one occurs in the proposed pit dewatering pond in Alternative C. The remaining would not be directly affected by project activities. Because no populations or individuals were found, known populations do not occur nearby, and the habitat was classified as marginal to poor, this species would not be affected and will not be discussed further.

Forest Service Sensitive Plant Species

The following Forest Service Sensitive plants were determined to have potential habitat in the analysis area (BKS, 2014b):

- Foxtail sedge – Potentially suitable habitat was identified (wet meadows and willow-sedge communities along streams dominated by a woodland overstory).
- Prairie moonwort - Potentially suitable habitat was identified in the analysis area as meadow grassland communities with well-drained, sandy, or limestone-derived soils.
- Highbush cranberry – Known from three extant occurrences in Wyoming, potentially suitable habitat in the analysis area was identified as shady deciduous woodlands surrounding streams and wetlands and seeps within riparian areas.
- Narrowleaf grapefern – Potentially suitable habitat was identified in the analysis area as meadow grassland vegetation communities with limestone derived soils and disturbance areas along old roads.
- Yellow lady's slipper – Potentially suitable habitat was identified in the analysis area as shady deciduous woodlands surrounding streams.

Potential suitable habitat was estimated prior to field work based on a desktop assessment of dominant vegetation community and soils. In particular, prairie moonwort, narrowleaf grapefern, and highbush cranberry were used to represent suitable habitat. From this assessment, the approximately 77 acres of montane grassland on NFS land was considered suitable for prairie moonwort. Approximately 0.5 acre was identified for narrowleaf grapefern. Approximately 21 acres were identified as potentially suitable for highbush cranberry.

Field surveys for all species with the potential to occur were conducted in 2012 and 2014. Surveys focused on areas identified as suitable habitat during the desktop review, then further determination of suitability in the field. In all cases, the potential for any of them to occur was determined as low during the field investigation due to limited suitable habitat. No individuals were observed during the field surveys.

Forest Service Plant Species of Local Concern and Target Plant Species

Forest Service Plant Species of Local Concern identified as having potential habitat in the analysis area are arrowleaf sweet coltsfoot and greenleaf willow. Surveys conducted in 2012 and 2014 found no occurrences. Potential habitat for arrowleaf sweet coltsfoot occurs in the analysis area as wetlands and seeps. Suitable habitat along Redwater Creek was identified for greenleaf willow, but no habitat for greenleaf willow was documented in the analysis area (BKS, 2014b).

Forest Service Target Plant Species

Forest Service Target Plant Species with potential habitat in the analysis area are:

- *Botrychium* "redbank" – Potentially suitable habitat is described as moist meadows to wetlands.
- Little grapefern – Potentially suitable habitat is described as moist meadows to wetlands.
- Pale moonwort – Potentially suitable habitat is described as grasslands and open woodlands.
- Rattlesnake f ern – Potentially s uitable h abitat i s d escribed a s m oist, g ulch b ottoms, de nse s pruce understories, and limestone cliffs.
- Small-flower c olumbine – Potentially su itable h abitat i n Wy oming i s d efined as s tream b anks i n coniferous and hazelnut forests.

Surveys conducted in 2012 found no occurrences of Forest Service Target Plant Species populations in the WDEQ Permit boundary. One positive occurrence for pale moonwort, little grapefern, and Botrychium "redbank" was recorded in 2011 at a single location outside the edge of the WDEQ Permit boundary.

Noxious and Invasive Weeds

Surveys for Wyoming state Designated Noxious Weeds (Wyoming Weed and Pest Council, 2012a) and Crook County Declared Weeds (WDEQ, 2012) were conducted in conjunction with baseline vegetation and special status plant surveys in 2011 and 2012 (BKS, 2014b). Species found include: common mullein, wild licorice, bull thistle, ox-eye daisy, yellow toadflax, scotch thistle, musk thistle, western houndstounge, Canada thistle, quackgrass hoary cress, Russian knapweed, spotted knapweed, and common tansy.

Dalmatian toadflax, an additional species with potential to occur that is listed on the Wyoming weed list, was not observed during 2011 surveys. However, it was previously documented within the analysis area (US Forest Service, 2009a).

3.11.3 Environmental Consequences

3.11.3.1 Direct and Indirect Effects

Effects on timber are discussed in Section 3.14.3, and wetlands are discussed in Section 3.12.3.

Alternative A - No Action Alternative

Under Alternative A - Ongoing reclamation from previously completed exploration would result in younger and less dense vegetation with less overall cover than undisturbed conditions. Over time, density and cover would increase to be similar to undisturbed conditions.

Effects Common to All Action Alternatives

Construction and Operation

The acres of each vegetation community type within the Mine Area would vary by alternative. Prior to any excavation or construction activities vegetation would be stripped from the surface along with the topsoil. Disturbance areas include the Mineable Pit, PUG Plant and facilities, sediment storage ponds, drainage channels, dewatering pond, haul roads, guardhouse, topsoil stockpile and WRF. Trees would be harvested

prior to striping (See Timber, Section 3.13). Topsoil would be stored in topsoil piles and seeded with a native cover crop for the duration of the mine.

Water pipelines, power lines, fences, and exploration activities would also remove vegetation. The disturbance would be considered temporary, as reclamation would occur following installation of the infrastructure. There would be no need to store topsoil and seeding would take place following construction. Seedbeds may need preparation prior to seeding if there is excessive soil compaction or loss of topsoil. These areas would be avoided unless repairs or maintenance is needed. If maintenance or repairs require removal or disturbance of vegetation, the disturbed areas would be reclaimed as soon as feasible.

The clearing of vegetation and alteration of local hydrology would impact wetland vegetation communities. See Wetlands (Section 3.12).

Special Status Plants

Wetlands and montane grasslands were identified as the two primary vegetation types of interest when surveys for special status plants were conducted. Effects to suitable habitat for Forest Service Sensitive, Species of Local Concern, and Target Species may be inferred by amount of acreage disturbed and the duration of disturbance that is proposed within the habitats listed for each species. Effects to suitable habitat for arrowleaf sweet coltsfoot, foxtail sedge, highbush cranberry, yellow lady's slipper, botrychium "redbank", small-flower columbine, rattlesnake fern, and little grapefern may be inferred from amount of wetland and riparian acreage disturbed and the duration of disturbance by alternative (also see Wetlands 3.12). Effects to suitable habitat for prairie moonwort, pale moonwort, and narrowleaf grapefern, may be inferred from the amount of grassland acreage disturbed and the duration of disturbance by alternative. Initially, potentially suitable habitat was grouped into the broad categories of wetland, riparian, and grassland vegetation types when identifying potential habitat areas with GIS. Then field surveys further refined potential areas of suitable habitat and reported that the occurrence of truly suitable habitat was low (BKS, 2014b).

There was one positive occurrence for pale moonwort, little grapefern, and botrychium "redbank" recorded in 2011 at a single location in Section 20, T52N R63W. The data point for this observation is located on the edge of the WDEQ Permit boundary and does not occur within a proposed disturbance footprint. These species would not be impacted by proposed project activities.

Due to the low occurrence of potentially suitable habitat and the negative survey results, in particular within areas of proposed disturbance, effects to special status plants and their habitat would be minimal.

Noxious and Invasive Weeds

Weed management would be necessary under all action alternatives, as each would expose bare soil and traffic would potentially transport weed seed into the Mine Area. Implementation of the Weed Management Plan is included under all alternatives, as are design features and environmental protection measures (Section 2.6) to minimize weed infestations. Ongoing weed management and monitoring (Section 2.9.5) would reduce the potential impacts. With implementation of proposed weed management, protection measures, and monitoring, impacts to vegetation communities and special status plant habitat would be minimal.

Reclamation

Reclamation would include measures to reduce impacts on vegetation. Design features include measures to retain native vegetation to the extent possible, use revegetation practices that optimize plant establishment, store and replace topsoil carefully, use weed-free mulch, fertilize, and revegetate as soon as practicable. Reclamation would reestablish vegetation types over the long term. Following mining and at the onset of reclamation, topsoil would be spread over the reclaimed area at an even depth and the approved native seed mix would be sowed. In most areas reclamation would restore the entire disturbance area. Depending on the alternative, there would be areas that may be a permanent loss, such as the Mineable Pit or WRF, where the vegetation community would not be returned to ecological function or provide for multiple uses.

After reclamation, there would be younger and less dense vegetation with less overall cover than the current conditions. Over time, density and cover would increase to be similar to current conditions, except with Alternative G, where trees and shrubs would be periodically removed from the WRF and Mineable Pit covers.

Areas that were in a disturbed condition prior to the Proposed Action would likely remain in that disturbed state and would not support native vegetation.

Alternative C

Vegetation Types

Alternative C would disturb the least vegetation on NFS lands compared to the other alternatives (**Table 46**).

Table 46.
Alternative C Acres of Disturbance by Vegetation Type on NFS Lands by Mine Component

Mine Component[1]	Crop	Disturbed	Riparian	Aspen	Grass	Ponderosa Pine	Wetland	Total
Mine Pit	0	4.1	10.2	18.7	44.0	154.6	0.5	232.1
PUG	0	0	0	0	1.6	0.9	0.1	2.6
Facilities	0	0	0	0	0	14.4	0	14.4
PUG Haul Road	0	0.1	0.7	0	0	5.1	0.1	6.0
WRF	0	0	0	0	0	0.2	0	0.2
WRF Haul Road	0	0	0	2.3	0	2.0	0	4.3
Secondary Haul Road	1.1	0	0	0	0	13.8	0	14.9
Miller Ck Rd New	0.8	1.8	0	0	0.2	13.9	0	16.7
Pit Dewater Pond	0	0	1.9	0	0	2.8	0.2	4.9
Sedimentation Pond	0	0	0.5	0	0	3.7	0.3	4.5
Drainage Channel	0	0	0	0.3	0.1	1.8	0	2.2
Water Pipeline	0	0	0	0	0	0.4	0	0.4
Topsoil Stockpile	0	0.6	0	0	0.7	25.8	0	27.1
Topsoil Stockpile Access	0	0	0	0	0	0.2	0	0.2
Fence Construction	0	0.2	0.4	0.3	0.3	8.3	0.1	9.6
Fence Maintenance	0	0.1	0	0.4	0.4	6.3	0.1	7.3
25kV ROW (includes Structure locations)	0	0	0	0	0	6.2	0	6.2
Total	**1.9**	**6.9**	**13.7**	**22.0**	**47.3**	**260.4**	**1.4**	**353.6**

[1]Existing road disturbance not reported (5.6 ac.).

Alternative C would also disturb 502 acres of private land due to construction of the WRF, the sediment pond, the Beaver Creek reroute, and the Miller Creek Road access improvements. Disturbance would primarily

occur to ponderosa pine forest and grassland types. Approximately 11 acres of state of Wyoming lands would be disturbed, mostly grasslands and ponderosa pine.

Reclamation/Closure

Reclamation in Alternative C would not use all native seed for its revegetation efforts, which would introduce non-natives and possibly inhibit the re-establishment of native grassland types.

Much of the Mineable Pit would be reclaimed as constructed, meaning that the highwalls and the eventual pit lake would not support native grassland, ponderosa pine, or aspen vegetation. This vegetation would be permanently lost within the Mineable Pit footprint. Above the water, lands may revegetate with opportunistic plants, including weeds. Monitoring would evaluate and treat weed infestations.Reestablishment of the ponderosa pine forest would take longer than the grassland, riparian, or aspen types. Herbaceous vegetation would be restored with BMPs and design features in place, including proper topsoil handling, minimizing the amount of area disturbed, and using an approved seed mix. Since ponderosa pine can readily regenerate in exposed soils, the reestablishment of the forest type may begin once the soil has been reclaimed, depending on distance to a seed source.

See Wetlands Section (3.12.3) for additional discussion of effects on wetlands.

Alternative D

Construction and Operations

Vegetation Types

There would be more acres disturbed on NFS lands under Alternative D (**Table 47**) than Alternative C. There would be an increase in disturbance acres for all vegetation types compared to Alternatives C, E, and G, primarily due to the larger WRF footprint and increased disturbance during reclamation to restructure the pit walls. Wetlands would be impacted more in Alternative D than with Alternative C.

Alternative D would also disturb approximately 448 acres of privately owned lands, slightly less than Alternative C. Effects would primarily occur as the removal of ponderosa pine forest and hardwood forest types for construction of the WRF, and ponderosa pine and grassland along Warren Peak Road. Vegetation removal would not occur on state lands.

Special Status Species

One positive occurrence for pale moonwort, little grapefern, and Botrychium “redbank” was recorded in 2011 at a single location in Section 20, T52N R63W within the Grassland vegetation type. The data point for this observation is located on the edge of the WDEQ Permit boundary and does not occur within a proposed disturbance footprint.

Reclamation/Closure

At the onset of reclamation, topsoil would be spread over the reclaimed area at an even depth. The seed mix on NFS lands would be native species, which would improve the restoration of native vegetation types over that described in Alternative C.

Highwall reduction on the Mineable Pit would increase the amount of vegetation affected by nearly 95 acres, however this would enable reclamation of the entire mine pit. Reclamation of these areas includes measures (topsoil placement and revegetation) to avoid accelerated erosion on the 3:1 slopes.

Table 47. Alternative D Acres Disturbed by Vegetation Type on NFS lands							
Mine Component[2]	**Disturbed**	**Riparian**	**Aspen**	**Grass**	**Ponderosa Pine[1]**	**Wetland**	**Total**
Mine Pit	4.1	10.2	18.7	44.0	154.6	0.5	232.4
PUG	0	0	0	0	2.1	0	2.1
Facilities	0	0	0	0.2	14.3	0	14.5
PUG Haul Road	0.2	0.9	0	0	9.5	0	10.6
WRF	0.3	3.3	0	0	56.1	1.1	60.8
WRF Haul Road	0	0	6.0	1.9	3.0	0	10.9
Warren PK RD New	0.8	0.2	0	7.7	36.2	0	45.0
Pit Dewater Pond	0	0	0	0	7.9	0	7.9
Sedimentation Pond	0.1	0.2	0	0	6.0	0.6	6.9
Drainage Channel	0	0.3	0	0.1	2.7	0	3.1
Water Pipeline	0	0.1	0	0	0.9	0.1	1.1
Topsoil Stock Pile	0	0	0	0	4.0	0	4.0
Fence Construction	0.3	0.3	0.2	0.3	3.2	0.1	4.4
Fence Maintenance	0.1	0	0.4	0.6	4.7	0.1	5.9
Pit Reclamation	1.3	0	12.2	18.3	63.0	0	94.8
25kV ROW	0.4	0	3.5	6.7	12.9	0	22.2
Total*	**7.6**	**15.5**	**37.5**	**79.8**	**381.1**	**2.5**	**526.6**

[1] Includes 14.7 acres of Other Forest vegetation type

[2]Existing road disturbance and existing power line access and overland travel not reported (20 ac.).

Alternative E

Construction and Operations

There would be more acres of total vegetation disturbance on NFS lands under Alternative E (**Table 48**) than Alternatives C and G, but less than Alternatives D and F. However, less acreage of NFS lands would be within the Mine Area fence under Alternative E compared to all other alternatives. Acreage disturbed during reclamation to reduce pit walls contributes to the greater total acreage disturbed.

Alternative E would result in greater disturbance to private lands. There would be approximately 456 acres of disturbance to vegetation on private lands, primarily to ponderosa pine and grassland types due to construction of the WRF. Components such as the power lines, the PUG Plant and facility buildings, as well as the topsoil piles would be placed on the private lands, reducing the amount of vegetation affected by these components on NFS lands. The topsoil pile, the PUG and other facilities, and the Miller Creek access route would also contribute to the total acres of private land disturbed. No state lands would be affected under Alternative E.

Reclamation/Closure

At the onset of reclamation, topsoil would be spread over the reclaimed area at an even depth. The seed mix on NFS lands would be native species, which would improve the restoration of native vegetation over that described in Alternative C. As with Alternative D, highwall reduction on the Mineable Pit would increase the amount of vegetation affected; approximately 104 additional acres would be disturbed. Formation of a pit lake would permanently remove these acres from reestablishing vegetation.

Table 48. Alternative E Acres Disturbed by Vegetation Type on NFS lands							
Mine Component	**Disturbed**	**Riparian**	**Aspen**	**Grass**	**Ponderosa Pine[1]**	**Wetland**	**Total**
Mine Pit	4.1	10.2	18.7	44.0	154.6	0.5	232.1
PUG Haul Rd	0.2	0	0.7	1.2	0.1	0	2.2
WRF	0	0	2.0	0.0	1.1	0	3.1
WRF Haul Road	0.2	0	0	0.5	0	0	0.7
FSR 879.1 to Warren Peak New	2.5	0	1.9	5.6	25.0	0	35.0
Pit Dewater Pond	0	2.7	0	0	2.2	0.5	5.4
Sedimentation Pond	0	0.1	0	0	3.5	0.0	3.6
Drainage Channel	0	0	0.6	0.1	2.0	0	2.7
Water Pipeline	0	0	0.6	0.5	1.5	0	2.6
Topsoil Stockpile	0	0	0	0	0.3	0	0.3
Fence Construction	0.1	0	0.2	0.2	3.0	0	3.5
Fence Maintenance	0.1	0	0.4	0.4	6.1	0.1	7.1
Pit Reclamation	1.6	0	12.5	19.6	70.7	0.0	104.4
Total	**8.8**	**13.0**	**37.6**	**72.1**	**270.1**	**1.1**	**402.7**

[1] Includes 9.1 acres of Other Forest vegetation type.

Alternative F

Construction and Operation

There would be more acres of disturbance on NFS lands under Alternative F (**Table 49**) than all other alternatives. The footprint of the WRF is larger, which would increase total disturbance.

Table 49. Alternative F Acres Disturbed by Vegetation Type on NFS lands							
Mine Component	**Disturbed**	**Riparian**	**Aspen**	**Grass**	**Ponderosa Pine[1]**	**Wetland**	**Total**
Mine Pit	4.1	10.2	18.7	44.0	154.6	0.5	232.1
PUG Haul Road	0	0	0.6	0.6	0	0	1.2
WRF	5.0	6.7	6.5	3.1	205.5	5.4	232.2
FSR 879.1 to Warren Peak New	0.7	0	1.9	5.6	22.9	0	31.1
Pit Dewater Pond	0	2.7	0	0	2.2	0.5	5.4
Sediment Pond	0.1	0.1	0	0	6.1	0.1	6.4
Drainage Channel	0	0	0.3	0.1	2.0	0	2.4
Water Pipeline	0	0	0.5	0.4	1.5	0	2.4
Topsoil Stockpile	0	0	0	0	0.3	0	0.3
Fence Construction	0	0	0.2	0.2	3.3	0.1	3.8
Fence Maintenance	0.1	0.1	0.4	0.4	7.1	0.1	8.2
Alt F Pit Reclamation	0.7	0.0	5.1	8.1	27.9	0.0	41.7
25kV ROW	0.2	0	1.0	2.6	8.4	0	12.2
TOTAL	**12.7**	**19.8**	**35.2**	**65.1**	**443.9**	**6.7**	**583.3**

[1] Includes 7.4 acres of other forest type.

Disturbance from WRF Haul Road in Alternative F is included in WRF (Figure 7).

Approximately 469 acres of vegetation on privately owned land would be affected, mostly ponderosa pine forest and some aspen. Approximately 28 acres of grassland would be affected on private lands. This is similar to impacts from Alternative E. There would be no vegetation removed on state lands under this alternative.

Reclamation/Closure

At the onset of reclamation, topsoil would be spread over the reclaimed area at an even depth. The seed mix on NFS lands would be native species, which would improve the restoration of native vegetation over that described in Alternative C. Reclamation would require additional disturbance (42 acres) to reduce the slope of most of the pit highwalls. Formation of a pit lake would permanently remove these acres from reestablishing vegetation.

Alternative G

Construction and Operations

Alternative G (**Table 50**) would disturb less vegetation on NFS lands than Alternatives D, E, and F. Total disturbance would be slightly higher than Alternative C due to the expanded WRF footprint. The WRF would extend onto NFS lands in Section 15 in order to stay north of Beaver Creek by at least 300 feet.

Table 50.
Alternative G Acres Disturbed by Vegetation Type on NFS Lands

Mine Component	Crop	Disturbed	Riparian	Aspen	Grass	Ponderosa Pine	Wetland	Total
Mine Pit	0	4.1	10.2	18.7	44.0	154.6	0.5	232.1
PUG	0	0	0	0	0	2.1	0	2.1
Facilities	0	0	0	0	0.2	14.3	0	14.5
PUG Haul Road	0	0.2	.9	0	0	9.5	0	10.6
WRF	0	0.3	3.3	0	0	56.1	1.1	60.8
WRF Haul Road	0	0	0	6.0	1.9	3.0	0	10.9
Miller CK Rd New	0.6	2.1	0	0	0.1	12.7	0	15.5
Pit Dewater Pond	0	0	0	0	0	7.9	0	7.9
Sediment Pond	0	0.1	0.2	0	0	6.0	0.6	6.9
Drainage Channel	0	0	0	0.3	0.1	2.7	0	3.1
Water Pipeline	0	0	0.1	0	0	0.9	0.1	1.1
Topsoil SP	0	0	0	0	0	3.8	0	3.8
Fence Construction	0	0.3	0.3	0.2	0.3	3.2	0.1	4.4
Fence Maintenance	0	0.1	0	0.4	0.6	4.7	0.1	5.9
25kV ROW	0	0	0	0	0	6.6	0	6.6
TOTAL	**0.6**	**7.2**	**15.0**	**25.6**	**47.2**	**288.0**	**2.5**	**386.2**

Approximately 478 acres of vegetation, of which 360 acres are ponderosa pine forest, would be disturbed on private lands. There are 10 acres on state lands that would be disturbed, 3.7 of which are ponderosa pine forest.

Reclamation/Closure

Alternative G would permanently affect the least amount of vegetation on NFS lands. Most disturbance would be temporary but long term, and reclaimed during mine closure. The only permanently affected vegetation would be mostly ponderosa pine forest from the expansion of Miller Creek Road. Under this alternative no wetlands would be permanently lost.

Approximately 371 acres of NFS lands would be reclaimed at closure. Under this alternative reclamation would restore the mine pit and associated disturbance to nearly the original topography; there would be no steep slopes left from the mine pit and no pit lake. Reclamation of the 232.1 acre pit would convert the native vegetation which is approximately 155 acres of ponderosa pine forest, 19 acres aspen, 10 acres riparian and 44.0 acres of montane grasslands to all grasslands. Areas reclaimed soon after disturbance account for 17.6 acres.

Alternative H

Construction and Operations

Alternative H (**Table 50**) would disturb less vegetation on NFS lands than Alternatives D, E, F and G.

Vegetation on approximately 467 acres, of which 343 acres are ponderosa pine forest, would be disturbed on private lands. There are 10 acres on state lands that would be disturbed, 3.7 of which are ponderosa pine forest.

Reclamation/Closure

A pit lake, about 107 acres would form, permanently affect mostly ponderosa pine. Reclamation on the pit would disturb and additional 39 acres of mostly ponderosa pine (24 acres), with some grass (9.5 acres) and aspen (5 acres). Most disturbance would be temporary but long term, and reclaimed during mine closure. The only permanently affected vegetation would be mostly ponderosa pine forest from the expansion of Miller Creek Road.

Table 51.
Alternative H Acres Disturbed by Vegetation Type on NFS Lands

Mine Component	Crop	Disturbed	Riparian	Aspen	Grass	Ponderosa Pine	Wetland	Total
Mine Pit	0	4.1	10.2	18.7	44.0	154.6	0.5	232.1
PUG	0	0	0	0	0	2.1	0	2.1
Facilities	0	0	0	0	0.2	14.3	0	14.5
PUG Haul Road	0	0.2	.9	0	0	9.5	0	10.5
WRF	0	0	0	2.0	0	1.1	0	3.1
WRF Haul Road	0	0.4	0	1.0	1.5	0.1	0	3.0
Miller CK Rd New	0.6	2.1	0	0	0.1	12.7	0	15.5
Pit Dewater Pond	0	0	0	0	0	7.9	0	7.9
Sediment Pond	0	0.0	0.1	0	0	4.6	0	4.7
Drainage Channel	0	0	0	0.6	0.1	1.9	0	2.6
Water Pipeline	0	0	0.3	0	0	0.0	0.1	0.3
Topsoil Stockpile	0	0	0	0	0	4.0	0	4.0
Fence Construction	0	0.1	0.0	0.2	0.3	3.6	0.1	4.2
Fence Maintenance	0	0.1	0	0.4	0.6	6.4	0.1	7.6
25kV ROW	0	0	0	0	0	6.2	0	6.2
TOTAL	**0.6**	**7.0**	**11.5**	**22.9**	**46.8**	**229.0**	**0.3**	**318.6**

3.11.3.2 Cumulative Effects

The analysis area for cumulative effects on vegetation is the analysis area plus a 5-mile buffer. This area was used to capture effects to vegetation at a landscape scale. The types of other activities that may affect vegetation are primarily forest management related, such as timber harvesting and forest treatments, and livestock use.

Alternative A

Cumulative effects would not occur under Alternative A - No Action, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Past and present activities that have affected vegetation include timber harvesting, forest treatments, prescribed burns, weed control, range improvements, exploration, and mineral development. These activities have altered or removed vegetation, and affected soil properties. Harvesting activities and forest treatments have primarily affected the ponderosa pine community type. Future activities that require vegetation removal or cause surface disturbance will continue to affect vegetation type acreage and plant community composition. Effects of the Proposed Action on vegetation (i.e. removal) would combine with these past, present, and future activities and result in cumulative effects of altered vegetation communities and soil properties. However, effects from timber harvesting, forest treatments, and exploration are diminished over time as vegetation reestablishes and soil productivity improves, overall forest health improves, and reclamation activities are completed.

It is also possible these activities have altered or removed suitable habitat for special status plant species and resulted in establishment or spread of non-native species and weeds. Effects on special status species are minimized through habitat protection and avoidance provided through implementation of current forest policy, BMPs, and design features that require additional future surveys for Ute ladies'-tresses. Populations of special status plant species were not identified during project surveys. Cumulative effects to special status plants are not anticipated.

Cumulative effects of altered species compositions and weed infestations would continue through reclamation.

Cumulative Effects by Alternative

The magnitude of cumulative effects to vegetation would differ by alternative at levels that may be inferred by the direct and indirect analysis. Surface disturbance and vegetation removal is greatest under Alternative F, and would thus have the greatest cumulative effect of altered vegetation communities and potential for weed infestations. Alternative C has the least acreage of vegetation removed, but would reclaim less acreage, as the Mineable Pit would be left in place and a pit lake would form. Reclamation under Alternative C would not use all native seed, making the potential for introduction of non-natives higher. This may affect the potential for native grassland to re-establish compared to other alternatives.

Alternative F would disturb the greatest amount of ponderosa pine forest, which when combined with effects of timber harvesting and forest treatment activities, would result in greater cumulative effects to this vegetation type than other alternatives. Alternative F would also disturb more wetlands than other alternatives, increasing cumulative effects on this vegetation type.

The impermeable cap under Alternative G would prevent re-establishment of forest communities in the Mineable Pit at closure, thus also resulting in greater cumulative effects to ponderosa pine vegetation, but reducing cumulative effects to grassland types, which would likely re-establish.

The potential for cumulative effects to riparian areas would be less under Alternatives D, E, G, and H due to design features to avoid riparian habitats. Cumulative effects of increases in weeds and loss of native vegetation would be less under Alternatives D, E, F, G, and H, as design features such as the use of native seed mixes and topsoil management would be implemented.

3.11.3.3 Irreversible and Irretrievable Impacts

Impacts identified above that are considered irreversible and irretrievable include:

- Vegetation that would never be reestablished in the Mineable Pit in Alternative C, E, and F.

- Forested vegetation that would forever be replaced with grass or shrub vegetation on the WRF and Mineable Pit due to the impermeable caps in Alternative G (see Timber, Section 3.13).

3.12 Wetlands

3.12.1 Area of Analysis and Methods

The analysis area for determining wetland impacts consists of the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes These disturbance areas include the Mineable Pit, PUG Plant, sediment storage ponds, dewatering pond, power line, access roads and secondary roads, and the WRF. This area allows for a comparison of wetland disturbance among alternatives.

Acres of disturbance were mapped by alternative in GIS. GIS was used to calculate acres by wetland type using baseline aquatic resources inventory (ARI). The ARI was originally conducted in 2011, with an additional more detailed ARI conducted in 2014 (BKS, 2014b). Field surveys used recommended methods in accordance with USACE Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys and Coast Region (Version 2.0) (USACE, 2010), and Regulatory Guidance Letter No. 05-05 (USACE, 2005).

In areas where field inventory data was not available, such as the proposed power line and access road routes, National Wetland Inventory data was used (USFWS, 2001).

Wetlands are discussed in terms of their type (Cowardin, 1979). Five types were identified in the analysis area, including:

- Herbaceous (i.e., palustrine emergent in the Cowardin system) are dominated by erect, rooted, herbaceous species, such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), sedges (*Carex* spp.), rushes (*Juncus* spp.), spikerushes (*Eleocharis* spp.), and various grasses and forbs.
- Forested (i.e., palustrine forested, or PFO in the Cowardin system) are wetlands dominated by tall shrubs or trees 20 feet tall or taller. Common species include Bebb willow (*Salix bebbiana*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*).
- Shrub (i.e., palustrine scrub-shrub or PSS in the Cowardin system) include wetlands dominated by woody vegetation less than 20 feet tall. These wetlands are commonly dominated by species such as Bebb willow, other willows. Shrub wetlands often have an understory and openings dominated by herbaceous wetland species.
- Aquatic beds are wetlands where plants primarily grow below the water surface for most of the growing season in most years. These wetlands are best developed in relatively permanent water or repeat flooding conditions.
- Unconsolidated bottoms are wetlands with less than 30 percent vegetative cover and over 25 percent cover of particles smaller than stones.

3.12.2 Affected Environment

Approximately 26.7 acres of wetland were identified in the wetland analysis area. These wetlands are in the Upper Beaver Creek watershed and are found in drainage bottoms adjacent to Beaver, Whitelaw, and Whitetail creeks. Small, locally isolated wetlands occur infrequently as the majority of wetlands are found in large herbaceous, shrub, and forest mosaics occupying channel floodplains. Herbaceous wetland (**Photo 6**) accounts for the majority of the area. All of the wetland types are in generally good condition given the history of livestock grazing. Livestock tend to congregate in wetlands as there is water and shade present. As a result, vegetation cover is removed, soils are disturbed from hoof action, and nitrates are added. These

actions decrease wetland's ability to store and filter water during high stream flow events. **Table 52** shows the acres by ownership and **Figure 31** shows the delineated wetland types.

Photo 6. Typical herbaceous and shrub wetland mosaic within the analysis area

3.12.3 Environmental Consequences

3.12.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, due to the primary location of wetlands in the floodplain and CWA regulations stressing wetland avoidance, it is unlikely that future mine exploration would affect wetlands.

Effects Common to All Action Alternatives

Table 52. Acres of Wetland Types in the Analysis Area

Wetland Type	NFS	Private	Total
Aquatic Bed	0.7	0.2	0.9
Herbaceous	15.8	0.6	16.4
Forested	4.9	1.1	6.0
Shrub	2.7	0.6	3.3
Unconsolidated Bottom	0.1	0	0.1
Total	**24.2**	**2.5**	**26.7**

Construction

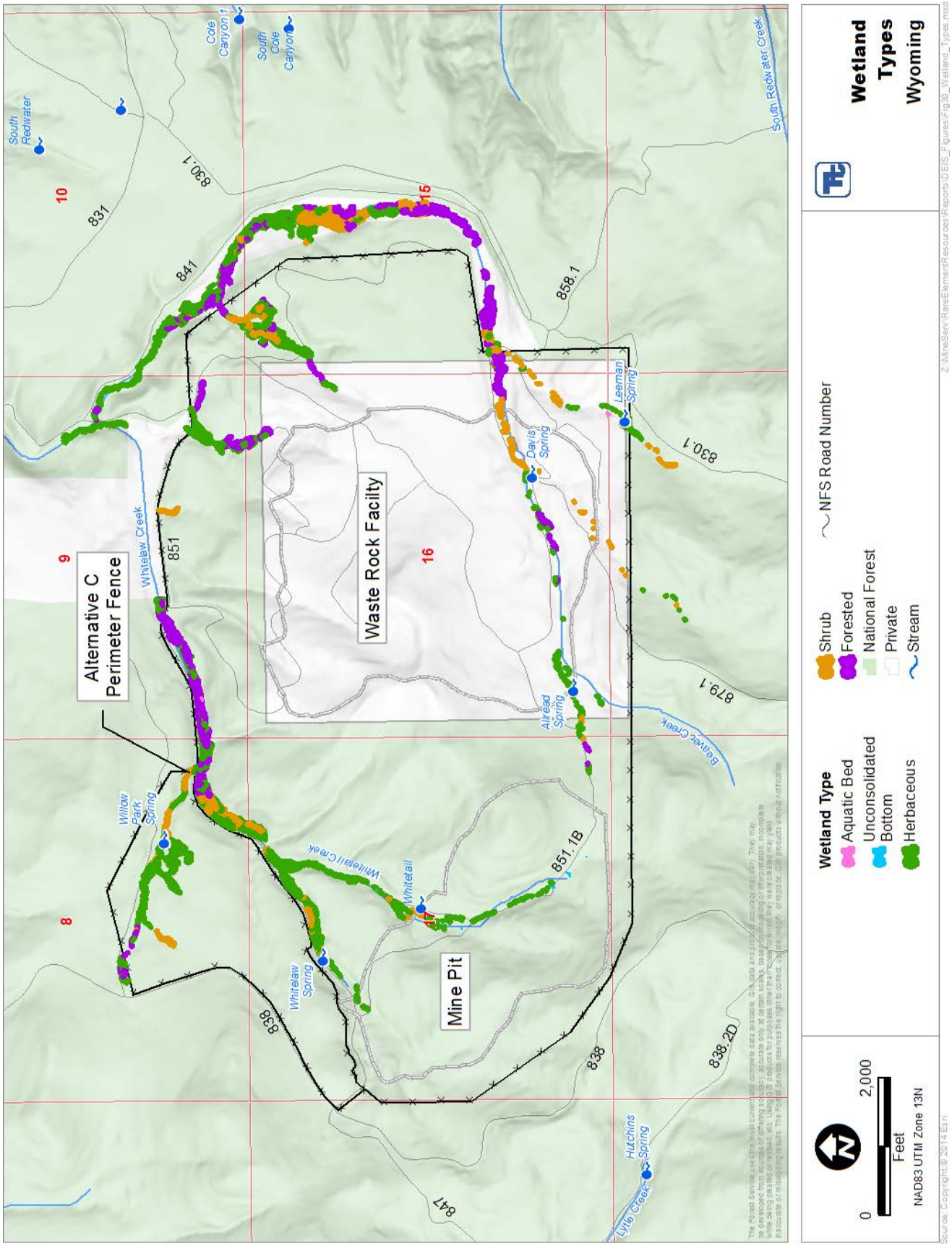
The primary impact to wetlands would result from the clearing of vegetation, vegetation type conversion (i.e., a change to shrub or herbaceous type), alteration of local hydrology, and soil disturbance. These impacts would occur from construction of the mine pit, PUG haul road, sediment capture ponds, water pipeline installation, fencing, and fence maintenance road. The majority of these impacts would occur on NFS lands and may happen over time as various mine components are developed versus all at once. In some instances (i.e. fence construction), vegetation clearing and type conversion would be temporary, with the wetland eventually re-establishing. However for the majority of construction impacts, alteration of local hydrology and soil disturbance (i.e., addition of fill material), would result in permanent wetland impact.

Alteration of wetland vegetation, soils, and hydrology in the headwaters of Beaver Creek, would permanently alter existing wetland water storage potential, sediment filtering, and important fish, wildlife, and livestock habitat. Vegetation clearing in wetlands would reduce their ability to slow water, which promotes water infiltration, resulting in wetland water storage.

Additionally, vegetation clearing would expose soils to overland flow and other sources of erosion such as raindrop impact, which could result in increased sedimentation in waterways and loss of wetland productivity as top soil is eroded away.

Construction of the mine pit would permanently remove ephemeral portions of upper Whitelaw and Whitetail creeks. Water traditionally collected by these channels and drained in the Whitelaw and Whitetail creeks, would be routed into drainage ditches and eventually discharged into a sediment pond or the headwaters of Beaver Creek. This change in local surface water hydrology would have limited long-term impacts on wetlands in Whitelaw and Whitetail creek drainages.

Blasting that would occur during construction could fracture bedrock and alter local hydrology, resulting in either increased or decreased wetland extent. Fractures in bedrock that alter local hydrology would permanently affect these wetlands. Effects of blasting on ground and surface water is discussed further in Water Section 3.10.2.


Wetland Types Wyoming
Wetland Type
Aquatic Bed
Unconsolidated Bottom
Herbaceous
Shrub
Forested
National Forest
Private
Stream
NFS Road Number
0
2,000
Feet
NAD83 UTM Zone 13N
Alternative C Perimeter Fence
Waste Rock Facilty
Mine Pit
Willow Park Spring
Whitelaw Creek
Whitetail
Whitelaw Spring
Hutchins Spring
Lytle Creek
Alfread Spring
Davis Spring
Leeman Spring
Beaver Creek
South Redwater Creek
South Redwater
Cole Canyon 1
South Cole Canyon
8
9
10
15
16
831
841
851
830.1
858.1
879.1
838
838.2D
851.1B
847

Operation

Wetlands would be lost within the mine facility footprint during the life of the mine (approximately 45 years). Wetlands may become isolated due to the location of components such as the WRF. These impacts vary by alternative and are discussed below. In some instances wetlands may re-establish where they once existed following dismantling of features at mine closure.

Construction of the WRF would result in a new artificial landscape feature. Vegetation would be established and drainage channels and sediment ponds constructed to reduce erosion and capture sediment before entering wetlands located down gradient of the WRF. Construction of this feature would be ongoing, throughout the life of the mine. Regrading, contouring, revegetation, and topsoil placement would occur concurrent with WRF development to reduce potential erosion. The use of mulch, silt fences, and temporary channels that discharge into sediment ponds would reduce erosion resulting from raindrop impact, shorten flow pathways,

and capture sediment before entering wetlands. These BMP's would be sufficient to capture most sediment eroded during WRF development; however, the potential exists for minimal, long-term addition of sediment into wetlands immediately adjacent to WRF sediment ponds. Similarly, additional sediment could enter wetlands located along Beaver Creek in areas where the creek is located immediately adjacent to the WRF. Additional surface water flow is anticipated in Whitetail Creek and lower Whitelaw Creek from discharge of mine pit dewatering. As the majority of wetlands are located adjacent to stream channels, this additional stream flow may temporarily increase wetland extent during mine operation. However, increased streamflow could cause channel scour, which may lead to lowering or incised channels, permanently disconnecting these channels from the wetland floodplain.

Although stream flow is expected to increase on Whitetail Creek, flow may decrease into upper Whitelaw Creek as water taken from the mine pit is diverted into Whitetail Creek. The changes in surface flow may result in decreased wetland extent adjacent to upper Whitelaw Creek. The magnitude of wetland loss is dependent on changes to local hydrology. These impacts would likely be limited in extent.

Impacts from operations are the same for all alternatives and will not be discussed individually below.

Reclamation/Closure

Reclamation would include vegetation surface preparation as described in Section 2.6.5. Some water diversion structures would be removed, while others would be maintained in-place and pre-mining surface contours would be reestablished where practicable (see Section 2.6.7). While it is possible some wetlands would reestablish following reclamation, it is unlikely as wetlands require a specific combination of soil conditions and hydrology to support wetland vegetation. The seed mixture, including plants that can tolerate seasonally saturated soils is currently being developed.

Per Forest Plan Standard 1302, wetland reclamation would be subject to 404 regulation, which would require compensatory mitigation for wetland losses during construction and post-mine reclamation.

Table 53. Alternative C Wetlands Acres[1] Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5		0.5
PUG	0.1		0.1
PUG Haul Road	0.1		0.1
WRF		0.9	0.9
Secondary Haul Road	<0.1		<0.1
Pit Dewatering Pond	0.2		0.2
Sediment Ponds	0.3	0.5	0.8
Water Pipeline	<0.1		<0.1
Beaver Creek Reroute		<0.1	<0.1
Topsoil Stockpile	<0.1		<0.1
Fence Construction	0.1		0.1
Fence Maintenance	0.1		0.1
Total Wetland Acres	**1.4**	**1.4**	**2.8**

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

Alternative C

Construction

Approximately 2.8 acres of wetland would be impacted from construction of Alternative C, including the PUG Plant, WRF, pit dewatering pond, Beaver Creek reroute, and topsoil stockpile. Effects would occur equally on NFS lands and private lands, and would mainly affect small areas of herbaceous wetland **(Figure 31**) (**Table 53**). Construction effects of Alternative C on wetlands would be greater than Alternative E, but less than Alternatives D, F, and G.

The PUG Plant facility, topsoil stockpile, and Beaver Creek reroute would affect approximately 0.2 acres of wetland in Alternative C that would not be affected by other alternatives.

Table 54. Alternative E Wetlands Acres[1] Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5		0.5
PUG Haul Road	<0.1	0.1	0.1
Pit Dewatering Pond	0.5		0.5
Sediment Ponds	<0.1	0.2	0.3
Water Pipeline		<0.1	<0.1
Fence Construction	<0.1		0.1
Fence Maintenance	0.1	<0.1	0.1
Total Wetland Acres	**1.1**	**0.3**	**1.4**

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

The PUG facility footprint, PUG haul road, and a topsoil stockpile would be in upper Willow Park, impacting several wetland features connected to an unnamed tributary of Whitelaw Creek (**Figure 31**). Combined, the PUG, PUG haul road, and topsoil stockpile would result in the loss of roughly 0.2 acres of wetland. Wetlands would be filled to provide adequate stability for the road bed and PUG footing. This estimate is based on the best available data and does not account for additional areas of fill adjacent to the road bed or PUG that could be required to meet construction standards. These additional wetland impacts would likely be minor, resulting in less than 0.1 acre wetland loss. Construction of the PUG and PUG haul road would result in long-term, permanent wetland loss.

Mine pit dewatering would be captured in upper Whitetail Creek, resulting in a loss of 0.2 acres of wetland from construction of the dewatering capture pond.

Location of the WRF and Beaver Creek reroute may result in isolated wetlands in the headwaters of Beaver Creek. While the surface connection between these wetlands and those further down gradient would no longer exist, a groundwater hydrologic connection may persist. In this instance, these wetlands would no longer be considered isolated. At this time it is unknown if a groundwater connection exists between these features. Roughly 0.2 acre could be isolated from other wetlands or waters.

Construction of the WRF represents the largest wetland impacts from this alternative. Roughly 0.9 acre of wetland located adjacent to the headwaters of Beaver Creek and its tributaries would be permanently lost.

Combined, construction of sediment ponds within existing drainages would permanently fill approximately 0.8 acre of wetland. The majority of these impacts occur at sediment ponds placed to capture WRF drainage, and would impact Beaver Creek and an unnamed tributary to Whitelaw Creek.

Table 53 shows the acres of wetland affected by construction and ownership.

Reclamation/Closure

Following reclamation and creation of the pit lake (up to 100 years post-mining), evaporation from the pit lake may continue to remove groundwater, thereby changing local hydrology and resulting in decreased wetland extent. This would only affect wetlands hydrologically connected to groundwater supplying the pit lake. A detailed discussion of the pit lake effects on groundwater in the Alternative C environmental consequences on water (Section 3.10.2).

Depending on topography, soils, and water quality within the pit lake, small wetlands may develop around the fringes of the lake in areas where sediment accumulates.

Effects on wetlands resulting from reclamation in areas other than the mine pit would be similar to those described above as common to all alternatives.

Alternative D

Construction

Approximately 2.8 acres of wetland would be impacted from construction of Alternative D, including the WRF. Effects would mainly take place on NFS lands, and would generally impact small areas of herbaceous wetland (**Table 54**). Construction effects of Alternative D on wetlands would be greater than Alternative E, the same as G, but less than Alternatives C and F. Impacts from construction are similar to those described in Alternative C, with the following exceptions.

Table 55. Alternative D Wetlands Acres[1] Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5		0.5
PUG Haul Road	0.1		0.1
WRF	1.1	0.2	1.4
Sediment Ponds	0.6	0.1	0.7
Water Pipeline	0.1		0.1
Fence Construction	0.1		0.1
Fence Maintenance	0.1	<0.1	0.1
Total Wetland Acres	**2.5**	**0.3**	**2.8**

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

Rerouting Beaver Creek would not be required; however, construction of the WRF would affect 1.4 acres of wetland, second only to impacts from the WRF design in Alternative F. Under this alternative the WRF is shifted to the north on to NFS lands. This shift avoids impacts to Beaver Creek. Impacts would be localized on unnamed tributaries to Whitelaw and Beaver Creeks, which support more extensive wetlands than Beaver Creek, thus increasing impacts when compared to Alternative C (**Table 53**).

This alternative reduces PUG, PUG haul road, and topsoil pile impacts by shifting these features out of wetlands in the Willow Park area (**Figure 31**). Relocation of these features reduces wetland impact by roughly 0.2 acre compared to Alternative C.

Table 54 shows acres of wetland affected by construction and corresponding ownership.

Reclamation

Effects on wetlands resulting from reclamation would be similar to those described above as common to all alternatives.

Alternative E

Construction

Approximately 1.4 acres of wetland would be impacted from construction of Alternative E, including the pit dewatering pond. The majority of impacts would occur on NFS lands, and result in the fewest acres of wetland impacted of all alternatives. Impacts from construction are similar to those described in Alternative D, with the following exceptions.

Table 55 shows acres of wetland affected by construction and corresponding ownership.

Impacts are the lowest of all alternatives analyzed because the WRF would not impact wetlands in tributaries to Beaver Creek and Whitelaw Creek or the upper reach of Beaver Creek.

The dewatering pond would be expanded from Alternative C, more than doubling wetland impacts in upper Whitetail Creek. A total of 0.5 acres would be permanently filled, representing a long-term loss of wetlands.

Reclamation

A shallow pit lake would result in effects on wetlands similar to those described under Alternative C.

Alternative F

Construction

Approximately 7.2 acres of wetland would be impacted from construction of Alternative F. The majority of impacts would occur on NFS lands, and result in the greatest acres of wetland impact of all alternatives. **Table 56** shows acres of wetland affected by construction and corresponding ownership.

Impacts are the highest of all alternatives analyzed because the WRF would be designed to mimic the natural landscape, which would extend the footprint to the north and east when compared to other alternatives. This increased footprint would affect nearly 6 acres of wetland (**Table 56**). The shift in WRF footprint would result in permanent loss of two wetland complexes in tributaries to Beaver Creek and Whitelaw Creek (Figure 8). It is likely that these losses would result in notable adverse effects to wetland function such as water storage and sediment reduction in these drainages.

Table 56. Alternative F Wetlands Acres Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5		0.5
PUG Haul Road		0.1	0.1
WRF	5.4	0.4	5.9
Pit Dewatering Pond	0.5		0.5
Sediment Ponds	0.1		0.1
Water Pipeline		<0.1	<0.1
Fence Construction	0.1		0.1
Fence Maintenance	0.1		0.1
Total Wetland Acres	**6.7**	**0.5**	**7.2**

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

The 404 permit process would require the notification of the WDEQ for draining greater than 5 acres of wetland.

Similar to Alternative C, location of the WRF may result in less than 0.1 acre of isolated wetland in the headwaters of Beaver Creek. The effects on wetlands would be similar to those described under Alternative C.

Reclamation

A shallow pit lake would result in effects on wetlands similar to those described under Alternative C.

Construction of the WRF to mimic the natural landscape could improve long-term stability of the feature, reduce slope steepness and flow path length and therefore reduce potential erosion. This reduction in erosion from the WRF would reduce the amount of sediment that could enter adjacent wetlands following reclamation.

Alternative G

Construction

Impacts from construction would be similar to those described in Alternative D.

Table 57 shows acres of wetland affected by construction and corresponding ownership.

Alternative G includes a re-route for NFS Road 851 that connects to NFS 838.2A which exists on the north side of the Willow Park area. Upgrades of the NFS Road 838.2A would be completed using BMPs to minimize erosion potential of creeks and stream. No direct impacts to the Willow Park area would occur.

Table 57. Alternative G Wetlands Acres Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5		0.5
PUG Haul Road	0.1		0.1
WRF	1.1	0.2	1.4
Sediment Ponds	0.6	0.1	0.7
Water Pipeline	0.1		0.1
Fence Construction	0.1		0.1
Fence Maintenance	0.1	<0.1	0.1
Total Wetland Acres	2.5	0.3	2.8

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

Reclamation

Effects on wetlands resulting from reclamation would be similar to those described above as common to all alternatives.

Alternative H

Construction

Impacts from construction would be similar to those described in Alternative D for the PUG location and similar for Alternative E for the WRF.

Table 58 shows acres of wetland affected by construction and corresponding ownership.

Reclamation

Effects on wetlands resulting from reclamation would be similar to those described above as common to all alternatives.

Table 58. Alternative H Wetlands Acres Affected

Mine Component	NFS	Private	Total
Mine Pit	0.5	0.0	0.5
PUG Haul Road	0.1	0.0	0.1
WRF	0.0	0.0	0.0
Sediment Ponds	0.0	0.2	0.2
Water Pipeline	0.0	0.0	0.0
Fence Construction	0.1	0.0	0.1
Fence Maintenance	0.1	0.0	0.1
Total Wetland Acres	0.7	0.2	0.9

Source: Acres calculated in GIS.
[1] Rounding errors may be present.

3.12.3.2 Cumulative Effects

The cumulative analysis area for wetlands is the analysis area plus a 5-mile buffer. This buffer includes the headwaters of watersheds surrounding the Beaver Creek drainage. These watersheds eventually drain into the Belle Fourche River.

Alternative A – No Action

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Past and present livestock use in the Upper Beaver Creek watershed has likely affected wetlands. Grazing, trampling, and degraded water quality have occurred at specific locations of concentrated use, but livestock management practices have minimized these effects to systems as a whole. Although effects on overall health and function of these systems has not been documented, the combined effects of concentrated use with proposed losses of wetlands, riparian areas, and water quantity, would result in cumulative effects. Timber harvesting and exploration also occur in the Upper Beaver Creek Watershed. These activities are subject to forest management policy (Forest Plan guidance, EO 11990) and CWA regulations, which have minimized effects and prevented permanent losses of wetlands. Effects from timber harvesting and exploration activities in the future are anticipated to be similar, and policies in place would continue to minimize future effects and prevent permanent losses of wetland habitats. Future livestock use would continue to degrade wetland and riparian habitats and water quality, combine with project effects, and result in cumulative effects to wetlands and riparian areas.

Cumulative Effects by Alternative

Alternative C would result in permanent loss of wetland and riparian habitats, increasing the potential for cumulative effects of habitat degradation and permanent loss caused by other past, present, and reasonably foreseeable future activities. Alternatives D, E, F, G, and H provide additional protection to wetlands and riparian areas through varying amounts of avoidance, and would minimize the potential for cumulative effects as habitat degradation and permanent loss.

3.12.3.3 Irretrievable and Irreversible Consequences

Based on the analysis described above the irretrievable and irreversible consequences by alternative include:

- Permanent loss of 0.5 acres of NFS wetlands currently in the Mineable Pit in all alternatives.
- Permanent loss of wetlands currently located where the WRF would be in Alternatives C (0.9 acre), D (1.4 acres), F (5.9 acres), G (1.4 acres) and H(1.4) acres.

3.13 Fish and Wildlife

Wildlife and fish species that are known to or may occur in the Project Area and their habitat considered include those listed under the Endangered Species Act by the USFWS; the Regional Forester's (Region 2) list of Sensitive Species (2015 update); Black Hills National Forest Management Indicator Species; Black Hills National Forest Species of Local Concern; WGFD Species of Greatest Conservation Needs; and other general wildlife species groups (big game; avian; lagomorphs; small mammals; bats; reptiles and amphibians; and aquatic species including macroinvertebrates and fish).

3.13.1 Analysis Area and Methods

The analysis area for wildlife encompasses the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes (see Section 3.2.1 and **Figure 10**). Adjacent lands were also included so appropriate disturbance boundaries for specific species as recommended by the WDEQ- LQD Guideline No. 5 (WDEQ, 1994)and the USFWS. The area surveyed for baseline is shown in the report *Bear Lodge Project Bull Hill Mine 2012 and 2013 Wildlife Baseline* (ICF International, 2014). The analysis area for fish includes the aquatic habitat that may be directly or indirectly affected by project activities. Effects on a species' viability in the Black Hills National Forest is evaluated, which is referred to as the "Planning Area" per Region 2 FSM 2672.42.

Unless otherwise identified, all survey results discussed are from the project baseline surveys (ICF International, 2014). Supplemental information was provided by Forest Service professionals or other government agencies wildlife professionals, scientific literature reviews, past surveys, and online locality information.

3.13.2 Affected Environment

Federal and state lists of fish and wildlife were reviewed to determine species with the potential to occur in the analysis area. Species that are known or are likely to occur or have habitat that occurs in the analysis area are discussed in this EIS. More detailed information on the species discussed, including scientific names and habitat requirements is in the project file.

Habitats of the Project Area

Primary habitat type descriptions for fish and wildlife that may occur are discussed below. Additional descriptions of the dominant vegetation are in Vegetation, Section 3.11 and Wetlands, Section 3.12. Dominant vegetation types are listed as Riparian, Wetland, Ponderosa Pine, Aspen, Other Forest, Cropland, and Grassland (montane and mixed-grass prairie).

Riparian and associated stream and wetland habitat is primarily found in Whitelaw Creek and Beaver Creek, tributaries to the Belle Fourche River. Creeks and streams vary in annual quantities and flow durations. Stream channels are typically less than six feet wide, less than 24 inches deep, with numerous pools and riffles. Flows are generally steady and moderately fast to rapid across the steeper gradients. Heavy runoff and snow melt commonly create scoured and eroded stream channels. A few scattered beaver dams provide larger ponds along some drainages (e.g., Whitelaw Creek and Beaver Creek). Numerous springs are present throughout the analysis area. Riparian habitats are prevalent along wider drainages and in reduced gradient areas along Whitelaw Creek, much of Beaver Creek, Houston Creek, and Ogden Creek.

Riparian areas, wetlands, streams, and open water habitats support foraging areas and nesting substrates for migratory birds. Foraging habitat is also common as meadows, open woodlands, and grasslands. Suitable raptor refuge and nesting habitat is present in the analysis area, as woodlands, rock outcrops, and cliffs. The Black Hills National Forest has adequate habitat to support nesting and winter populations of bald eagles. Nesting bald eagles are known along the Belle Fourche River in northern Crook County.

Golden eagles inhabit open country from barren areas to open coniferous forests. They nest on cliff ledges, preferably overlooking grasslands (DeGraaf, et al., 1991). Suitable habitat for golden eagles is limited.

Sampling of Beaver Creek at one location, downstream of the confluence with Whitelaw Creek, detected no fish. WGFD surveys along the upper end of Whitelaw Creek found only brook trout. WGFD records indicate brook trout have been stocked. Diverse aquatic invertebrate populations are important for supporting healthy fish populations. Although physical characteristics of Whitelaw Creek and Beaver Creek indicate potential support of diverse macroinvertebrate populations, natural flow fluctuations due to weather patterns and headwater characteristics likely contribute to lower invertebrate diversity in these creeks (ICF International, 2014).

Suitable habitat for several reptiles and amphibians is found in the riparian and wetland habitats; these areas are also important in supporting mammals. Beaver were found during baseline surveys (primarily in Beaver and Whitelaw Creeks).

Suitable bat habitat for foraging and breeding occurs as ponds, riparian corridors, rock outcrops, tree snags, mine adits, and natural caves. One adit is found within the analysis area, in Section 18. It is a well-known site that has been monitored by the USFS and has been the site of mitigation activity. It was included in the 2012 acoustical surveys for the project. The potential for this adit to serve as a winter hibernacula is limited due to its relatively high elevation and location along the leeward slope where deep snow tends to accumulate and cover the adit portal. Prolonged snow coverage would inhibit the spring emergence period (ICF International, 2014). No other large adits were identified within the proposed WDEQ Permit boundary.

Terrestrial habitat is dominated by mature and immature ponderosa pine forest and variable-aged quaking aspen hardwood forest. These forest types support the majority of species considered in this analysis.

Many portions of the analysis area have been selectively logged, resulting in a more open canopy and landscape mosaic; adding shrub and grassland openings and small meadows. Roads and recreational trails traverse the prominent ridgelines with some extending into narrow canyon floors.

Ruffed grouse and wild turkey are common upland game birds in the Bear Lodge Mountains, and all have been documented in the analysis area (USFWS, 2008). Suitable breeding, nesting, brood rearing, and roosting habitat for wild turkey is present, with important fall and spring transitional habitat and limited winter habitat (WGFD, 2015).

The area provides mule deer, elk, and white-tailed deer habitat. The WGFD has designated portions as spring, summer, and fall habitat (ICF International, 2014).

Hares and rabbit were documented and abundance is known to influence the nesting productivity of certain raptor species. Small mammals have also been documented in each of four major habitat types: 1) ponderosa pine forest, 2) hardwood forest, 3) grassland/meadows, and 4) riparian bottomlands.

Species Occurrence Potential

Coordination with federal and state wildlife agencies refined the lists of species of concern to those discussed below.

Threatened and Endangered Species

Of the species listed in Wyoming by the USFWS as Endangered, Threatened, Proposed, or Candidate, the Northern long-eared bat could occur in Crook County.

Northern Long-Eared Bat

On May 4, 2015, the USFWS elevated the status of the northern long-eared bat to threatened throughout its range due to population declines attributed to white-nose syndrome (USFWS, 2015). Critical habitat for the northern long-eared bat has not been designated. The bat’s range includes Campbell, Crook, and Weston counties. Dense to moderately dense woodlands, rocky outcrops, and riparian corridors provide adequate

seasonal roosting and foraging habitat. Bat surveys conducted in 2012 documented this species at three of four survey sites. It was not detected near the adit in Section 18.

Greater Sage-grouse

The analysis area does not provide the sagebrush dominated habitat for greater sage-grouse, a candidate species. It does not contain any Greater Sage-grouse Core Breeding Areas nor any known areas of seasonal sage-grouse use. This species is not discussed further in the EIS.

Region 2 Sensitive Species

Bald Eagle

Bald eagles depend on roosting sites near water sources in winter months to forage and rest. Nesting bald eagles are known along the Belle Fourche River in northern Crook County. This species was detected during baseline surveys of the analysis area as an incidental observation.

Lake Chub

The native lake chub ranges throughout eastern and central Canada and the northern U.S. It occupies varied habitats but is most common in streams, gravel- bottomed pools and along rocky lake margins. The population trend is downward. Historically it was more widely distributed in the Black Hills, but now only occurs in Deerfield Reservoir (Isaak, et al., 2003). Lake chub is unlikely to occur in the analysis area; suitable habitat appears limited and disconnected from the known population. It was not detected during project baseline surveys. This species is not discussed further given its absence in the analysis area.

Finescale Dace

Finscale dace range from northwest Canada to New England and in relict populations in Wyoming and South Dakota. Habitat is cool, weedy streams, ponds, and lakes where it forages on algae, mollusks, and aquatic macroinvertebrates (Baxter & Stone, 1995). Beaver ponds may be favored habitat. This species is documented in only a few locations in the Black Hills (Isaak, et al., 2003). It was not detected during project baseline surveys. This species is not discussed further given its absence in the analysis area.

Mountain Sucker

Mountain sucker is a native species that is well-distributed on the Black Hills National Forest. They are associated with low gradient stream reaches with high pool-to-riffle ratios. Mountain sucker are known to occur in Beaver Creek and were found as recently as 2012 during a survey conducted by WGFD, downstream of the Mine Area (Hirtzel, 2012). However, none were detected during 2012/2013 sampling efforts conducted in Whitelaw Creek and Beaver Creek.

Cooper's Rocky Mountain Snail

This species thrives with less cover and litter than other snails, and tends to avoid wet areas. It may be found on downed logs, tree trunks or limestone talus. It forages on decayed deciduous leaves and other herbaceous detritus, primarily on relatively undisturbed north or east-facing slopes within ponderosa pine - deciduous forest. Activities that change moisture levels, ground temperature, and litter and vegetation cover have likely affected this species (US Forest Service, 2005). The species is endemic to the Black Hills National Forest; however, there are no known populations in the Bearlodge District. The known populations occur in two creek systems that are primarily on the portion of the Black Hills National Forest that is in South Dakota (US Forest Service, 2005) (US Forest Service, 2001).

Yellow-Billed Cuckoo

Both the western and eastern subspecies of yellow-billed cuckoo breed in Wyoming. Their geographic range is split west and east of the Rocky Mountains, respectively. However, eastern Wyoming may be an area where the subspecies intergrade. Genetic studies are ongoing to determine if the subspecies designations are

valid. The eastern subspecies is declining within its range but is still locally common, while populations of the western subspecies have been dramatically reduced and it only occurs in small, isolated locations. The USFWS lists only the western yellow-billed cuckoo as threatened (range does not include the analysis area).

Observations of the species in Wyoming are rare, with six breeding areas confirmed or suspected, including the Bear Lodge Mountains. This location is approximately 3.5 miles to the southwest of the proposed Mine Area, along the South Fork of Miller Creek. Yellow-billed cuckoo habitat in Wyoming consists of expansive stands of dense riparian habitat with large cottonwood trees below about 7,000 feet. The primary threat to the species is loss of cottonwood riparian habitat. Small population size, patchy distribution, large fluctuations in population size, and pesticides may also be contributing to the species declines (Bennett & Keinath, 2001; Bennett & Keinath, 2003; USFWS, 2014). The species has been documented along Beaver Creek, but was not detected during surveys of the analysis area.

Black Hills Redbelly Snake

The Black Hills redbelly snake is endemic to the Black Hills and has been documented along Whitelaw Creek in the mine permit area by the Forest Service. It uses a variety of habitat types, usually moist cover types with ample down woody debris (US Forest Service, 1996). The habitat trend is stable, although there is no population trend data available.

Northern Leopard Frog

In the Black Hills National Forest, this species is dependent on mesic habitats such as aspen, white spruce, and riparian areas (US Forest Service, 1996) and may be associated with beaver ponds. It occurs in a wide variety of habitats including, but not limited to, creeks, lakes, ephemeral wetlands and ponds with few or no fish for breeding, and mesic uplands during the summer (Fischer, et al., 1999). It has been documented along Whitelaw and Beaver Creeks in the mine permit area by the Forest Service. This species is relatively common on the Black Hills National Forest, is known in all Black Hills counties, and the local population seems stable (Smith, 2003).

Northern Goshawk

Northern goshawk is a forest habitat generalist that requires an abundant prey base. There are confirmed breeding records in Custer, Meade, Lawrence, Crook, and Pennington counties within the Black Hills. It breeds in dense mature ponderosa pine. The goshawk is a winter resident in ponderosa pine throughout most of the Black Hills. This species was detected during surveys of the analysis area. Known nest locations were visited during 2012 and 2013 surveys. Of the four known locations, none were active. One of the four was documented as being in good condition, but nesting substrate and material was gone at the other three (ICF International, 2014).

Northern Harrier

The northern harrier is found in marshes, wet meadows, grasslands, and shrub-steppe and nests on the ground within moist vegetation (US Forest Service, 1981). There are no confirmed occurrence on the Black Hills National Forest, and it was not detected during surveys of the analysis area. This species is not assessed in the EIS.

American Peregrine Falcon

The American peregrine falcon was delisted by the US Fish and Wildlife Service in August 1999. The American peregrine falcon nests near rocky cliffs and often hunts near water. It was formerly considered a rare summer resident in the Black Hills and is now considered extirpated from the Black Hills and South Dakota (SDOU, 1991). This species was not detected during surveys of the analysis area and is not assessed in the EIS.

Grasshopper Sparrow

The preferred habitat for grasshopper sparrows is mixed-grass prairie with grass heights of approximately 30 centimeters and 50 percent cover (Slater, 2004). They tend to avoid ecotones between mixed grass and other habitats, and have been documented as avoiding the exterior 50 meters of a stand. They require habitat with a bare ground component that provides insects and seeds for foraging. They are summer residents in the Black Hills National Forest and winter south into Mexico and the southeastern United States. This species shows a significant decrease range-wide and a non-significant decrease in Wyoming. Grasshopper sparrows were detected during surveys of the analysis area.

Loggerhead Shrike

The loggerhead shrike prefers open habitat including shrub-steppe, deserts, and grasslands with access to elevated perches and impaling stations. Winters in the southern U.S. and Mexico (US Forest Service, 1981). Populations have declined in North America in recent decades, but South Dakota populations have increased, although trend data for the Black Hills is not available. Habitat is limited to meadows and areas where pine encroaches on the prairie in the southern and western Black Hills (US Forest Service, 1996). This species was not detected during surveys of the analysis area.

Lewis' Woodpecker

Cottonwood riparian and open ponderosa pine forests are major breeding habitats for the Lewis’ woodpecker. Brushy understory is considered a special habitat requirement (US Forest Service, 1981). It is a primary and secondary cavity nester. It is known to breed locally (Luce, et al., 1999). Lewis' woodpecker may colonize large burned areas within a year of the burn. Preferred habitat is a mosaic of sound green trees, unsound large diameter trees, with 40- 70 percent canopy closure (US Forest Service, 2001). The regional population trend data is down, but there is no specific data for the Black Hills. This species was not detected during surveys of the analysis area.

Flammulated Owl

The flammulated owl nests in woodpecker holes made in mature aspen or ponderosa pine habitat (US Forest Service, 1981). It is not listed as a Black Hills resident by (Luce, et al., 1999) (SDOU, 1991). However, flammulated owls were sighted near the Hanna/Spearfish Canyon area in the spring of 2002 (Panjabi, 2005) and at a bat- monitoring site near Woodcock Spring in the southern Black Hills in 1992. This species was not detected during surveys of the analysis area.

Burrowing Owl

This species prefers well-drained, level ground with sparse vegetation where burrows are common or may be dug. In Wyoming, burrowing owls are most commonly found in the south and east. It is considered uncommon (WGFD, 2010). This species was not considered as having the potential to occur in the analysis area and no individuals were detected during baseline surveys of the analysis area. Therefore, this species is not considered further in the analysis.

Black-backed Woodpecker

In the Black Hills, potential limits to persistence of black-backed woodpeckers include: fire suppression, salvage logging, and loss of late-successional pine forest (Panjabi, 2001). This species occurs most frequently in recently burned habitat, and at lower densities in other forest types including late-successional pine forest. It was not detected in baseline surveys of the analysis area. This species is also an MIS and is discussed further below.

American Marten

Preferred habitat for the American martin is moist coniferous forest with infrequent fire intervals and to a lesser degree, drier coniferous forest with frequent fire return intervals (Buskirk, 2002) The American Marten uses conifer forests usually dominated by white spruce with near-ground structure. The marten is present in

the Black Hills National Forest and has been documented in the Bear Lodge Mountains. Reintroduction efforts in 1980s resulted in two populations - one in Spearfish Canyon and the second in the Black Elk Wilderness (US Forest Service, 2001). Researchers have documented efforts by martens to move between the two areas (US Forest Service, 2001). It was not detected in baseline surveys of the analysis area.

Black-tailed Prairie Dog

This species of prairie dog does not hibernate. It is a burrowing animal that prefers sparsely vegetated areas with soils that are easily dug. It was not detected in baseline surveys of the analysis area. Due to known distributions and lack of suitable habitat in the analysis area, this species is not discussed further in this EIS.

Fringed Myotis

Little is known regarding the current status of populations of the Black Hills subspecies of fringed myotis, and virtually nothing is known about this species in Wyoming. It ranges across the western U.S. from the Pacific coast east to the Rocky Mountains, with an isolated population occurring in the Black Hills of South Dakota and Wyoming. Fringed myotis is considered a rare species across its range though it can be locally abundant in some areas, including the Black Hills. It is most commonly found in oak, pinyon, and juniper woodlands or ponderosa pine forests but it may also use desert, grasslands, and other woodlands. It is generally found between 4,000 and 7,000 feet. This bat gleans insects, especially beetles and moths, from the ground or vegetation. Roosts are often near water, with small sources, such as springs and cattle ponds being most frequently used. Fringed myotis roost in caves, mines, buildings, bridges, rock crevices, and snags. This species was detected in the analysis area during 2012 baseline surveys. Little is known about migration patterns, but it is believed that the species occurs in Wyoming in all seasons. Primary threats are roost disturbance, habitat alteration, White-nose Syndrome, and toxic chemicals (Griscom & Keinath, 2011; Keinath, 2003).

Regal fritillary

This species is found in remnant tall-grass prairies and adjacent wet grassy areas. It is not likely to occur in the analysis area due to lack of suitable habitat and known population distributions. It is not discussed further in this EIS.

Townsends big-eared bat

Townsend big-eared bat ranges widely across all of the western U.S. but is locally limited by availability of roosting sites. It has been documented in all counties of the Black Hills in both summer and winter, and was detected in the analysis area during surveys conducted in 2012. It is restricted to areas with large caves or other cavern-like roosting sites, such as mines, lava tubes, and abandoned buildings. Townsend’s big-eared bat forages in a wide range of habitats, which is likely a reflection of where roosting sites are located. It is generally found within mesic coniferous or deciduous forests, and forages along forest edges, streams, and small open patches within woodlands. This bat feeds primarily on moths and requires open, still water sources. Declining population trends are attributed primarily to renewed mining at historic sites and closure of abandoned mines (Gruver & Keinath, 2003; Gruver & Keinath, 2006; Schmidt, 2006). This species was detected in the analysis area during surveys conducted in 2012.

Hoary bat

This species occurs throughout Wyoming, and travels to the southern United States for the winter months. They prefer to forage in open areas for large insects and roost in deciduous and coniferous trees; making forest edges their preferred habitat (Griscom, et al., 2012). This species was detected in the analysis area during surveys conducted in 2012.

Rocky Mountain Bighorn Sheep

This species does not occur in the Bear Lodge area. The closest herd is a transplanted herd in the Elk Mountain area to the south, in Weston County. This species is not discussed further in the EIS.

Monarch Butterfly

Little is known about the monarch butterfly (*Danaus plexippus*) in Wyoming. It has been documented in every county in the state at least once, but it is unknown how common they are (Monarchs and Milkweeds, 2015). Starting in October, populations east of the Continental Divide migrate to overwintering sites in Mexico (Commission for Environmental Cooperation, 2008). It spends spring and summer on breeding grounds, where eggs are laid on leaves of the milkweed plant (*Asclepias* spp.) (Commission for Environmental Cooperation, 2008) . There are six species of milkweed in Crook County (USDA, NRCS, 2015), the most common of which in the Black Hills is likely the showy milkweed (*A. speciosa*). Milkweeds typically grow in disturbed areas such as roadsides and pastures. Once the larvae (caterpillars) are fully grown they leave the milkweed to find a pupation site (Commission for Environmental Cooperation, 2008). Adult butterflies are generalists and feed on a wide variety of nectar plants. Primary threats to monarch butterflies include large scale insecticide use, loss of milkweed from agricultural and natural areas due to herbicide use, loss of breeding habitat from urban development, degradation of overwintering sites, parasites, and climate change (Commission for Environmental Cooperation, 2008).

Western Bumblebee

The western bumblebee (*Bombus occidentalis*) was once common and widespread across the western US, including most of Wyoming (Evans, et al., 2008). Crook County is on the edge of this species' mapped range but exact distribution is unknown because it has never been systematically sampled across its range. It is an important pollinator of many commercial crops and wildflowers (Evans, et al., 2008). The western bumblebee is a generalist species and will visit a diversity of flowering plants and crops across various elevations. It requires habitats with numerous and diverse flowering species that bloom from spring to autumn (Evans, et al., 2008). Only the queen survives the winter by burrowing in the ground. The queen emerges from hibernation in late winter or early spring and lays eggs underground, typically in abandoned rodent nests, to begin a new colony (Evans, et al., 2008). Populations in certain areas have declined dramatically in the past 15 years. It is not known if declines are occurring range-wide (Evans, et al., 2008). The species is threatened by commercial bumblebee rearing (which introduces disease); habitat alteration from agriculture, urban development, and grazing; invasive plants and insects; and insecticide use. In particular, sprays used to control spruce budworm in forests have resulted in massive losses of this species in the past (Evans, et al., 2008).

Management Indicator Species

The Forest Plan Management Indicator Species (MIS) are monitored as indicators of healthy Forest condition. Management of MIS is guided by Forest Management Objective 238, which provides for maintenance or enhancement of their habitats.

Mountain Sucker

Mountain sucker is discussed above as a Forest Service Sensitive species, but is also an MIS species. As such, population health is monitored to reflect riparian/aquatic habitat condition. They are associated with low gradient stream reaches with high pool-to-riffle ratios. Land or water management practices that alter flow regimes may affect mountain sucker populations by altering habitat availability or quality during sensitive life stages. Habitat loss due to stream impoundment and habitat degradation from increased sedimentation may also affect the Mountain sucker. Habitat connectivity may be important to the persistence of population.

Black-backed Woodpecker

In the Black Hills, potential limits to persistence of black-backed woodpeckers include: fire suppression, salvage logging, and loss of late-successional pine forest (Anderson, 2003; Panjabi, 2001). This species occurs most frequently in recently burned habitat, and at lower densities in other forest types including late-successional pine forest. Black Hills National Forest monitoring of black-backed woodpeckers addresses forest condition and habitat diversity, particularly the availability of late successional pine stands, snags, and

burned forest. Black-backed woodpeckers serve as an indicator of the abundance, distribution, and condition of snag habitat and burned habitat (Panjabi, 2001). This species was not detected during project surveys (ICF International, 2014).

Brown Creeper

Preferred habitat of the brown creeper within the Black Hills National Forest is late-successional ponderosa pine and white spruce (US Forest Service, 1996). The abundance and distribution of this species is tied to large trees and late successional coniferous forest on the Black Hills National Forest (Panjabi, 2001). As such, forest management actions may affect habitat condition, quantity, and distribution (US Forest Service, 1996); (Wiggins, 2005). Brown creeper habitat and/or population trends serve as an indicator of the abundance, distribution, and condition of large trees and late successional coniferous forest habitat. This species was detected during surveys of the analysis area.

Golden-Crowned Kinglet

This species is distributed across the boreal forests and mountainous regions of North American (DeGraaf, et al., 1991). It is typically found during the breeding season in spruce-fir forests, other coniferous habitats and riparian woodlands (Johnsgard, 1986). It is considered an uncommon permanent resident at higher elevations within the Black Hills (SDOU, 1991) and is generally confined to the spruce cover type in the Black Hills National Forest (US Forest Service, 1996). This species was not detected during surveys of the analysis area.

Grasshopper Sparrow

Preferred habitat for grasshopper sparrows is mixed-grass prairie with grass heights of approximately 30 centimeters and 50 percent cover (Slater, 2004). They tend to avoid ecotones between mixed grass and other habitats, and have been documented as avoiding the exterior 50 meters of a stand. They require habitat with a bare ground component that provides insects and seeds for foraging. They are summer residents in the Black Hills National Forest and winter south into Mexico and the southeastern United States. This species shows a significant decrease range-wide and a non-significant decrease in Wyoming (Sauer, et al., 2012). Grasshopper sparrows were detected during surveys of the analysis area.

Ruffed grouse

Ruffed grouse were formerly common in the Black Hills but have apparently declined in abundance in the first half of the 1900s. They now appear to be uncommon and declining in the Black Hills. A primary threat to the population viability of ruffed grouse is loss and degradation of habitat. Ruffed grouse occur at low densities in mid-elevation forest habitats (Wiggins, 2006).

Optimal habitat for ruffed grouse is comprised of a mixture of early and late seral-stage aspen forest and riparian woodlands with year-round water flow (e.g., streams, creeks). The primary factor thought to limit ruffed grouse population expansion is a lack of young, dense aspen stands that are preferred habitat for nesting and brood-rearing females. Currently, the mix of habitat elements necessary (on the landscape level) to maintain healthy populations of ruffed grouse are lacking (Wiggins, 2006). The best available information suggests that increasing the availability of both early and late seral-stage aspen, reducing livestock grazing along riparian corridors and in aspen forests, and relaxing stringent fire suppression policies are likely to have the greatest positive impacts on ruffed grouse populations. This species was detected during surveys of the analysis area.

Song sparrow

Song sparrows are closely associated with riparian areas and wet meadows (Panjabi, 2001). Song Sparrows are considered good indicators of riparian habitat condition. Combined with Beaver, population trends of this species would indicate riparian habitat condition. This species was detected during surveys of the analysis area.

Beaver

Historically, beaver have influenced riparian vegetation and stream flows on the Black Hills National Forest, often converting intermittent drainages to perennial streams (Parrish, et al., 2002). Beaver are an indicator species because of its relationship to riparian/aquatic habitat condition, status as a keystone species, available monitoring protocols, and dependence on riparian forest and shrub habitat. Degradation and loss of riparian shrubs and forests from historic management activities on the Black Hills National Forest, combined with loss of hardwood on adjacent uplands are likely factors limiting beaver persistence. This species was detected during surveys of the analysis area.

White-tailed deer

Conversion of deciduous forest to ponderosa pine from long-term fire suppression in the Black Hills National Forest has reduced diversity of forage available to deer and altered deer habitat (Uresk & Severson, 1998). Increased ponderosa pine density and canopy cover has resulted in large areas of pine forest with depauperate understories and reduced available forage for deer (Parrish, et al., 2002). Invasion of ponderosa pine into meadow habitats has reduced forb, shrub, and grass availability to foraging deer. White-tailed deer habitat trends and/or population parameters serve as indicators of abundance, distribution, and condition of understory shrubs and general forest habitat diversity. This species was detected during surveys of the analysis area.

Black Hills National Forest Species of Local Concern

Species of local concern are identified as not warranting a sensitive species designation at the regional level, but deserve attention at the local forest level (US Forest Service, 2005). Management of Species of Local Concern is guided by Forest Management Objective 221, which directs for the conservation or enhancement of habitat for these species.

Atlantis Fritillary

The Atlantis fritillary is endemic to the Black Hills. It is known from three counties: Pennington, Custer, and Lawrence. Habitat is higher elevation moist boreal forests and riparian areas with adjacent meadows (NatureServe Explorer, 2001).

Tawny Crescent

Tawny crescent habitat is typically moist aspen stands and riparian forest near the transition between deciduous and coniferous forests (Royer & Marrone, 1992). This species' habitat has declined in the Black Hills National Forest due to pine encroachment into wet meadows and decreases in water flows, and the resulting degradation of riparian areas (US Forest Service, 2001).

Callused Vertigo

The callused vertigo is the most widely distributed Black Hills vertigo species found in wet, relatively undisturbed forest on limestone or schist substrate. It is most common at sites with a varied understory, diverse flora, and deep litter, on shaded north-facing slopes. This species is cryptic and feeds on the surface of half decayed leaves. It is vulnerable to management activities such as grazing, logging, major forest fires, and pesticide and herbicide spraying, which may lead to the extirpation of local populations (Frest & Johannes, 2002).

Mystery Vertigo

The mystery vertigo is only found in the Northern Black Hills where it is restricted to rich lowland wooded sites often with white spruce vegetation communities, on limestone or schist- derived soils. Important habitat components include closed canopy forest, deep litter, and rich floral understory. This species feeds on partially decayed leaves and the organic coating on rock surfaces. It is vulnerable to management activities

such as grazing, logging, catastrophic fires, and pesticide and herbicide spraying, which may lead to the extirpation of local populations (Frest & Johannes, 2002).

Frigid Ambersnail

The frigid ambersnail is found in the Black Hills at low to medium elevations, in somewhat dry forests on limestone talus, near the slope base. The most frequent vegetation at known colonies was open ponderosa pine forest with a mixture of deciduous trees and shrubs. Since this species has sparse populations it may be more vulnerable to management activities, such as logging and grazing, than other land snails. Some of the colonies on the Black Hills are located near highways and roads (Frest & Johannes, 2002).

Striate Disc

The striate disc is found in moist habitat such as riparian areas, north-facing slopes on calcareous soils, mesic forest floors. This species cannot regulate body fluids and is susceptible to desiccation if habitat dries out. Populations may be negatively impacted by logging, grazing, and road construction (US Forest Service, 2001).

Sharp-Shinned Hawk

The sharp-shinned hawk habitat in the Black Hills is riparian forests and conifers (SDOU, 1991). It is listed as an uncommon permanent resident in the Black Hills (SDOU, 1991; Peterson, 1995). Nest sites are typically in dense conifer stands often adjacent to deciduous trees (Stephens & Anderson, 2002). This species was detected during surveys of the analysis area.

Cooper's Hawk

The Cooper’s hawk is a forest habitat generalist that forages near the ground taking avian and mammalian prey (Stephens & Anderson, 2002). Preferred nest sites are in tall, large-diameter trees in dense stands, often with a significant sapling component. Dense forest may also be important for foraging (Stephens & Anderson, 2002). This species was detected during surveys of the analysis area.

Broad-Winged Hawk

The broad-winged hawk is a common Buteo of the Wyoming and South Dakota Black Hills. It nests in pine stands with a deciduous component, often in large diameter ponderosa pine (Stephens & Anderson, 2002; Luce, et al., 1999). The entire broad-winged hawk population of the Black Hills migrates south to Central and South America (Ehrlich, et al., 1988). This species was detected during surveys of the analysis area.

Northern Saw-Whet Owl

The northern saw-whet owl is a forest habitat generalist found at lower to middle elevations in forested habitat, particularly in riparian areas. Nest sites are cavities excavated by flickers and other large woodpeckers. Nests tend to be in mature forest, while dense sapling-pole-sized stands are preferred for roosting (Johnson & Anderson, 2003; Anderson, 2003). This species often forages along forest edges preying upon small mammals. In the Black Hills seasonal migration is likely between high- and low-elevation habitat (Johnson & Anderson, 2003). This species was not detected during surveys of the analysis area.

Pygmy Nuthatch

The pygmy nuthatch is found primarily in mature ponderosa pine forests and may be an irregular migrant in other coniferous types (US Forest Service, 1981). Unlogged forests host larger populations than logged (Kingery, 1998). This species is an uncommon resident of the Black Hills. No local trend data is available although Black Hills National Forest habitat trend is stable (Allen, et al., 2005). Pygmy nuthatches may require snags greater than 19 inches DBH (Kingery, 1998). This species was not detected during surveys of the analysis area.

American Dipper

The American dipper favors fast-flowing streams with rock, sand, and rubble substrates (Kingery, 1998) associated with the dipper's main food source, aquatic invertebrates (Anderson, 2002). In the Black Hills they are found primarily in Spearfish Creek and Rapid Creek watersheds (SDOU, 1991; Peterson, 1995). This species was not detected during project surveys of the analysis area, but a confirmed record by USFS biologists was reported to have occurred in July 2012 at the confluence of Whitelaw and Beaver creeks (ICF International, 2014).

Black and White Warbler

The black and white warbler nests in deciduous woodlands on or near the ground and feeds primarily on insects (Ehrlich, et al., 1988; Luce, et al., 1999). It has been observed in Wyoming counties of the Black Hills but breeding has not been confirmed (Luce, et al., 1999). Breeding records in the South Dakota Black Hills have been confirmed (SDOU, 1991; Peterson, 1995). This species was not detected during surveys of the analysis area.

Small-Footed Myotis

The small-footed myotis is a year-round resident of the Black Hills. Hibernacula are known in the Black Hills including Davenport, Jewel, French Creek, and Igloo Caves. Mine hibernacula are also documented (Turner, 1974). Summer roost sites are typically buildings, caves, and mines (Luce, et al., 1999). This species usually forages near water including creeks, ponds, and reservoirs where it feeds on flying insects, particularly beetles (Turner, 1974). This species was detected during surveys of the analysis area.

Long-Legged Myotis

The long-legged myotis occupies montane areas throughout western North America and is widely distributed in the Black Hills between 4,500 and 6,000 feet (Turner, 1974). It is a year-round resident in the Black Hills. Hibernating individuals are known to use caves in the Black Hills including Bush's and Jewel Cave (Luce, et al., 1999; Turner, 1974). Caves and snags are used in summer as roost sites. This species forages over meadows, ponds, streams and open mesic habitats of the Black Hills where it feeds on flying insects, particularly moths (Luce, et al., 1999; Turner, 1974). This species was detected during surveys of the analysis area.

Northern Flying Squirrel

The northern flying squirrel ranges throughout the mountainous western U.S. and boreal forests of North America (US Forest Service, 1996). In the Black Hills the highest densities are found in white spruce forests in moist canyons of the Northern Black Hills (Turner, 1974). Northern flying squirrels are found throughout in mature woodlands with tall, large trees and existing dead snags; previously excavated cavities; dense, moist (e.g., ferns) understory cover that support fungi; and near waterways (Hough & Dieter, 2009).They use hollow trees and cavities for nest sites (US Forest Service, 1996). Uneven aged management of spruce may benefit this species (US Forest Service, 1996). This species was not detected during surveys of the analysis area.

Meadow Jumping Mouse

The meadow jumping mouse is associated with riparian areas along small streams in meadows or beneath forests usually with an understory of deciduous shrubs, grasses, forbs, and fallen logs (Luce, et al., 1999; Turner, 1974). This species is a profound hibernator, retreating to burrows in dry ground from October to May. Burrows are also used for nests (Clark & Stromberg, 1987). Habitat may be impacted by management practices which reduce understory shrubs, grasses, and forbs in low to mid-elevation riparian areas (Clark & Stromberg, 1987; Luce, et al., 1999). Maintenance of dense understory vegetation is an important management consideration for this species (Clark & Stromberg, 1987). This species was detected during surveys of the analysis area.

Other Species

Wild Turkey

Wild turkeys use a variety of habitats available and are a rather common species in the area. Riparian corridors and moist habitats are particularly important for foraging brood hens. Hardwood forests are also foraged for berries and nuts. Turkeys commonly use coniferous forested areas as cover from predators and for roosting in trees at night. Nesting habitat is also present in the analysis area. Wild turkeys used all major wildlife habitat types found within the area across a broad range of elevations, but were observed to use grasslands and disturbed areas only sparingly. There is excellent breeding, nesting, brood rearing, and roosting habitat for wild turkey (WGFD, 2015), important fall and spring transitional habitat, and very limited winter habitat. This species was detected during surveys of the analysis area.

Big Game

The analysis area provides mule deer, elk, and white-tailed deer habitat. The WGFD has designated portions of the analysis area as spring, summer, and fall habitat (ICF International, 2014). Aerial and ground surveys were conducted in 2011 and 2013. The WGFD defines spring/summer/fall range as containing habitats that support a big game population or portion of the population from the end of the previous winter to the onset of persistent winter conditions, which is commonly between early May and late November. The extreme eastern and southeastern margins of the analysis area is designated Winter-Yearlong Range. The far southern extent stretching along the south end of the proposed Miller Creek Access Road is designated by the WGFD as mule deer yearlong range.

3.13.3 Environmental Consequences

All effects are described at the scale of the analysis area, unless otherwise specified. Effects are based on the assumption that the wildlife design features and environmental protection measures presented in Section 2.6.8 and **Appendix A**, including monitoring that will be required as part of the WDEQ permit (Section 2.9.6), would be fully implemented and strategically located to minimize impacts.

3.13.3.1 Direct and Indirect Effects

Alternative A - No Action

Under Alternative A- No Action, there would be no direct or indirect effects on wildlife. Effects from ongoing reclamation of previous exploration would eventually revegetate and reestablish habitat.

Effects Common to All Action Alternatives

Exploration, Construction, and Operation

The overall effects on fish and wildlife from each action alternative are similar, but differentiated by the acres of habitat affected. All species known to occur or with the potential to occur in the analysis area would be affected by habitat alteration or loss. Impacts to wildlife would also be caused by the increase in human presence, noise, and lights, which may result in avoidance of suitable, undisturbed habitat near the Mine Area and changes in foraging and breeding behavior. These impacts would be similar across all phases of the project (exploration, construction, operation, reclamation, and closure). Direct impacts such as mortality due to vehicle collision; and surface disturbance, erosion, and spills (see Section 3.8.3.1), could occur over the life of the project. Loss or degradation of perennial stream habitat (see Section 3.10.2.1) would affect fisheries; however water quality standards set by the DEQ would be monitored and maintained, including water treatment before discharge (see Sections 2.9.2 and 2.9.3). Operations would also include herbicide application for weed control; invertebrates, avian species, and amphibians are considered more susceptible to herbicide use than other wildlife groups.

Radioactivity would be monitored (see Section 2.9.3) to meet regulatory requirements. Impacts from radioactive and non-radioactive materials are described in Section 3.18 Public Health. Impacts to wildlife and fisheries would be similar and may be inferred by the analysis of potential risk to the public.

Table 59 presents a summary of impacts analyzed below on species. The analysis considers impacts to individuals in the analysis area and the species' viability within the Planning Area (see Section 3.13.1).

Table 59.
Special Status Species Effects Determinations

Species	Effects Determination	Rationale
ESA Listed - Threatened, Endangered, or Candidate		
Northern Long-Eared Bat	May affect, likely to adversely affect.	Species was detected during project surveys and suitable foraging habitat would be affected.
Forest Service Region 2 Sensitive Species		
Bald eagle	May adversely impact individuals, but not likely to result in a loss of population viability in the Planning Area, nor cause a trend toward federal listing.	Individuals are known to use areas in vicinity of project during migration and for winter roosting; closest known nesting area is near Belle Fourche River. Suitable nesting habitat (e.g. large mature trees along riparian corridors in close proximity to large bodies of water) is not present in project area or vicinity.
Mountain sucker	May adversely impact individuals, as effects on habitat would occur for several years; not likely to result in a loss of population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Direct impacts to Beaver Creek as habitat effects is primary reason for determination, however, species not detected during project surveys of Beaver and Whitelaw creeks. Population numbers are not known, but records show it has been known to occur in Beaver Creek downstream of project area. Species is known to occur throughout Planning Area; therefore suitable habitat exists elsewhere to support population viability.
Cooper's Rocky Mountain Snail	Impacts would not likely occur to individuals.	Populations are not known to occur in the analysis area.
Black Hills Redbelly Snake	May adversely impact individuals, but not likely to result in a loss of population viability in the Planning Area, nor cause a trend towards federal listing.	Individuals and habitat would likely be affected; but effects are low relative to species numbers range wide.
Northern Leopard Frog	May adversely impact individuals; not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Individuals and habitat would likely be affected; but effects are low relative to species numbers range wide. This species is relatively common on the Black Hills National Forest, is known in all Black Hills counties, and the local population seems stable (Smith, 2003).
Black-backed Woodpecker	May adversely impact individuals; not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Species not detected in project surveys. Suitable habitat occurs elsewhere across the Planning area; individuals would be able to disperse to other suitable areas.

Table 59. Special Status Species Effects Determinations		
Species	**Effects Determination**	**Rationale**
Northern Goshawk	May adversely impact individuals, not likely to result in a loss of population viability in the Planning Area. Not likely to cause a trend towards federal listing.	The species occurs across a wide range and is able to disperse to other locations of suitable habitat. The majority of historic nest locations documented in the survey area were no longer present during baseline surveys.
Loggerhead Shrike	May adversely impact individuals, but would not affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Suitable habitat occurs, but individuals not detected during project surveys.
Lewis' Woodpecker	May adversely impact individuals, but not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Suitable habitat occurs, but individuals not detected during project surveys.
Yellow-Billed Cuckoo	May adversely impact individuals; not likely to result in loss of population viability in the Planning Area. Not likely to cause a trend towards federal listing.	Effects to riparian habitat would occur over the long-term. Effects to individuals would be low as large numbers are not known to occur in project area.
Flammulated Owl	Not likely to adversely impact individuals nor population viability in the Planning Area.	Species is not known to occur in the analysis area and habitat is marginal.
American marten	Not likely to adversely impact individuals. Not likely to affect population viability in the Planning Area. Not likely to cause a trend towards federal listing.	Suitable habitat and known populations do not occur in project area.
Fringed Myotis, Townsend's Big-Eared Bat, Hoary bat	May adversely impact individuals; not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Effects to riparian areas providing foraging and/or roosting habitat would occur over the long-term. These species were detected during baseline surveys. Effects to individuals would be low as individuals are known to occur across the Planning area and would likely disperse to these other areas of suitable habitat.
Monarch butterfly	May adversely impact individuals, but not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Individuals would be able to avoid active disturbance and disperse to locations of suitable habitat (i.e. milkweed outside of project disturbance areas) that is available in the Planning Area.
Western bumble bee	May adversely impact individuals; not likely to affect population viability in the Planning Area. Not likely to contribute to a trend towards federal listing.	Habitat consisting of abundant flowering plants and croplands is not provided by the project area.

Table 59. Special Status Species Effects Determinations		
Species	**Effects Determination**	**Rationale**
Black Hills National Forest Management Indicator Species		
Species	**Effects Determination**	**Rationale**
Black-backed Woodpecker	Individuals may be affected by habitat removal. The proposed project would not maintain or enhance species' habitat.	Effects to habitat (e.g. removal) would occur; species was not detected during project surveys.
Brown Creeper	Individuals may be affected by habitat removal. The proposed project would not maintain or enhance species' habitat.	Effects to habitat would occur.
Golden-Crowned Kinglet	Individuals may be affected by habitat removal. The proposed project would not maintain or enhance species' habitat.	Effects to habitat would occur.
Grasshopper Sparrow	The proposed construction and operations would not maintain or enhance species' habitat. Individuals would likely be affected during construction and operations May provide beneficial long-term benefits to this species by increasing grassland habitat during the reclamation phase.	The species is known to occur in the analysis area and habitat (e.g. grasslands) would be affected. Grassland habitat would increase over the long-term following reclamation.
Ruffed grouse	Individuals would likely be affected during construction and operations. The proposed project would not maintain or enhance species' habitat.	The species is known to occur in the analysis area and habitat would be affected.
Song sparrow	Individuals would likely be affected during construction and operations. The proposed project would not maintain or enhance species' habitat.	The species is known to occur in the analysis area and habitat would be affected.
Beaver	Individuals would likely be affected during construction and operations. The proposed project would not maintain or enhance species' habitat.	The species is known to occur in the analysis area and habitat would be affected.
White-tailed deer	Individuals would likely be affected during construction and operations.. The proposed project would not maintain or enhance species' habitat. May provide beneficial long-term benefits to this species by altering forest structure and increasing mid-succession forests during the reclamation phase.	The species is known to occur in the analysis area and habitat would be affected. Mid-succession forest habitat would increase over the long-term following reclamation.
Mountain sucker	Effects to the species are discussed above as USFS Region 2 Sensitive. The proposed project would not maintain or enhance species' habitat.	See above.
Species of Local Concern		
Species	**Effects Determination**	**Rationale**
Invertebrates: Regal fritillary, Tawny crescent, Callused	The proposed project would not conserve or enhance habitat for these species of local concern. Individuals	Impacts to suitable habitats would occur.

Table 59. Special Status Species Effects Determinations		
Species	**Effects Determination**	**Rationale**
vertigo, Mystery vertigo, Frigid ambersnail, Striate disc	would likely be affected by loss of habitat.	
Birds: Cooper's Hawk, Broad-winged Hawk and Northern Saw-whet Owl, Sharp-Shinned Hawk, Pygmy Nuthatch, American Dipper and Black and White Warbler	The proposed project would not conserve or enhance habitat for these species of local concern. Individuals would likely be affected by loss of habitat.	Impacts to suitable foraging and nesting habitats would occur.
Mammals: Small-footed myotis, Long-eared myotis, Long-legged myotis, Northern flying squirrel	The proposed project would not conserve or enhance habitat for these species of local concern. Individuals would likely be affected by loss of habitat.	Impacts to suitable foraging and roosting habitats would occur.
Other Species Groups		
Species	**Effects Determination and Rationale**	
Big game (elk, mule deer, white-tailed deer)	Loss and alteration of habitat and increase in human presence would likely affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Mortalities may occur due to vehicle collisions and fence entrapments. Not likely to cause a loss of species viability range-wide.	
Migratory Birds	Loss and alteration of habitat and increase in human presence would affect individuals and cause dispersal into other adjacent areas of available and suitable habitat. Not likely to cause a loss of species viability range- wide, as individuals would be able to move away from activity.	
Wild turkey	Likely to adversely impact individuals and local population viability in the analysis area. Not likely to cause a loss of species viability range-wide, as populations are known to use other areas of suitable habitat in the vicinity.	

Construction and Operation

ESA Listed Species

Northern Long-Eared Bat

Construction would cause direct loss or modification of Northern long-eared bat habitat, as woodlands (roost habitat) are cleared for mining, some drainages (foraging habitat) are diverted or relocated, and riparian and wetland habitat is removed. Other indirect impacts may include the abandonment of foraging locations as bats respond to reduced forest cover and increased noise. Northern long-eared bats do not travel more than 78 meters from the edge of intact forest structure (Henderson & Broders, 2008). Bat foraging areas very close to highways and presumably also to other sources of intense, broadband noise are degraded in their suitability (Schaub, et al., 2008).

Operation activities would include night-time lighting, potentially altering bat foraging activities. Traffic patterns extended to 20 hours, 5 days a week would likely disturb foraging activities in localized areas where roadways approach riparian or wetland habitats.

Modification and loss of habitat and changes in behavior caused by construction and operations would be likely to adversely affect northern long-eared bat. However, bats are mobile and suitable habitat that would not be affected is available. The percentage of wetland and riparian habitat affected is a relatively small amount compared to similar habitat available elsewhere in the project vicinity.

Forest Service Region 2 Sensitive

Effects determinations for Region 2 Sensitive Species according to Region 2 FSM 2672.42 are shown in **Table 59**. The analysis considers potential impacts on habitat within the analysis area and how the species would be affected by the alteration to habitats within the larger Planning Area (Black Hills National Forest). Construction and operation would eliminate habitat for those species that are known to occur or known to have suitable habitat within the analysis area. Impacts would be direct, due to removal of habitat and potential for vehicle collisions, and indirect, by causing increases in noise and human presence.

Management Indicator Species

For all MIS considered, construction and operations would not be consistent with Forest Service Management Objective 238. The proposed project would disturb habitat for MIS species and likely affect individuals. Direct impacts may occur due to vehicle collisions. Indirect effects are likely and would be caused by increased human presence and noise. In particular, impacts to riparian, late-succession forests, and grasslands would result in the greatest potential for impacts.

Species of Local Concern

For all Species of Local Concern considered, construction and operations would not be consistent with Forest Service Management Objective 221. The proposed project would not conserve or enhance habitat for Species of Local Concern. The proposed project would disturb habitat for these species and likely affect individuals. Direct impacts may occur due to vehicle collisions. Indirect effects are likely and would be caused by increased human presence and noise. In particular, impacts to riparian, late-succession forests, and grasslands would result in the greatest potential for impacts.

General Wildlife Habitat and Species

Riparian and Wetland Species and Fish

The analysis area contains aquatic habitats associated with Whitelaw and Beaver creeks that support fish, amphibians, invertebrates, mammals, and avian species (ICF International, 2014). Construction would cause a direct loss or modification of riparian and wetland habitats on NFS lands, ranging from approximately 13 acres of riparian and 1.1 acres of wetlands in Alternative E to 19.8 acres of riparian and 6.7 acres of wetland in Alternative F. This equates to approximately 20 to 38 percent of riparian and wetland habitat in the analysis area (estimated at approximately 70 acres).

These habitats for fish and wildlife would be directly impacted to varying degrees as shown in Section 3.11.3.1. Impacts would occur to all species that rely on wetland and riparian areas for habitat. Complete loss or alteration is possible, including effects of groundwater table drawdown and water quality following completion of mining activities for 45 year life of mine plus reclamation, and in some alternatives, may be permanent.

Alterations to perennial channels in Beaver and Whitelaw creek would result in direct loss of habitat, which would likely affect brook trout as well as the mountain sucker, as it has been documented to occur in Beaver Creek. Indirect impacts on habitat may extend downstream as increased sediment flows, altered channel flows, and altered stream-bottom substrates, which would also likely affect brook trout and the mountain sucker.

Forest Species – Ponderosa Pine and Aspen

Wildlife species known to use ponderosa pine and aspen (mixed hardwood) habitats would be affected by habitat loss and alteration to varying degrees, as shown in Section 3.11.3.1. Species not able to disperse into other available habitat would be directly impacted. Other species, able to move would be disturbed and stressed, but would likely re-establish in adjacent areas. Loss of mature ponderosa pine stands and snags would affect cavity nesters and other species dependent on a late-successional stand structure. Loss of pine forest habitat on NFS lands would range from a low of about 260 acres in Alternative C to a high of

approximately 472 acres in Alternative F (see Section 3.11.3.1). Approximately twice as much aspen type would be removed under Alternative F compared to Alternative C. This correlates to removal of approximately 8 percent to 16 percent of the pine and hardwood vegetation types mapped in the analysis area (estimated at 3,000 acres). Overall, ponderosa pine habitat would be most affected by vegetation removal.

Grasslands Species

Construction would cause a direct loss or modification of grassland habitat on NFS lands, ranging from approximately 47 acres in Alternatives C and G, to 80 acres in Alternative D. This equates to 15 to 26 percent of grasslands mapped in the analysis area (estimated as 304 acres).

Other General Wildlife Species

Migratory Birds

Effects on migratory birds would primarily occur as loss of nesting and foraging habitat, and avoidance of suitable habitat in proximity to human activity. Individuals may be killed or abandon nests during construction if vegetation removal is conducted during the nesting season (generally early spring through early summer) or activities occur in close proximity to an active nest.

Big Game

While it is unlikely that the Mine Area fence would exclude deer or elk in normal crossings, it is highly likely to produce episodic individual deaths from entanglement while crossing during more stressful periods (e.g. adverse weather, snow accumulations, fleeing predators etc.). It also would have a likelihood of altering habitat use or seasonal/daily migration routes.

Fenced-off acreage in the Mine Area by alternative is shown in Table 15 Comparison of Activities by Alternative.

Mining operations would cause direct loss or modification of all existing habitats where ground disturbing activities would occur. Ponderosa Pine habitat represents almost 70 percent of this disturbance on NFS lands. Loss of this habitat negatively impacts protective cover from predators, reduces foraging opportunities, and removes breeding and brood rearing habitat. The extent of these impacts on local populations is uncertain and likely to vary seasonally.

During operations, direct loss of some individuals to traffic would occur over the life of the project. Losses would not be significant and no population impacts would occur.

Wild Turkey

Wild turkeys would be affected by loss of their preferred habitats, which include riparian and wetland areas, and aspen and ponderosa pine forests. Disturbance to these habitats would make it unusable to turkeys during the life-of-mine, approximately 45 years.

Reclamation/Closure

Impacts to the Northern long-eared bat during reclamation and closure would be similar to those during construction and operation, as noise disturbance and lighting may continue to affect foraging behavior and use of roost sites.

Effects on fish and wildlife would be similar as discussed under construction and operation, in that direct effects of habitat removal would continue until reclamation is complete. Reestablishment of mature habitats would take several years, even decades for mature forest types, beyond the 45-year life of mine. Long-term effects of habitat degradation can be expected. Whitelaw and Beaver Creek after mining would be required to meet Class 2AB water quality standards that would protect fish and aquatic life (including water entering surface water from the Mineable Pit through groundwater and from the WRF).

Impacts would also likely include habitat conversion from coniferous/deciduous forest to increased grassland habitat during reclamation, and changes in relative abundances of various aspen age structures. These effects may occur over the long-term. Behavioral changes caused by altered habitat and traffic disturbances, and increased predation from cover removal would occur.

Alternative C

A 5-strand barbed-wire fence would be constructed. While it is unlikely that this fence would exclude deer or elk in normal crossings, it would likely result in individual deaths from entanglement while crossing during more stressful periods (e.g. adverse weather, snow accumulations, fleeing predators). It would also likely alter habitat use or seasonal/daily migration routes.

Effects on habitat are quantified in the Vegetation Section (see **Table 46**). Alternative C would result in the least acreage of habitat loss on NFS lands, both by individual types and collectively. Migratory birds are typically attracted to waterbodies for foraging and as migration stop-over areas. While this may equate to a beneficial change in habitat availability for migratory birds, species using the pit lake may be exposed to environmental contaminants if groundwater quality is affected. Pit lake water quality is discussed in Section 3.10.3. Construction of the secondary haul road would cause further habitat loss and fragmentation, primarily within ponderosa pine habitat.

Reclamation/Closure

While total acreage of habitats disturbed is not highest under Alternative C compared to other alternatives, effects would differ based on final reclamation planned. Under Alternative C, the mine pit would be left open resulting in a permanent loss of 232 acres of habitat on NFS lands. A pit lake would eventually fill and the return of a viable shrub/tree dominated landscape to those acres would not occur. Formation of the pit lake would permanently change the habitats currently present in the Mineable Pit.

Alternative C proposes the most re-channeling and re-directing of perennial flows. Stream flow in Whitetail Creek, Whitelaw Creek, and Beaver Creek would be diminished because the pit lake would intercept runoff. Flow would not make it to streams and the lake would evaporate water, which may be evidenced in groundwater drawdown and a reduction in water quantity to gaining streams. This may be a permanent reduction in the instream water quantity, which would affect aquatic species, in particular the mountain sucker.

Alternative D

Design features and environmental protection measures would be included under Alternative D to minimize effects on wildlife and aquatic species. A 100-foot setback of the WRF footprint from Beaver Creek and elimination of the design to divert Beaver Creek would eliminate direct and indirect impacts to aquatic species, including the mountain sucker. Allread Spring and Davis Spring would be avoided. Whitelaw Creek and its spring would be avoided by reconfiguration of the haul road.

A three or four-strand wildlife-friendly fence would be constructed around the Mine Area within 200 feet of facilities and adjusted to avoid and protect natural resources. The wildlife-friendly fence would reduce the risk of entanglement and death of wildlife (see Section 2.4.3.4).

The mine pit would be backfilled with waste rock to eliminate effects of the pit lake. The power line would be routed to the east and would follow existing roads, which would minimize additional habitat fragmentation. The remaining corridor where not cited along existing roads would require vegetation maintenance, resulting in habitat fragmentation and alteration, primarily within ponderosa pine habitat.

Effects on habitat are quantified in the Vegetation Section (see **Table 47**). Alternative D would result in greater habitat loss on NFS lands, as an acre basis, than Alternative C. It is second in total habitat alteration to Alternative F, primarily attributed to loss of ponderosa pine forest. Construction of the new Warren Peak Road would increase habitat fragmentation and loss in this area, primarily within ponderosa pine habitats.

However, under Alternative D impacts to the high-quality habitats of riparian and wetland areas would be reduced by proposed design features.

Reclamation/Closure

Under Alternative D the mine pit would be partially backfilled and the reclaimed area returned to use by wildlife. The steepness of remaining highwalls would be reduced to a 3:1 slope, disturbing an addition 95 acres of habitat. However, reclamation revegetation and elimination of the pit lake may return more acres to productive habitat after 100 years.

The reclamation for this alternative would take 18 years to reshape and backfill the Mineable Pit plus an additional 2 years to place topsoil and revegetate. The reclamation activity would extend the impacts on wildlife caused by the increase in human presence, noise, and lights, which may result in avoidance of suitable, undisturbed habitat near the Project Area and continued changes in foraging and breeding behavior.

Effects on fish from a possible pit lake intercepting runoff as described in Alternative C would be avoided.

Alternative E

Design features and environmental protection measures described in Section 2.6.8 would be included under Alternative E to minimize effects on wildlife and aquatic species.

The wildlife-friendly fence would be the same as Alternative D. Effects on aquatic habitats would be the same as Alternative D.

The time required to complete the pit reclamation would be the same as Alternative D and there would be the same impacts from human activities.

Effects on habitat are quantified in the Vegetation Section (see **Table 48**). Overall habitat disturbance is greater than but similar to Alternatives C and G, but less than Alternative D and Alternative E. The use of generators as the primary power supply eliminates effects of a power line, but increases effects from noise on wildlife. Intact habitat in the vicinity of the generators would likely become unsuitable and avoided due to the added noise.

Reclamation/Closure

Under this Alternative the pit lake would remain, but the steepness of remaining highwalls would be reduced to a 3:1 slope, increasing the habitat disturbance over Alternative C by 104 acres, and Alternative D by 10 acres. This alternative disturbs the most acres of habitat for pit reclamation. However, reclamation revegetation may return more acres to productive habitat after 100 years. Formation of the shallow pit lake would permanently change the habitats currently present in the Mineable Pit on about 107 acres.

Effects on fish from a possible pit lake intercepting runoff would be the same as Alternative C. If no lake develops, impacts on fish would be the same as Alternative D.

Alternative F

Design features and environmental protection measures would be included to minimize effects on wildlife and aquatic species. The WRF would be reconfigured to avoid riparian and wetland resources. The wildlife-friendly fence would be the same as Alternative D.

Effects on habitat are quantified in the Vegetation Section (see **Table 49**). Alternative F would result in the greatest amount of habitat loss or alteration, primarily to the ponderosa pine type. Disturbance to riparian and wetland habitat acreage is also greatest under Alternative F.

Reclamation/Closure

The time required to complete the pit reclamation would be slightly less than Alternative D and disturb 53 fewer acres of habitat.

Pit reclamation would be as described in Alternative E, allowing a partial return of 38 acres to wildlife use. A pit lake would preclude 107 acres from producing forage. The reclamation in this alternative would take 12 more years than Alternative C for reshaping the Mineable Pit, except for the south and southeast sides, and an additional 2 years for revegetation. This would mean the length of time for excluding wildlife access to the Mine Area would be longer. Formation of the pit lake would permanently change the habitats currently present in the Mineable Pit.

Effects on aquatic species, including the mountain sucker, from a pit lake would be the same as Alternative C.

Alternative G

Design features/ environmental protection measures would be included under Alternative G to minimize effects on wildlife and aquatic species. The WRF would be reconfigured to avoid Beaver Creek and water would be pumped to a treatment plant before discharge. Downstream impacts on aquatic species caused by water quality degradation are not anticipated. Alternative G would also reduce impacts to water resources and aquatic species through avoidance of Beaver Creek, Allread Spring, and Davis Spring**.**

The wildlife-friendly fence would be the same as Alternative D.

Effects on habitat are quantified in the Vegetation Section (see **Table 50**). Total acreage disturbed is similar but slightly greater than Alternative C. Acreage by type is also similar to what would be disturbed under Alternative C, but the mine area would be smaller and a wildlife-friendly fence would be constructed.

Reclamation/Closure

The mine pit would be completely backfilled, returning the 232 acres of disturbed area to useable habitat for wildlife in the long-term. The Mineable Pit would have an impermeable cap so habitat would be reclaimed to a grassland type. Current, existing cover by ponderosa pine in that area is sparse, thus, the permanent change would probably not affect wildlife. No pit lake would develop, so impacts on aquatic species would be the same as Alternative D.

The WRF would be much smaller on closure, but no trees would be allowed to grow. This would result in a permanent conversion of ponderosa pine forest to grassland. This change would forever favor grassland species over pine forest dependent species. It is unknown exactly how many acres the final WRF would cover, however, based on volume of 33 million tons (Section **0**) compared to the WRF design for 123 million tons in Alternative C (Section 2.4.2.3) on 445 acres, the WRF in Alternative G would require about 26 percent of the area, or 119 acres.

The reclamation under this alternative would take 31 more years than Alternative C to backfill the Mineable Pit. The reclamation activity would extend the impacts on wildlife caused by the increase in human presence, noise, and lights, which may result in avoidance of suitable, undisturbed habitat near the Project Area and changes in foraging and breeding behavior.

Alternative H

Design features/ environmental protection measures would be included under Alternative H to minimize effects on wildlife and aquatic species. Downstream impacts on aquatic species caused by water quality degradation are not anticipated. Alternative H would also reduce impacts to water resources and aquatic species through avoidance of Beaver Creek, Allread Spring, and Davis Spring**.**

The wildlife-friendly fence would be the same as Alternative D.

Effects on habitat are quantified in the Vegetation Section (see **Table 51**). Acreage by type is also similar to what would be disturbed under Alternative C, but the mine area would be smaller and a wildlife-friendly fence would be constructed.

Reclamation/Closure

Pit reclamation would be as described in Alternative F, allowing a return of 38 acres to wildlife use. A pit lake would preclude 107 acres from producing forage. The reclamation in this alternative would take 12 more years than Alternative C for reshaping the Mineable Pit, except for the south and southeast sides, and an additional 2 years for revegetation. This would mean the length of time for excluding wildlife access to the Mine Area would be longer. Formation of the pit lake would permanently change the habitats currently present in the Mineable Pit.

Effects on aquatic species, including the mountain sucker, from a pit lake would be the same as Alternative F.

The WRF would be the same Alternative E.

3.13.3.2 Cumulative Impacts

The cumulative analysis area for wildlife and fisheries includes activities within the analysis area plus a 5-mile buffer.

Alternative A – No Action

Cumulative effects would not occur under Alternative A - No Action, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Past and present projects that would result in cumulative effects to wildlife and fisheries include timber harvesting and forest treatments, general vegetation treatments, livestock grazing, exploration activities and minerals development, and road building and maintenance. These activities have affected wildlife in general by eliminating or altering habitats, and causing changes in behavior from increased human presence. Cumulative effects from activities involving vegetation removal may also include increased potential for predation, loss of thermal cover, and loss of foraging, breeding, and brood-rearing areas. Additional removal of snags would result in cumulative effects to cavity nesters. Cumulative effects to wildlife habitat and behavior would occur under all action alternatives, and would vary in levels that may be inferred by the direct and indirect analysis. Alternative F would result in the greatest cumulative loss of habitats expressed as total acres disturbed.

Past and present forest management and exploration activities that implemented avoidance measures and were conducted in accordance with water quality BMPs have minimized the potential for cumulative effects on riparian and aquatic habitats.

Cumulative effects to federally listed species or habitats may occur, as additional habitat is modified or lost.

3.13.3.3 Irretrievable and Irreversible Consequences

Irretrievable and irreversible impacts on wildlife and fish identified above include:

- Loss of 232 acres of terrestrial habitat from the Mineable Pit in Alternative C;
- About 107 acres of pit lake would permanently eliminate terrestrial wildlife habitat in Alternatives F and H, and likely in Alternative E: and
- Loss of wetland and perennial stream habitat; reduction in water flows due to formation of pit lake in Alternatives C, E, and F.

3.14 Timber and Fire Management

3.14.1 Area of Analysis and Methods

The impact analysis area for timber includes the Mine Area (including access) regardless of ownership, the WDEQ Permit boundary, and the exploration boundary (see **Figure 32**).

Acres of disturbance were mapped by alternative in GIS. GIS was used to calculate the acres by vegetation type using the National Forest timber data in the FSVeg Spatial (2014). Data in the FSVeg Spatial (2014) was collected through the following methods:

- Common Stand Exam collected in 2002
- Walk through Exam
- Common Stand Exam collected in 2008
- Photo Interpretation in 2008
- Common Stand Exam collected in 2012.

Data in FSVeg Spatial (2014) was updated using the Forest Vegetation Simulator so that older data was projected to reflect current conditions.

FSVeg Spatial (2014) data was used to estimate timber volume removed based on the average volume per acre for each timber stand. FSVeg Spatial (2014) data was available for all of the NFS lands considered and some of the private lands. Where FSVeg Spatial (2014) timber volume or type information was not available for private or state lands, GAP Landcover data (USGS, 2011) was used.

As with any model, the information used is an estimate or projection of the conditions. As a biological component, timber conditions would change over the life of the project.

Timber is discussed using common terminology, including:

- Size is described by diameter at breast height (DBH), measured at 4.5 feet above the ground on the uphill side.
- Timber volumes are calculated in the database for merchantable sized timber in ponderosa pine stands. Merchantable sized timber refers to a ponderosa pine tree with a DBH greater than 6.9 inches.
- Volume is measured in board feet, one inch by one foot by one foot. These numbers become large, so the analysis uses a thousand board feet (MBF). A typical log truck carries about 5 to 7 MBF. A typical 2,400 square foot, single-family, timber-frame home uses about 16 MBF (Idaho Forest Products Commission, 2015).
- Because MBF is a better measure of lumber than wood fiber, volume is also measured in cubic feet, one foot by one foot by one foot. There is no direct conversion from board feet to cubic feet due to saw kerf and squaring loss from sawing a round wood into square wood. The cubic feet numbers also become large, so the analysis uses 100 cubic feet (CCF).

3.14.2 Affected Environment

The area is mostly comprised of mature ponderosa pine forest with areas of meadows (grasslands), exposed rock and road. Forest health is generally good, though many stands are well stocked with dense understories.

The area within the WDEQ Permit boundary includes both NFS and private lands. Timber information for the private lands within the WDEQ Permit boundary is available from surveys conducted in 2012. Data collection was under supervision of Forest Service. **Table 60** shows the acres by ownership and dominant cover type. **Figure 32** displays the canopy cover type by stand.

Figure 32. Timber and Vegetation Cover Types

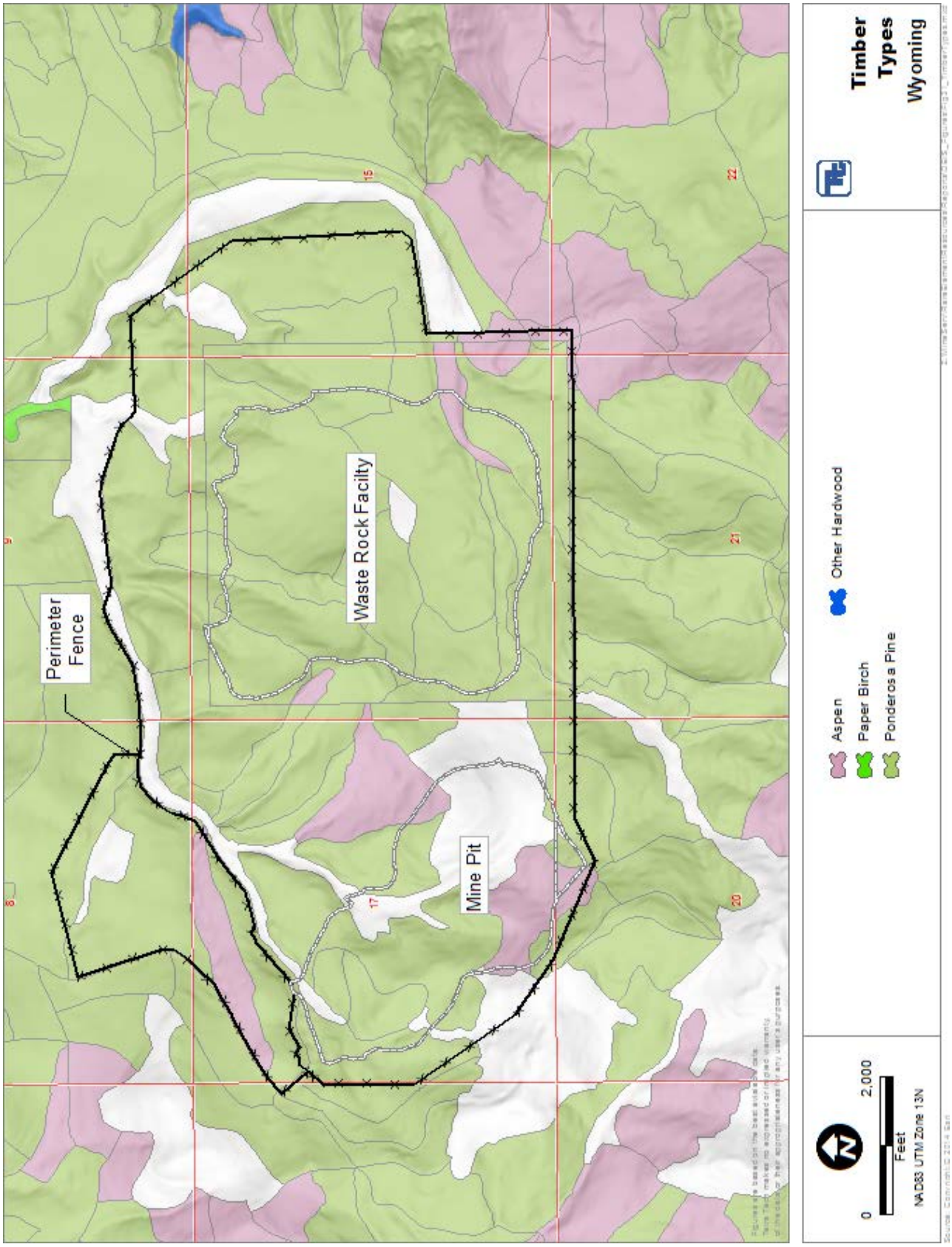


Table 60. Forest Cover Types Acres within WDEQ Permit Boundary				
Cover Types	**NFS**	**Private**	**Total**	**Average DBH**
Ponderosa Pine	1,898	602	2,500	14.2
Aspen	323	25	348	NA
Paper Birch	4	-	4	NA
Grass	434	65	499	NA
Total	2,659	692	3,351	NA

3.14.3 Environmental Consequences

3.14.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, impacts on the timber resource would be limited to a small amount of timber, if any, that may need to be removed for previously approved exploration activities, including access. Reclamation of areas disturbed for previously completed studies would restore areas and maintain timber suitability. The Forest Service would continue to manage timber according to the direction provided in the Forest Plan depending on the management area.

Effects Common to All Action Alternatives

Construction

Timber within the fenced Mine Area that needs to be removed from NFS lands would be sold, either to the proponent or competitively, depending on the need and efficiency. Timber removed from private lands would be managed as described in the authorizing permit. Timber would be removed within the Mine Area for construction of the Mineable Pit, PUG Plant and facilities, sediment storage ponds, drainage channels, water pipelines, dewatering pond, haul roads, and WRF. Most of the timber removed for these activities would be from NFS lands. Timber removed for construction of the Mineable Pit and WRF may be removed progressively instead of all at once.

Timber would also be removed as part of the power line construction.

Construction of access and secondary roads would require the removal of timber on NFS lands and private lands. Quantities are identified under each alternative, where information is available.

In most alternatives, the WRF would be on private land, or private with some NFS lands. In all alternatives the proposed WRF sites are forested. In all alternatives, the proposed WRF sites are or have in the past supported a forested condition.

Operation

Timber production would be restricted in areas of mine facilities during the life of the mine (approximately 45 years) plus the time required for reclamation and appropriate reforestation. The time required for reclamation and reforestation depends on the alternative. Timber would not be allowed to become reestablished during the life of the mine in the Mineable Pit, WRF, sediment ponds, dewatering pond, roads, or power line right-of-way. Some trees may be allowed to grow within the PUG Plant area if they would not interfere with operations or present a safety hazard. Trees would be removed from the power line right-of-way as needed to protect the power line from vegetative interference. It is likely that small trees which become reestablished in the right-of-way would be cut every 10 to 15 years during the life of the mine.

Once mine facilities are constructed, undisturbed timber areas would be monitored inside the fenced Mine Area for overall forest health and worker safety. If needed, timber would be treated appropriately in accordance with Forest Plan direction through either timber sale contracts or vegetation treatments following appropriate NEPA documentation. Outside of the fenced area, timber management would occur as normally guided by the Forest Plan. The mine is required to allow access to the Mine Area for administrative purposes, including timber (such as to maintain healthy forest conditions) and fire management.

Impacts on wildland fire management would be minimal because of ongoing monitoring as described in Section 2.6.9 and management according to the Fire Plan and agreements (see **Appendix B**). There would not be an increased risk of fire ignition due to mine operations because the mine would be required to abide by fire restrictions put in place by the Forest Service or Crook County as conditions warrant. Overhead power lines have started fires in the past, due to downed lines, bird strikes, accidents, or vandalism. These are rare and should it occur, fires would be managed as they would elsewhere on the forest or in the county.

Impacts from operations are the same for all alternatives and will not be discussed individually below.

Reclamation/Closure

Reforestation would take place in appropriate areas at closure and reclamation. The intent is to reclaim all timbered areas to pre-mining conditions. If necessary, trees would be planted if conditions require it and if a review indicates planting is likely to be successful. The areas of pit wall that are reclaimed would eventually develop into a productive forest. Reforestation on NFS lands would be managed according to the Forest Plan in place at that time.

Areas where timber re-establishment differs between the alternatives include the Mineable Pit, WRF, and portions of roads or power line that may be retained after mine closure for purposes other than mine access.

As the power line would not be necessary once PUG Plant facilities are removed, reclamation of the power line right-of-way on NFS lands would include reforestation in areas that are suitable for timber.

Table 61.
Alternative C Ponderosa Pine Timber Acres Affected

Mine Component	NFS	Private	State	Total
Mine Pit[1]	158	0		158
PUG[1]	15	0		15
Pug Haul Road[1]	6	0		6
WRF[1]	0	400		400
WRF Haul Road[1]	2	2		4
Secondary Haul Road[1]	13	0		13
Miller Creek New Const. [1,2]	9	16	5	30
Dewatering Pond[1]	2	0		2
Sediment Ponds[1]	1	8		9
Drainage Channel[1]	2	4		6
Water Pipeline[1]	0	0		0
Beaver Creek Reroute[1]	0	7		7
Topsoil Stockpile[1]	27	0		27
Topsoil Access[1]	0	0		0
Fence Construction[1]	9	0		9
Fence Maintenance[1]	7	0		7
Substation[2]	0	0	0	0
25kV ROW*[1,2]	6	4	1	10
Total Timber Acres	**257**	**439**	**6**	**702**

Sources: Acres calculated in GIS. [1] FSVeg Spatial (2014) Migration, [2] GAP Landcover. Not all ponderosa pine acres in **Table 46** are merchantable timber.

Alternative C

Construction Effects

Based on the estimated acres where timber would be harvested (**Table 61**), approximately 1,016 MBF (2,122 CCF) would be removed from NFS lands for mining, road construction, construction of facilities, and right-of-way maintenance. Construction effects of Alternative C on NFS timber overall would be greater than Alternative E and G, but less than Alternatives D and F.

Table 61 shows the timbered acres affected by construction. Acres that do not contribute to timber production are not included in the totals.

Reclamation/Closure

Because the Mineable Pit would be reclaimed as constructed and permanently fenced, approximately 122 acres of NFS timber (**Table 61**) would be permanently removed from timber production. The change would be permanent because of the likely formation of a pit lake and lack of timber growth on pit walls due to soil conditions.

Unlike Alternatives D, E, and F, no additional timber would be removed by reclamation of the Mineable Pit.

Table 62. Alternative D Ponderosa Pine Timber Acres Affected

Mine Component	NFS	Private	Total
Mine Pit[1]	158	0	158
PUG[1]	17	0	17
Pug Haul Road[1]	10	0	10
WRF[1]	55	378	433
WRF Haul Road[1]	3	4	7
Warren Peak Access[1,2]	32	7	38
Dewatering Pond[1]	8	0	8
Sediment Ponds[1]	6	2	8
Drainage Channel[1]	3	2	5
Water Pipeline[1]	1	0	1
Topsoil Stockpile[1]	4	17	21
Fence Construction[1]	4	0	4
Fence Maintenance[1]	5	1	6
25kV ROW[1,2]	10	0	11
Total Timber Acres	**314**	**411**	**726**

Sources: Acres calculated in GIS.
1 FSVeg Spatial (2014) Migration,
2 GAP Landcover.
Not all ponderosa pine acres in Table 47 are merchantable timber.

Alternative D

Construction Effects

Based on the estimated acres where timber would be harvested (**Table 62**), approximately 1,387 MBF (2,927 CCF) would be removed from NFS lands in Alternative D for mining, road construction, construction of facilities, and right-of-way maintenance. Construction effects of Alternative D on NFS timber overall would be greater than Alternative C, E and G, but less than Alternative F. Impacts from construction are similar to those described in Alternative C, with the following exceptions.

Approximately 55 acres of the WRF would be located on NFS lands requiring removal of 408 MBF (870 CCF) of NFS timber. Alternative D would include timber impacts on private and NFS lands compared to Alternative C with timber impacts on only private lands.

Although the PUG Plant and facilities would be reduced in size by nearly 70 acres and relocated from Alternative C to reduce impacts on wetlands and cultural resources, the location of these facilities in Alternative D affects an additional acre of timber compared to Alternative C.

The access route using Warren Peak Road would affect 30 NFS timbered acres and remove 114 MBF (241 CCF).

About 33 MBF (70 CCF) of timber would be removed from power line routes.

Reclamation/Closure

Pit slope reduction in Alternative D would increase the size of the area where timber would be removed by 67 acres, 228 MBF (492 CCF). This is considered a short-term effect because the intent is to reclaim this area to pre-mining conditions. Trees would be planted if conditions require it and if a review indicates planting is likely to be successful. Areas where reclamation of pit wall slopes occur are likely to eventually develop into productive forest.

Backfilling the pit would restore the Mineable Pit with soil and vegetation which may develop into forest in some areas. It is also possible that the WRF would remain in place on NFS lands. The soil cover on the WRF may be suitable for timber, but it is not certain.

Alternative E

Based on the estimated acres where timber would be harvested (**Table 63**), about 1,063 MBF (1,497 CCF) would be removed from NFS lands in Alternative E for mining, road construction, construction of facilities, and right-of-way maintenance. Construction effects of Alternative E on NFS timber overall would be the least of any alternative.

The PUG Plant and facilities would be located on private land near the WRF, eliminating the NFS acres affected, compared to 15 acres in Alternative C and 17 acres in Alternative D.

The access route using NFS Road 879.1 would affect 16 timbered acres of NFS lands and remove 69 MBF (151 CCF).

Reclamation/Closure

Pit slope reduction for reclamation would increase the size of the area where timber would be removed by 75 acres. An estimated 253 MBF (549 CCF) of merchantable timber would be removed for pit layback. This is considered a short-term effect because after this area is reclaimed, including replacing topsoil, trees would likely grow on this additional area. The intent is to reclaim this area to pre-mining conditions. Trees would be planted if conditions require it and if a review indicates planting is likely to be successful. Areas where reclamation would occur because of pit wall reduction are likely to develop into productive forest. The likely formation of a pit lake would result in a permanent loss suitable timber acres.

Table 63. Alternative E Ponderosa Pine Timber Acres Affected

Mine Component	NFS	Private	Total
Mine Pit[1]	158	0	158
PUG[1]	0	16	16
Pug Haul Road[1]	0	7	7
WRF[1]	2	370	372
WRF Haul Road[1]	0	0	0
Warren Peak Access[1,2]	29	2	31
Dewatering Pond[1]	1	0	1
Sediment Ponds[1]	3	7	10
Drainage Channel[1]	2	2	5
Water Pipeline[1]	1	3	4
Topsoil Stockpile[1]	0	17	17
Fence Construction[1]	3	0	3
Fence Maintenance[1]	7	1	7
25kV ROW	0	0	0
Total Timber Acres	**208**	**425**	**632**

Sources: Acres calculated in GIS. 1 FSVeg Spatial (2014) Migration, 2 GAP Landcover. Not all ponderosa pine acres in **Table 48** are merchantable timber.

Alternative F

Based on the estimated acres where timber would be harvested (**Table 64**), approximately 1,866 MBF (3,926 CCF) would be removed from NFS lands in Alternative F for mining, road construction, construction of facilities, and right- of-way maintenance. Effects of Alternative F on NFS timber overall would be greater than any other Alternative.

Approximately 206 acres of the WRF would be located on NFS lands requiring removal of 1,027 MBF (2,136 CCF) of NFS timber.

Effects of the PUG Plant and facilities would be the same as in Alternative D.

Table 64. Alternative F Ponderosa Pine Timber Acres Affected

Mine Component	NFS	Private	Total
Mine Pit[1]	158	0	158
PUG[1]	0	16	16
Pug Haul Road[1]	0	7	7
WRF[1]	206	383	589
WRF Haul Road	0	0	0
NFS Road 879.1	24	10	34
Dewatering Pond	1	0	1
Sediment Pond	6	1	6
Drainage Channel	2	0	3
Water pipeline	1	2	4
Topsoil Pile	0	17	17
Fence Construction[1]	4	0	4
Fence Maintenance[1]	8	0	8
25kV ROW[1,2]	9	1	10
Total Timber Acres	**419**	**437**	**855**

Sources: Acres calculated in GIS. 1 FSVeg Spatial (2014) Migration, 2 GAP Landcover. Not all ponderosa pine acres in **Table 49** are merchantable timber.

Reclamation/Closure

Pit slope reduction for reclamation would increase the size of the area where timber would be removed by approximately 42 acres, (189 MBF, 411 CCF). This is considered a short-term effect because after this area is reclaimed, including replacing topsoil, trees would likely grow on this additional area. However, unlike Alternative D, the pit lake would not be eliminated by additional backfilling. Therefore the overall effects on timber at reclamation is more like that described in Alternative E.

Alternative G

Based on the estimated acres where timber would be removed (**Table 65**), approximately 1,317 MBF (2,772 CCF) would be harvested from NFS lands in Alternative G for mining, road construction, construction of facilities, and right-of-way

Table 65. Alternative G Timber Acres Affected			
Mine Component	**NFS**	**Private**	**Total**
Mine Pit[1,2]	158	0	158
PUG[1]	17	0	17
Pug Haul Road[1]	10	0	10
WRF[1,2]	55	378	433
WRF Haul Road	3	4	7
Miller Creek Access Const.	7	10	17
Dewatering Pond	8	0	8
Sediment Pond	6	2	8
Drainage Channel	3	2	5
Water pipeline	1	0	1
Topsoil Pile	4	20	24
Guardhouse	0	0	0
Fence Construction[1, 2]	4	0	4
Fence Maintenance[1,2]	5	1	6
Substation[3]	0	0	0
25kV ROW	6	4	10
Total Timber Acres	**287**	**421**	**708**

Sources: Acres calculated in GIS. 1 FSVeg Spatial (20011) Migration, 2 GAP Landcover. Not all ponderosa pine acres in **Table 50** are merchantable timber.

maintenance. Effects of Alternative G on NFS timber overall would be greater than Alternative C and E, similar to Alternative D, and less than Alternative F.

Approximately 55 acres of the WRF would be located on NFS lands requiring removal of 408 MBF (868 CCF) of NFS timber. Unlike the rest of the alternatives, enough waste rock would be removed from the WRF and placed back into the Mineable Pit that, if desired, it is possible that mo

st of the NFS acres could be reclaimed, making this impact long-term but not permanent.

Construction of the Miller Creek access road would remove approximately 51 MBF (104 CCF) of merchantable NFS timber. This is less than Alternative C due to the reduced width of the road.

Effects of the PUG Plant and facilities would be the same as in Alternative D.

Completely backfilling the pit after mining would cause the operating period to be extended by approximately 31 years. During that period, the Forest Service would continue to review and monitor the mine site and take action if needed for timber resources.

Reclamation/Closure

Total Mineable Pit backfill would reclaim this area to pre-mining topography. The impermeable cover would preclude a forest developing there as tree roots would penetrate the cover and allow infiltration. Thus, 122 acres of ponderosa pine would be permanently removed. However, the current average volume is low, with just over 5 MBF (about 9 CCF) per acre.

Backfilling the Mineable Pit would remove waste rock from the WRF, possibly from the NFS land acres, allowing those acres to be completely reclaimed back to productive timber lands. The WRF would have an impermeable cap installed. Maintaining this cap would preclude timber because trees cannot be allowed to grow on top of the cap due to the potential for roots to penetrate the cap or for a tree to blow down and damage the cap or its soil cover. A permanent loss of suitable timber acres would result where the WRF remains on NFS lands.

Alternative H

Based on the estimated acres where timber would be removed (**Table 66**), approximately 943 MBF (1,985 CCF) would be harvested from NFS lands in Alternative H for mining, road construction, construction of facilities, and right-of-way maintenance. Effects of Alternative H on NFS timber overall would be greater than Alternative C and less than all other alternatives.

Construction of the Miller Creek access road would remove approximately 51 MBF (104 CCF) of merchantable NFS timber. This is less than Alternative C due to the reduced width of the road.

Effects of the PUG Plant and facilities would be the same as in Alternative D.

Reclamation/Closure

Pit slope reduction for reclamation would increase the size of the area where timber would be removed by approximately 42 acres, (189 MBF, 411 CCF), the same as Alternative F.

Table 66. Alternative H Timber Acres Affected

Mine Component	NFS	Private	Total
Mine Pit1	158	0	158
PUG1	2	0	2
Pug Haul Road1	8	0	8
WRF1	2	367	369
WRF Haul Road1	3	0	3
Miller Creek Access Const.	5	14	19
Dewatering Pond	3	0	3
Sediment Pond	3	7	10
Drainage Channel	2	2	5
Water pipeline	1	0	1
Topsoil Pile	2	12	14
Guardhouse	0	0	0
Fence Construction1, 2	4	0	4
Fence Maintenance1,2	5	0	6
Substation3	0	0	0
25kV ROW*1,2	6	5	11
Total Timber Acres	**206**	**408**	**613**

Sources: Acres calculated in GIS. 1 FSVeg Spatial (20011) Migration, 2 GAP Landcover. Not all ponderosa pine acres in **Table 50** are merchantable timber.

3.14.3.2 Cumulative Effects

The analysis area for cumulative effects to timber resources is the 5-mile buffer to account for other activities with timber impacts locally.

Alternative A

Cumulative effects would not occur under Alternative A - No Action, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Other activities that affect timber resources are timber harvesting, forest treatments, vegetation treatments, prescribed burns, and to a minor degree, exploration and road maintenance. The current condition of the forest is shaped by the human and natural events. Approximately 1,925 acres of timber has been or will be harvested by past, present, and reasonably foreseeable future timber management projects within the cumulative analysis area. This total includes the removal of timber from Section 16, the proposed location of the WRF, which would not regenerate. Timber sales on NFS lands in the cumulative analysis area are primarily located to the north of the Mine Area. Timber harvested on NFS lands is re-established as per Forest Plan guidelines.

Cumulative Effects by Alternative

The cumulative harvesting of timber resources would vary by alternative, the degree of which may be inferred from the direct and indirect analysis. Alternative F would remove the greatest amount of timber, resulting in greater cumulative effects to the resource compared to other alternatives. Compared to the approximately 1,925 acres of removal by past, present, and reasonably foreseeable future timber management projects, the removal under Alternative F would result in a 44 percent cumulative increase. Removal under Alternatives D, E, and F would be less overall, but would require additional timber removal during reclamation. The pit would be restored to a more natural state, but there would be a greater cumulative loss of timber in the long-term compared to Alternative C. However, the permanent removal of 122 acres of timber under Alternative C, E, and F would result in a permanent cumulative effect to the resource.

3.14.3.3 Irretrievable and Irreversible Consequences

Based on the analysis described above the irretrievable and irreversible consequences by alternative include:

- Permanent removal of NFS timber producing acres from timber production for the Mineable Pit under Alternative C, E, F and H and possibly Alternatives D and G;
- Permanent removal of NFS timber producing acres for the WRF in Alternatives D, E, and F; and
- Permanent removal of NFS timber producing acres for access roads in Alternatives C, D, E, F, G and H.

3.15 Livestock Grazing

3.15.1 Analysis Area and Methods

The analysis area for livestock grazing includes the entirety of allotments that are in the Project Area because an allotment is managed as a whole unit. GIS was used to calculate the acres in the fenced Mine Area where livestock grazing would not be permitted during mining and reclamation and to identify locations of improvements such as water developments and fences. GIS was also used to calculate the acres of primary range within the fenced Mine Area by community type.

3.15.2 Affected Environment

There are portions of the Warren Peak, Divide, Ogden and Blacktail grazing allotments in the Project Area and all except Blacktail Allotment would have portions in the fenced Mine Area (**Figure 33**). **Table 67** shows acres and land ownership in the Project Area, the allotment's total acres, and the percent of the allotment in the Project Area. Approximately 10 percent of the combined four allotments are in the Project Area.

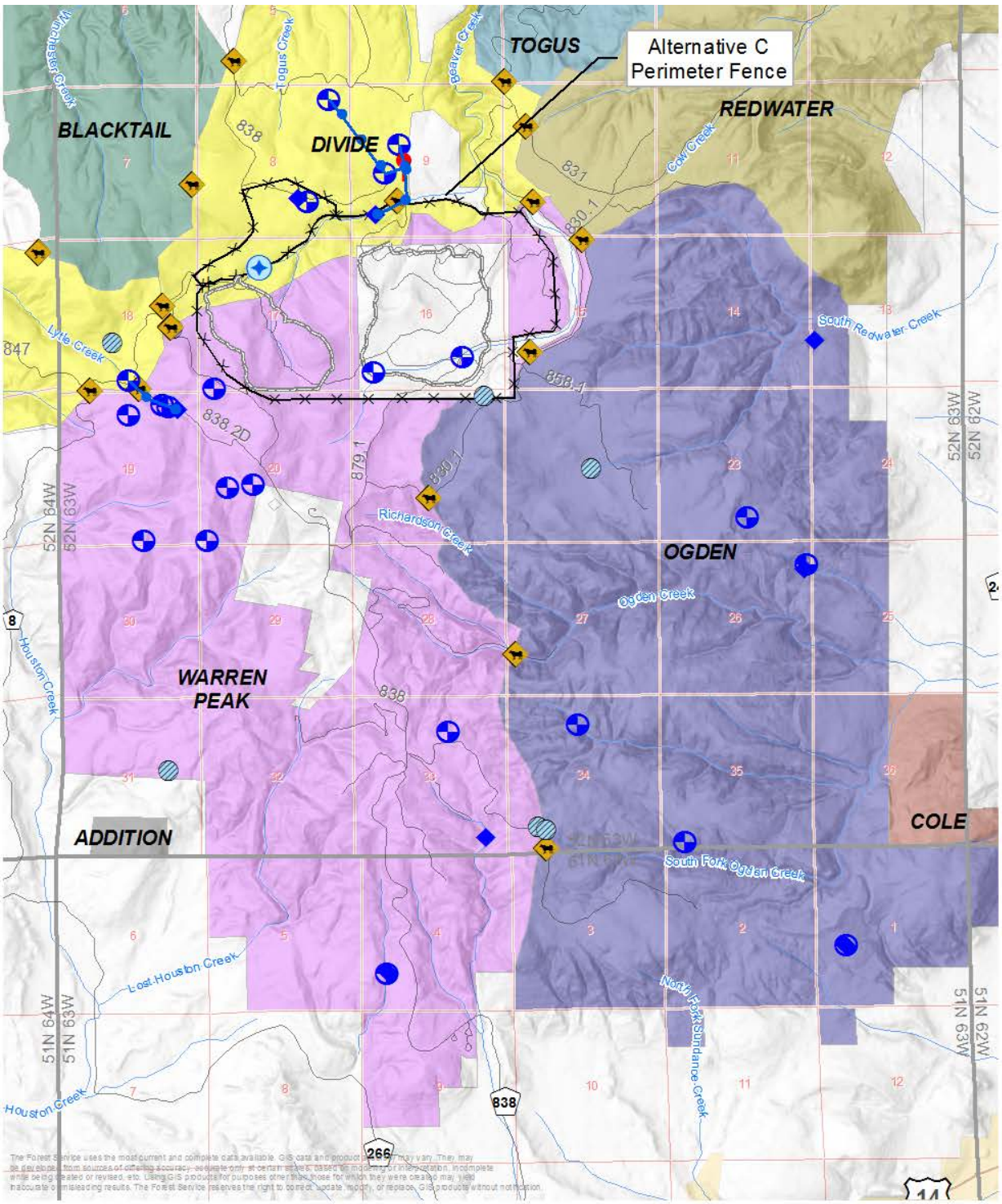
Livestock numbers, pasture rotations, and season of use can be modified annually to adapt to climatic conditions or administrative needs. This is done through the Annual Operating Instructions that are developed with permittees. These instructions implement the management direction set forth in the Allotment Management Plan (AMP). A grazing permit is the instrument that authorizes use and occupancy by the specific holder of the grazing permit to graze livestock. The AMP and Annual Operating Instructions are incorporated into the terms and conditions of the grazing permit.

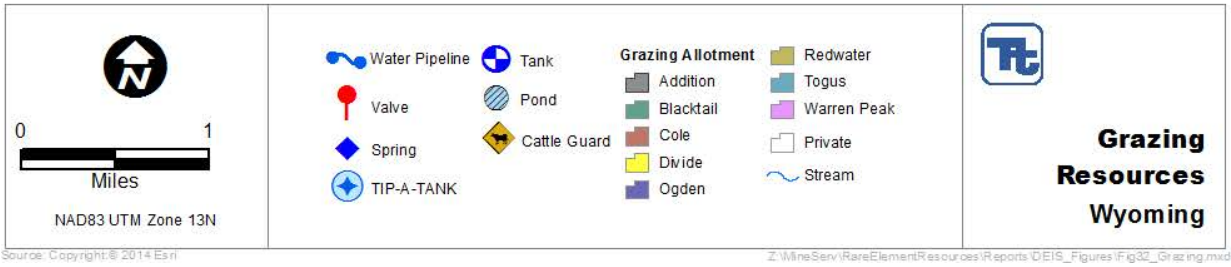
AMPs for all allotments were developed under an adaptive management approach based on monitoring resource conditions. If monitoring results indicate that resource problems persist, adaptive management options are identified that would be implemented to effect improvement in resource conditions. If monitoring indicates a need for change in management, any of the adaptive management actions listed in the AMPs could be implemented. Changes in season and numbers may occur based on resource conditions and needs; however the allocated Animal Unit Months (AUMs) would not be exceeded. Allowable use guidelines would be followed regardless of season and/or numbers. The permittees currently run cow/calf pairs. An AUM is the amount of forage an animal unit will consume in a month, approximately 800 pounds.

Forage within the allotments consists of grasses, forbs, and shrubs. Primary range includes grassland, meadow, and riparian communities. Forage under timber is available and often used, however, due to steeper slopes and lack of water on ridge tops, forage under timber is considered secondary range. Additional adjustments are often needed to account for distance to water, livestock behavior, and topography. For example, there may be a large meadow with high productivity but due to steep access and long distance to water livestock do not utilize it. Numbers and season of use for these four allotments has been developed over time based on the variables described above and actual

Table 67. Allotments in the Project Area

Allotment	Owner	Acres in Project Area	Total Allotment Acres	Percent of Allotment in the Project Area
Blacktail	NFS	142	10,240	1
Divide	NFS	879		
	Private	14		
	Total	893	3,367	27
Ogden	NFS	77		
	Private	1		
	Total	77	8,397	1
Warren Peak	NFS	1,266		
	Private	630		
	Total	1,896	8,059	24
Grand Total		**3,008**	**30,061**	**10**





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use. See Vegetation, Section 3.11 and Wetlands, Section 3.12 for further discussion on plant communities in the grazing allotments.Livestock grazing on the Warren Peak Allotment is permitted for 390 cow/calf pairs to graze from June 26 to October 5 for a total of 1,700 AUMs**.** This is a single-pasture, season-long use allotment. Lack of water and steep terrain limits the opportunities for a rotational system. There are three permittees that hold term grazing permits; two also have term private land permits. One of the private land permits currently includes Section 16 and private land to the east of Section 16. This permit is for 40 cow/calf pairs from June 26 to October 5. Twenty-eight pairs are associated with Section 16. The second private land permit includes land on the west side of the allotment.

Livestock grazing on the Divide Allotment is permitted for 214 cow/calf pairs from June 25 to October 15 to graze under one term grazing permit for a total of 795 AUMs. No livestock numbers are attributed to the 14 acres of private land in Section 16 in this allotment. The Divide Allotment is made up of two pastures in a deferred rotation system. A third pasture is a designated riparian pasture that is often grazed in conjunction with the east pasture for about two weeks annually.

The Ogden Allotment has one term grazing permit for 167 cow/calf pairs from June 16 to October 15 for a total of 670 AUMs. The Ogden Allotment is a two pasture rotation system.

The Blacktail Allotment would not have any acres in the fenced Mine Area and therefore would not be affected by the Mine Area and is therefore not discussed further.

Range improvements within each allotment include water developments, and interior pasture fences. Range improvements aid in livestock management through increased distribution of animals across the landscape. Roads and trails also aid in distribution of livestock.

3.15.3 Environmental Consequences

3.15.3.1 Direct and Indirect Effects

Alternative A - No Action Alternative

Under Alternative A- No Action, there would be no direct or indirect effects to livestock grazing, the livestock grazing allotments, or livestock improvements. The Black Hills National Forest would continue to administer the grazing allotments according to the present AMPs and Forest Plan.

Effects Common to All Action Alternatives

Exploration

Portions of all four of the allotments are in exploration boundary. Linear construction activities would have minimal and short term impacts with reclamation. Exploration would involve activities that would be reclaimed immediately after disturbance.

Construction and Operation

Available Forage and Water

The fenced Mine Area would remove primary grazing forage from the Divide, Warren Peak, and Ogden allotments for the duration of the mine operation, until mine closure and completion of reclamation. Design Features include use of native vegetation (that considers post reclamation livestock management), limiting disturbances outside of the Mine Area, and controlling noxious weeds and dust (Section 2.6.11). The loss of forage in the Ogden Allotment is minimal under all alternatives and would have little to no impact on numbers and season of use in that allotment.

A greater impact to livestock grazing would be the loss of access to water developments (see **Figure 33**). The Whitetail 02 spring source within the footprint of the pit would be lost, as would access to Davis Spring and Allread Spring on private lands due to the WRF. If the loss of access to these springs/developments is not

replaced with another source, more pressure would be placed on other water sources including riparian areas. Any water developments on NFS lands within the Mine Area that are deemed necessary may be required to be relocated. Section 2.6.11 includes the livestock water source design features. Replacement of the developments may include construction of new stock tanks outside of the fence with water pipelines extended from source to new tanks, or construction of a new watering source. Once the new development has been completed, maintenance of the development would be the responsibility of the livestock permittee. The Whitelaw riparian pipeline would be protected to help mitigate potential loss in AUMs.

Design features to replace water sources may allow for AUMs associated with the loss of access to forage from the fenced Mine Area to be absorbed by the rest of the allotment, resulting in no reduction in AUMs. Monitoring the entire allotment would determine if there are any impacts to the primary grazing vegetation and whether a reduction in numbers or change in the timing for grazing (Section 2.9.5) is needed as part of the adaptive management.

Some pasture fencing in the fenced Mine Area would be substituted with the new Mine Area fence. Construction and maintenance of the Mine Area fence would be the responsibility of the proponent. Repairing fences and cattle guards are design features (Section 2.6.11).

Trailing, temporary livestock holding and handling, gathering and trucking activities would not be allowed in the Mine Area.

The impacts to livestock grazing from construction of power lines and roads would be minimal and short term. There could be power line construction in the Divide, Warren Peak, and Ogden allotments.

Grazing Permits

Warren Peak Allotment: One of the two term private land permits (with 19 pair permitted) is on private land and would not be directly affected. Twenty-eight cow/calf pairs on the other term private land permit (totaling 40 cow/calf pairs) would be removed from the allotment permanently under all of the alternatives. The 28 pair were allocated to Section 16 and were part of the state grazing lease prior to the land being acquired by the proponent.

Ogden Allotment: The potential loss of forage in this allotment is minimal and would not affect permitted numbers under any of the alternatives.

Divide Allotment: Depending on the alternative 4 to 12 percent of the allotment would not be available for livestock grazing for the life of the mine and through reclamation.

If monitoring results indicate that there are persistent resource problems, adaptive management options are identified in individual AMPs that would be implemented to effect improvement in resource conditions. Changes and season and numbers may occur from year to year based on resource conditions and needs, however the allocated AUMs would not be exceeded. Regardless of season and/or number allowable use guidelines would be followed.

If monitoring results indicate a need to reduce AUMs that cannot be mitigated by a management change then grazing permits may be cancelled in whole or in part where a decision has been made to devote NFS lands to another public purpose than precludes grazing by permitted livestock (36 CFR 222.4(a)(1)).

Livestock Health and Safety

Increased artificial and 24-hour noise from the mine and truck traffic may cause increased stress, reduced milk production, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate and reduced thyroid activity. However, data from studies has been inconclusive that these problems persist (NoiseQuest, 2015). Livestock have been shown to become accustomed to increases in noise over time.

The increased traffic could cause livestock injury and loss, however the speed limit would reduce the possibility of these types of accidents (see Section 2.6).

Fugitive dust from blasting, trucking and other mining activities may affect the nearby livestock and their forage. Design Features have been developed to abate impacts from fugitive dust. Dust abatement such as watering gravel and dirt roads or treating roads with products such as magnesium chloride would mitigate most impacts. Cattle may be attracted to dust abatement chemicals especially salt based products, therefore, monitoring of the roadways is necessary to adjust the application amount if livestock are licking the roads excessively.

The potential increase of livestock exposure to radiation from the Bull Hill Mine is unknown, as current exposures of livestock to radiation are unknown. The public dose assessment did not indicate any significant level of radionuclides would be encountered outside of the fence line. Low levels of gamma radiation occur naturally at the mine site, however it is much lower than lethal doses that affect health. Gamma radiation doses decrease with increasing distance from the source, which means that doses beyond the Mine Area should be much lower than at waste rock or ore locations within the Mine Area. Ingestion of contaminated forage (through the deposition of particulates) would increase internal exposure of livestock to radiation. Meat from beef, sheep, or wild game would not likely contain significant concentrations of radioactive or hazardous elements, because of the limited amount of time spent grazing in the area of an active mine as well as the dilution in air-dispersed particulates. It is not expected that meat ingestion from beef, sheep, or wild game would be a significant exposure pathway (see Health and Safety Section 3.18.3).

Grazing Economics

Income from ranching is highly variable; the profitability can be significantly affected by a variation of market conditions as well as environmental ones. If access to federal lands for grazing is altered significantly, this change could affect ranching profits and overall business viability. As the AUMs would be adjusted based on monitoring, economic impacts cannot be estimated. However, the minor amount of primary vegetation affected (8 to 9 percent of the Mine Area) indicates that effects would likely be minor.

Reclamation/Closure

Reclamation of roads and power lines would occur soon after disturbance and forage production available to livestock would return eventually; however, there would be a reduction of forage due to widening of roads. This may be counter balanced with transitory range created by the power line and in fact increased available forage and ease livestock movement along the power lines for a number of years.

After completion of reclamation grazing would be allowed to resume within the formerly fenced Mine Area on NFS lands. Grazing may resume on the private land depending on the desire of the landowner.

Alternative C

Construction and Operation

Table 68 shows the acres of each allotment that would be in the Alternative C Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area.

Table 68.
Alternative C Allotment Acres in the Fenced Mine Area and Percent of Allotment

Allotment	NFS	Private	Acres within Fence	% of Total Allotment in Mine Area	Primary Grazing Vegetation Acres in Mine Area	% of Mine Area that is Primary Vegetation
Divide	401	14	415	12	48	12
Ogden	3	1	4	Less than 1	0	5
Warren Peak	662	619	1,281	16	103	8
Total	**1,066**	**634**	**1,700**		**152**	**9**

Table 69 shows the acres of disturbance outside the Mine Area in the Divide, Warren Peak, and Ogden allotments.

Table 69. Alternative C Acres of Disturbance Outside the Fenced Mine Area by Allotment				
Disturbance	**Divide**	**Warren Peak**	**Ogden**	**Total Disturbance**
Miller Creek Access Road New Construction	10.1	6.7		16.7
25 kV ROW	4.7	1.1		5.9
Total	**14.8**	**7.8**	**0.0**	**22.6**

The Divide Allotment water developments that would be no longer accessible to livestock because of the Mine Area fence are: Tip.A.Tank, Willow Park Spring and Tank, and Whitelaw Riparian Enclosure and Whitelaw Spring Development. However, the Whitelaw Spring Development water source and tanks would be outside the Mine Area and would maintain access for livestock as long as the spring continues to produce.

The Warren Peak Allotment water developments that would be within the fenced Mine Area and no longer accessible to livestock are on private land: Davis Spring development, and Allread Spring and Tank development. The Gator Tank would be outside of the Mine Area and remain available for livestock use.

About 3.9 miles of pasture fence would be moved to the Mine Area fence. Portions of roads the permittees use for access (NFS Roads 838.2A, 851, 891.1, and 879.1A) would no longer be available to Warren Peak Allotment and the Divide Allotment permittees.

Because of its location, the Miller Creek access road compared to the other alternatives would cause fewer impacts from fugitive dust and a reduced likelihood of potential livestock and vehicle conflicts on NFS lands.

Exploration activities would be reclaimed immediately after disturbance so impact to forage and livestock movement should be minimal.

Reclamation

The 232-acre Mineable Pit would not be available to livestock grazing after reclamation. As a result 210 acres of the Warren Peak Allotment and 22 acres of the Divide Allotment would be permanently unavailable.

Alternative D

Construction and Operation

There would be fewer acres in the Divide, Ogden, and Warren Peak allotments on NFS lands in the fenced Mine Area in Alternative D than Alternative C. There would be less acres of primary forage in the fenced Mine Area with Alternative D than Alternative C. However, there would be more total acres of disturbance under Alternative D compared to Alternative C. **Table 70** shows the acres of each allotment that would be within the Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area. **Table 71** shows the acres of disturbance outside the Mine Area fence in each allotment.

Table 70. Alternative D Acres within the Fenced Mine Area and Percent of Allotment						
Allotment	**NFS**	**Private**	**Acres within Fence**	**% of Total Allotment in Mine Area**	**Primary Grazing Vegetation Acres in Mine Area**	**% of Mine Area that is Primary Vegetation**
Divide	336	14	350	10	35	10
Ogden	2	1	3	Less than 1	0	0
Warren Peak	527	619	1,146	14	95	8
Total	**865**	**634**	**1,499**		**130**	**9**

The placement of the Mine Area isolates the northeastern corner of the Warren Peak Allotment, which would make this area difficult to access by livestock. No water would be available for cattle grazing in this area. As

this northeastern corner of the Warren Peak Allotment would be fenced into the Mine Area in Alternatives C and F, effects under alternative D would be similar. This area would not likely return to grazing use.

Leeman Spring Fed Dam and Fence, Whitelaw collection, Allread Spring and Tank, Davis Spring, and Tip.A.Tank would be in the fenced Mine Area and would not be accessible to livestock.

Approximately 3.3 miles pasture fence would be removed by the Mine Area.

Table 71.
Acres of Disturbance within Allotments in Alternative D

Disturbance	Divide	Warren Peak	Ogden	Total Disturbance
Warren Peak Access Road New Construction	6	47		52
25 kV ROW	3	11	9	25
Grand Total Disturbance	**11**	**68**	**18**	**102**

Reclamation

The backfilled and recontoured Mineable Pit would allow access and likely restore forage production on 232 acres for livestock grazing.

Alternative E

Construction and Operation

Alternative E would have the fewest acres of NFS lands in the Divide, Warren Peak, and Ogden allotments in the fenced Mine Area of all of the alternatives. There would be fewer acres of primary grazing vegetation in the Mine Area under Alternative E than Alternatives C, D, F, and G.

Approximately 2.1 miles of pasture fence would be replaced by the Mine Area fence.

Table 72 shows the acres of each allotment that would be within the Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area.

Table 72.
Alternative E Acres within the Fenced Mine Area and Percent of Allotment

Allotment	NFS	Private	Acres	% of Total Allotment	Primary Grazing Vegetation Acres in Mine Area	% of Mine Area that is Primary Vegetation
Divide	112	14	126	4	**6**	4
Ogden	2	1	3	Less than 1	**0**	0
Warren Peak	495	619	1,114	14	**93**	8
Total Acres	**609**	**634**	**1,243**		**99**	**8**

Leeman Spring Fed Dam and Fence, Allread Spring and Davis Spring would be fenced in the Mine Area. In the Divide Allotment the Willow Park Spring may still be accessible for use by livestock.

The effects to fencing, vehicle access, and livestock access described in Alternative D are the same as in Alternative E.

The disturbance outside the mine area would be limited to 42 acres for the access road. No power line would be constructed.

Reclamation

The Mineable Pit would be reclaimed to have recontoured slopes to allow access. A pit lake would preclude 107 acres from forage production.

Alternative F

Construction and Operation

Alternative F would have fewer acres of the Divide, Ogden and Warren Peak allotments on NFS lands in the fenced Mine Area than Alternatives C, but more acres than Alternatives E and similar acreage to Alternative D and G. **Table 73** shows the acres of each allotment that would be in the Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area. There would be more acres of disturbance within the allotments under Alternative F than Alternatives C, D, G and less than Alternative E. Alternative F would have 111 less acres of primary grazing vegetation within the fenced Mine Area than Alternatives C, D, and G but more than Alternative E.

Approximately 3.0 miles of pasture fence would be replaced by the Mine Area fence.

Table 73.
Alternative F Acres within the Fenced Mine Area and Percent of Allotment

Allotment	NFS	Private	Total	% of Total Allotment	Primary Grazing Vegetation Acres in Mine Area	% of Mine Area that is Primary Vegetation
Divide	172	14	186	6	8	4
Ogden	3	1	3		0	0
Warren Peak	682	619	1,302	16	103	8
Total Acres	**857**	**634**	**1,491**		**112**	**8**

Table 74 shows Alternative F disturbance outside the Mine Area. No disturbance would occur in the Divide allotment outside the Mine Area. The loss of livestock water improvements, permittee access, and fencing management would be the same as Alternative E.

Water Developments: Leeman Spring Fed Dam and Fence, Allread Spring and Tank and Davis Spring would be within the fenced Mine Area.

Table 74.
Disturbance Acres within Allotments in Alternative F

Disturbance	Warren Peak	Ogden	Total Disturbance
Access Road Alt F New Construction[3]	42		42
25 kV ROW	1	11	12
Power line Access Existing Disturbance	0	6	6
Total Acres	**43**	**17**	**59**

Reclamation

The Mineable Pit would be reclaimed to have recontoured slopes to allow access. A pit lake would preclude 107 acres from producing forage.

Alternative G

Construction and Operation

Under Alternative G there would be fewer acres of NFS lands in the Divide, Ogden, and Warren Peak Allotments in the fenced Mine Area than Alternatives C, more than Alternatives E and similar acreage to

Alternatives D and F. The effects of Alternative G to livestock grazing, livestock improvements, permittee access and livestock distribution would be similar to Alternatives D and F during the operation of the mine. There would be a little more disturbance of acres on NFS lands than Alternative C and less disturbance than Alternatives D, E, and G. There would be less acres of primary grazing forage within the fenced Mine Area under Alternative G than Alternatives C, more than Alternatives E and F but similar acres to Alternative D.

Approximately 3.3 miles of pasture fence would be replaced by the Mine Area fence.

Table 75 shows the acres of each allotment that would be within the Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area.

Table 75.
Alternative G Acres within the Fenced Mine Area and Percent of Allotment

Allotment	NFS	Private	Acres within Fence	% of Total Allotment	Primary Grazing Vegetation Acres in Mine Area	% of Mine Area that is Primary Vegetation
Divide	336	14	350	10	35	10
Ogden	2	1	3	Less than 1	0	0
Warren Peak	527	619	1,146	14	95	8
Total Acres	**865**	**634**	**1,499**		**130**	9

Table 76 shows acres of disturbance outside the fenced Mine Area by allotment. There would be no additional disturbance in the Ogden allotment outside the Mine Area.

Table 76.
Disturbance Acres within Allotments in Alternative G

Disturbance	Divide	Warren Peak	Total Disturbance
Access Road New Construction	10	5	15
25 kV ROW	5	1	6
Total Acres	**15**	**6**	**22**

Source: GIS

Leeman Spring fed Dam and Fence, Whitelaw Collection, Allread Spring and Tank, Davis Spring and Tip.A.Tank would be in the Mine Area and not accessible to livestock.

Reclamation

Reclamation would return the area to the pre-mine landscape which would likely support grazing at the current levels.

Alternative H

Construction and Operation

The effects of Alternative H on livestock grazing, livestock improvements, permittee access and livestock distribution would be similar to Alternatives D and F during the operation of the mine. There would be less disturbance of NFS acres than Alternative C, D, F and G and more disturbance than Alternatives E. There would be less acres of primary grazing forage within the fenced Mine Area under Alternative H than Alternatives C,D, F, or G, and the same as Alternatives E.

Approximately 2.2 miles of pasture fence would be replaced by the Mine Area fence.

Table 75 shows the acres of each allotment that would be within the Mine Area and the percent of primary grazing vegetation for each allotment within the fenced area in Alternative H.

Table 77. Alternative H Acres within the Fenced Mine Area and Percent of Allotment						
Allotment	**NFS**	**Private**	**Acres within Fence**	**% of Total Allotment**	**Primary Grazing Vegetation Acres in Mine Area**	**% of Mine Area that is Primary Vegetation**
Divide	250	14	264	8	12	5
Ogden	2	1	3	Less than 1	0	0
Warren Peak	491	619	1,110	14	87	8
Total Acres	743	634	1,377		99	7

Disturbance outside the fenced Mine Area by allotment would be the same as Alternative G (**Table 76**).

Leeman Spring fed Dam and Fence, Whitelaw Collection, Allread Spring and Tank, Davis Spring and Tip.A.Tank would be in the Mine Area and not accessible to livestock.

Reclamation

The Mineable Pit would be reclaimed to have recontoured slopes to allow access. Reclamation would return 38 acres of the Mineable Pit to the pre-mine landscape which would likely support grazing at the current levels. A pit lake would preclude 107 acres from producing forage.

3.15.3.2 Cumulative Effects

The analysis area for cumulative effects to livestock grazing includes the Warren Peak, Ogden, Divide, and Blacktail allotments in their entirety to address the impacts on the grazing permittees.

Cumulative Effects Common to All Action Alternatives

Timber harvesting, mineral exploration, and minerals development have altered rangeland resources. The changes in vegetation communities have affected livestock grazing to a limited degree. Effects have been minimal because livestock use is typically allowed to return following cessation of activity and reclamation. Also because timber harvesting does not occur in the vegetation types considered primary range (i.e. meadows, grasslands, and riparian). Reclamation after exploration has been localized and while livestock are restricted temporarily from these areas there has been no change in numbers and/or season of use due to these activities. The greater impact to livestock grazing has been the change in distribution due to activities. The reduction in available grazing area, forage, and water access caused by activities would cause a cumulative effect by placing increased grazing pressure on other areas for livestock use. Future reclamation, weed control, and range improvement projects would have a positive effect on livestock grazing.

Past and future timber harvest and prescribed fire may have created and will continue to create transitory range, increasing livestock distribution and available forage. Transitory range is an area that temporarily produces an increase in rangeland vegetation. These areas occur when the tree and sometimes shrub overstory are removed, making resources such as sunlight and moisture more available to the grass/forb component. Timber harvest and prescribed fire would not contribute cumulatively to the impacts of the mine on livestock grazing.

Cumulative effects on rangeland resources would occur from road construction associated with other past, present, and future projects, as vegetation is removed. An increase in roads would also provide more access to livestock and livestock managers; improving distribution patterns throughout an allotment.

Cumulative Effects by Alternative

When added to effects from past, present, and reasonably foreseeable actions described above, Alternative F results in the greatest amount of disturbance, removing the most acreage from livestock access. The potential for cumulative effects would be greatest within the Warren Peak Allotment as increased pressure to rangeland

resources would be experienced in other areas of the allotment. Alternative C removes the least acreage during construction and operations. However, the pit closure in alternative C permanently removes 232 acres from livestock use including one spring. Alternative G would return those acres to grazing use at the end of mining and reclamation. Alternative D would also reclaim the Mineable Pit with recontoured slopes that would allow access to return. Alternative E would be reclaimed to allow for forage production for livestock grazing if a pit lake does not form. Alternative F would be revegetated as well to allow for multiple land use; however, a pit lake would likely form.

3.15.3.3 Irretrievable and Irreversible Consequences

Based on the analysis described above the irretrievable and irreversible consequences by alternative include:

- Headwaters of Whitetail Spring permanently removed from livestock access under all alternatives;
- Up to 232 acres permanently lost to grazing use under Alternative C;
- About 107 acres of pit lake would permanently eliminate grazing in Alternatives F and H, and likely in Alternative E; and
- In Warren Peak Allotment, one term private land permit for 28 cow/calf pairs would be removed from the allotment permanently under all of the alternatives.

3.16 Recreation and Land Use

This section analyzes the impacts on recreational activities and special uses. Information in the Social and Economics (Section 3.18) reflects the analysis in this section. Safety of road use is analyzed under Access and Transportation (Section 3.4). Aesthetics and Visual Quality (Section 3.5) analyzes viewpoints.

3.16.1 Area of Analysis and Methods

The analysis area for recreation and land use is the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes. Changes to the recreation setting, recreation activities, and desired recreation experience are analyzed by the changes in the recreation opportunities through all phases of project activities.

3.16.2 Affected Environment

Figure 34 displays recreation features.

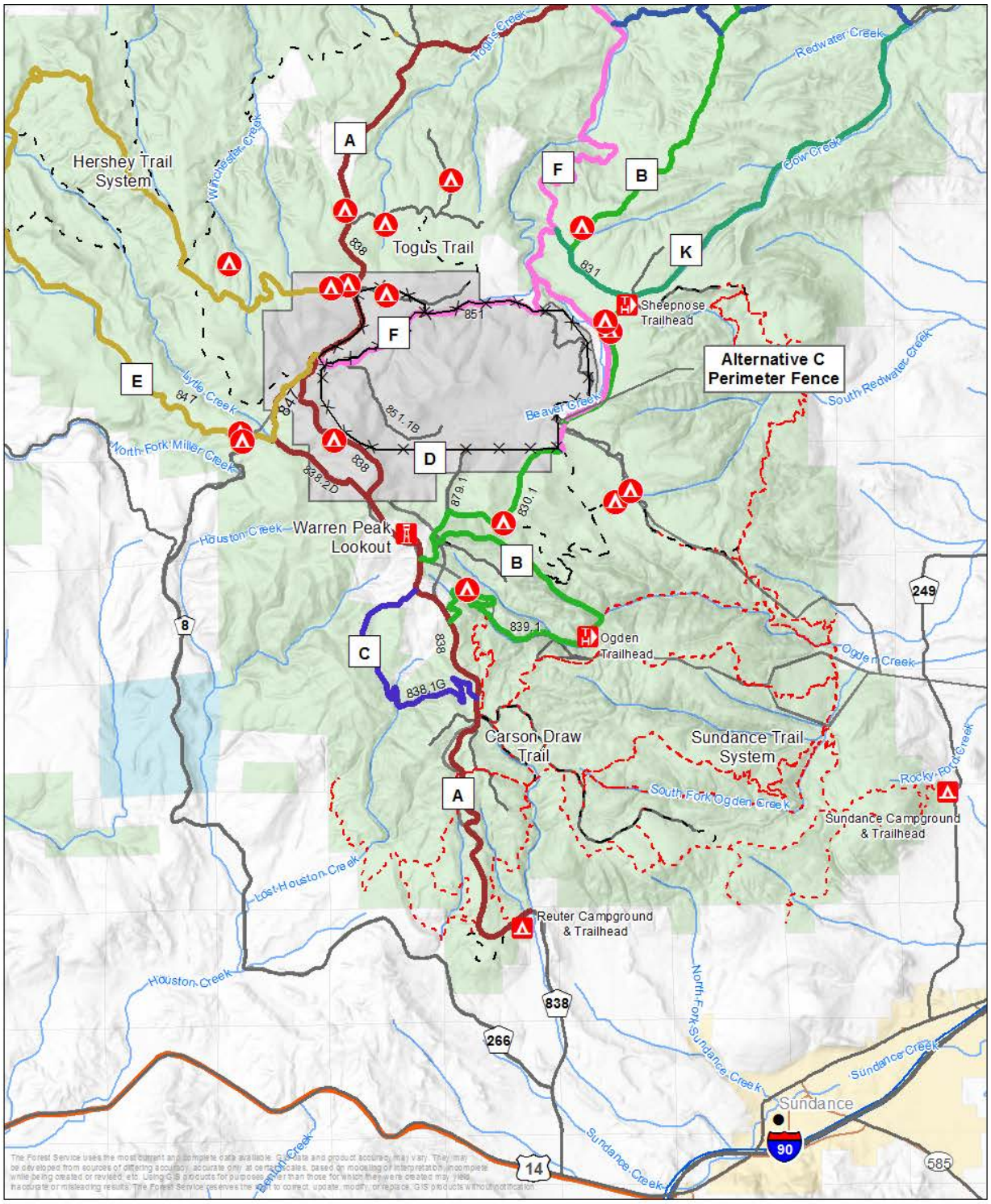
Developed Recreation Opportunities

The Reuter Campground is located 3 miles south of the Mine Area and accessed from the Warren Peak access road (NFS Road 838) proposed under Alternatives D, E, and F. The Sundance Horse Camp and Trailhead is located about 3.5 miles east of the Mine Area. Both campgrounds are outside of the Project Area, but included in the analysis due to proximity of proposed mine access route and power line corridors.

The Warren Peak Fire Tower, located a half mile south of the Mine Area, is a recreation destination offering viewing opportunities. Scenic integrity is discussed in Section 3.5 Visuals and Aesthetics. Over the past five years, between the months of June to October, visitor usage at the fire tower averages about 1,900 visitors.

Dispersed Recreation Opportunities

Portions of groomed snowmobile trails A, C, D, E, and F are in the Project Area. Snowmobile trails and facilities within or adjacent to the fenced Mine Area include sections of Snowmobile Trails A and F, and the snowmobile bathroom. Other snowmobile trails are affected by the proposed access routes and power line corridors. Snowmobile trails are also used by dog sled teams.


Hershey Trail System
Winchester Creek
Togus Creek
Redwater Creek
Cow Creek
A
F
B
K
E
D
C
Togus Trail
838
831
851
847
851.1B
838.2D
879.1
830.1
839.1
838.1G
Sheepnose Trailhead
Alternative C Perimeter Fence
South Redwater Creek
Lytle Creek
Beaver Creek
North Fork Miller Creek
Houston Creek
Warren Peak Lookout
Ogden Trailhead
Ogden Creek
249
8
Carson Draw Trail
Sundance Trail System
Rocky Fork Creek
South Fork Ogden Creek
Sundance Campground & Trailhead
Lost Houston Creek
Reuter Campground & Trailhead
Houston Creek
North Fork Sundance Creek
Sundance Creek
266
Sundance
90
14
585
Bentonit Creek
0
1.5
Miles
NAD83 UTM Zone 13N
Campground
Trailhead
Dispersed Campsite
Lookout Tower
Snowmobile Trail
A
B
C
E
F
H
K
Project Area
National Forest
State
Private
Stream
Non-Motorized Trail
Trail Open to 50 in. or Less in Width
NFS Road Number
Recreation
Wyoming

Dispersed camping is a recreation opportunity where visitors camp in areas without the services of tables, bathrooms, or grills. The Black Hills National Forest, through the motor vehicle use map (US Forest Service, 2015b), has designated motorized dispersed camping opportunities to within 300 feet of NFS roads. In the Project Area on NFS lands, this include NFS Roads 851, 851.1B, 838.2A, 838, 879.1A, 847, and 854.1.

Not all segments of the roads are appropriate for a dispersed camp site. Visitors tend to look for natural opening with flatter surfaces to accommodate their needs. Dispersed camping opportunities also exist along the designated trails for non-motorized activities.

The Project Area includes opportunities for motorized trail riding for vehicles less than 50-inches in width. Two designated trails, Trail 1041 (0.4 miles) and Trail 1042 (0.6 miles) are in the northwest of the Project Area. Other motorized opportunities occur for all vehicles as designated on the Black Hills Motor Vehicle Use Map (US Forest Service, 2015b) and include NFS Roads 847, 851, 879.1A, 838.2A, 851.1B, 879.1, 854.1, and 838.

Sections of the Sundance non-motorized system trails, 93A, 93I, 93K, and 93L would be within proposed power line corridors, depending on the alternative. Non-motorized recreation visitors are not confined to the designated trail system, which is used by hikers, hunters, anglers, horseback riders, and mountain bikers. Carson Draw Trails which are accessed from Reuter Campground and Trailhead are all season trails used for both summer and winter activities which includes cross country skiing and snow shoeing.

NFS lands are open to all forms of hunting in accordance with state laws. Hunt areas and seasons are established by the WGFD. The Project Area has several hunt area designations depending on the species; Hunt Area 2 for mule deer and white-tailed deer, Hunt Area 116 for elk, and Hunt Area 1 for turkey. The available open public hunting lands within each WGFD hunt area would vary depending on the fenced Mine Area under each alternative.

Recreation Opportunity Spectrum

The Forest Plan uses the Recreation Opportunity Spectrum (ROS) to classify recreation opportunities on NFS lands according to the available range of recreation experiences, opportunities, and settings. ROS classes are described as: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Natural, Roaded Natural Non-Motorized, Rural, and Urban. (US Forest Service, 2006). The Forest Plan classified the ROS for the Project Area as roaded natural (99.3%) and semi-primitive non-motorized (0.7%) on the eastern edge in Management Area 3.32. Management Area locations are shown in Figure 2.

Roaded natural classification means that remoteness is of little relevance and full access is the norm. Roaded natural characteristics are predominately natural appearing settings with moderate sights and sounds of human activities and structures. The overall perception is one of naturalness. Evidence of human activity varies from area to area and roads and motorized equipment are common in this setting.

Semi-primitive non-motorized classification means distant sight and/or sound of human activity is acceptable and motorized travel is more than ½ hour walk as the norm. Non-motorized trails are acceptable and retention of naturalness is the norm.

Existing Use Levels and Trends

Popular game species in the area include mule deer, white-tailed deer, elk, and wild turkey. Data compiled on average annual hunter use days by hunt area (WGFD, 2015), including the WDEQ Permit boundary, shows the following:

- Hunt Area 2 – Mule Deer and White-tailed Deer (estimated at 643,232 total acres which includes about 85,000 acres of NFS lands),
  - From 2004 to 2013, annual average of 4,814 general license mule deer hunter use days.
  - From 2004 to 2013, annual average of 14,618 white-tailed deer hunter use days.

- Hunt Area 116 - Elk (estimated at 1,464,593 acres which includes about 85,000 acres of NFS lands),
  - In 2013, 8,627 elk hunter use days (the first year of general license bull hunting).
  - The previous 10-year average, which included a strictly limited quota system for bulls, was 3,708 elk hunter use days.
- Hunt Area 1 - Wild Turkey (estimated at 2,241,195 acres which includes about 160,000 acres of NFS lands).
  - From 2004 to 2013, the annual average spring wild turkey hunter use days was 7,926. Fall turkey hunter annual average use days for this same time period totaled 3,289 (includes a general license wild turkey hunting season without restriction to landowner ship).

Within these hunt areas, the total NFS lands with public access account for about 13 percent of the lands open for hunting in Hunt Area 2, 6 percent in Hunt Area 116 and 7 percent in Hunt Area 1. Additional lands, including BLM lands, state lands, and private land with special agreements with the state, are available for public hunting as long as there is public access to the properties. It is difficult to know how many acres from these other sources are available for open public hunting, so the analysis will focus only on NFS lands.

The WGFD also conducted a traffic study during the 2014 fall hunting season (Oct. 13 to Nov 19, 2014) using a combination of WGFD personnel counting hunters in vehicles and extrapolating the mean number of hunters per vehicle to traffic counters placed at two locations on Whitelaw Road (NFS Road 851). The study estimated approximately 85 percent of the vehicles contained approximately 2 hunters per vehicle with a daily average of 30 vehicles traveling NFS Road 851. In the study, WGFD estimated that about 10 percent of the vehicles were hunting in the Project Area (WGFD, 2015).

Noise Study

A noise inventory was conducted at 12 locations for the Bear Lodge Project over a 24 hour period in October 2012. FS personnel reviewed several of the sites in August 2015 and concurred with most of the readings documented in the study, except one along the proposed Miller Creek access route that had extremely high readings. On average, the Bear Lodge Project and proposed access route have a 40 to 50 dB(A) ambient noise level. The lowest reading in the report showed the Reuter campground at 37 dB(A), while the highest was Vista West community at 62 dB(A). The junction of NFS Roads 838, 847, and 851 at the Mine Area had a readings of 47 dB(A). Comparative sampling by the FS resulted in an average of 45 to50 dB(A) for one time sample readings around the Project Area. These readings are typical of environmental conditions and day-to-day life, with normal conversation averaging 60 dB(A) (Behrens and Associates, Inc., 2014).

Noise is defined as unwanted sound that may be disturbing or annoying. The character of noise is defined by it loudness, its pitch and also by the way the noise varies with time. Environmental noise generally derives, in part, from a combination of distant noise sources; i.e. traffic, wind in trees, and industrial or farming activities. These distance sources create a low level “background noise” in which no particular individual source is identifiable. In addition to background noise, is the super-imposed noise events that are usually for short duration, but definable; i.e. aircraft flyovers, screeching of brakes, and single car drive-by, all causing the noise level to fluctuate significantly from moment to moment. Hearing loss is generally a concern when exposed continuously to 85 dB(A) or above.

Elements of this project that would generate noise include mining equipment, PUG Plant operations, vehicles on the roads, and people. Blasting is considered a super-imposed noise element. The evaluation of noise impacts is dependent on many factors including wind, topography, vegetation, and distance from the source.

Recreation Special Use Permit Events

There are five recreation events that occur annually within close proximity to the Project Area:

3. Mountain bike/run race on Sundance System trails in September

4. Mule ride on Sundance System trails in June
5. MS road bike ride on Warren Peak (NFS Road 838, paved portion) in August
6. Snowmobile poker run on snow trails in February
7. Cross-country skiing snow festival in February – first issued in 2015

In addition to these recreation events, the Project Area overlaps with two commercial big game hunting outfitter and guiding permits; Seven J Outfitters and Trophy Ridge Outfitters. Seven J Outfitters permitted area overlaps with the fenced Mine Area, while Trophy Ridge Outfitters permitted area borders the proposed access road along NFS Roads 838 and 847.

Land Special Use Permit

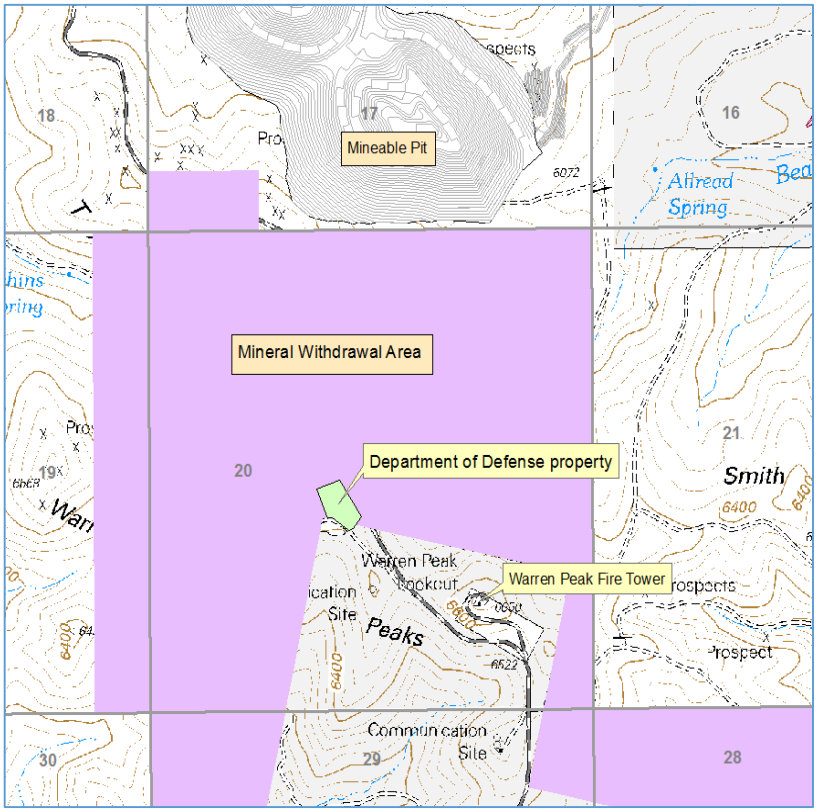
Land Special Use Permits are those permits issued to private individuals or agencies that utilize NFS lands for special purposes, such as access, utility corridors, or other special needs. There are no land special use permits in the Project Area; however, outside of the Project Area, there are several permits. Depending on the alternative, there is permitted use for power line corridor, telephone corridor, communication towers, and a snotel site for measuring winter snows that could be affected by construction of the proposed access route or power line corridor.

Mineral Withdrawal

A mineral withdrawal (**Figure 36**) established pursuant to Executive Order No. 10355 by the Department of Air Force in May 1963 lies approximately a half mile (to the south of the proposed mineable pit in sections 17, 19, 20 of T52N R63W. This mineral withdrawal prohibits the prospecting, location, entry, and purchase under the mining laws of the United States on NFS lands to aid in programs of the Department of the Air Force for utilization of the surface in connection with the construction, operation, and maintenance of the Sundance Air Force Station and appurtenances. For the mineral withdrawal area in Sections 19, 20 and 29, the Forest Service signed a restrictive order in 1971 (amended in 1975) to prohibit the use of explosives. The purpose of the mineral withdrawal is to provide a buffer zone to protect the PM-1 Site, 3.5 acres which contains buried nuclear waste material.

The Forest Service retained the right within the mineral withdrawn lands to continue management activities that do not affect the mineral resources such as timber management, livestock grazing, prescribed burning, and other land management operations, such as communication towers and utility lines.

Figure 35. DOD Mineral Withdrawal



3.16.3 Environmental Consequences

3.16.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, the existing recreation uses would continue under current conditions with the recreation setting and experience remaining largely the same. The settings, landscape, recreation sites, roads, and trails would continue to be affected by current conditions and ongoing actions, including previously approved exploration.

Effects Common to All Action Alternatives

Exploration

Exploration activities are proposed as shown in Figure 3. Recreation activities within this area include motorized less than 50-inch trails, roads open to all motorized vehicles, winter snowmobile trails, and opportunities for dispersed recreation such as hunting and dispersed camping. With the exception of the fenced Mine Area, recreation opportunities would continue in the exploration area. Temporary closures (1 to 3 months or until reclamation has been completed) may be necessary on existing roads if the exploration activities pose a safety concern. In accordance with the design features, no winter exploration would occur from December 1 to March 31.

Impacts to recreation opportunities from the proposed exploration activities would consist of increased noise from drill rigs and heavy equipment, an increase in traffic from equipment and water trucks accessing individual exploration sites, and light pollution from night-time exploration activities. These impacts are localized to the individual exploration areas. Temporary roads created for accessing exploration areas would be closed appropriately and not authorized for motorized use under the Forest Travel Management Plan.

Exploration activities would meet the existing ROS of Roaded Natural.

Construction and Operations

The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, angling, hunting, and winter and summer trail activities.

The recreational experience outside of the Mine Area would include an increase in human presence, noise and dust, and overall disturbance from construction and operations. Combined noise would be most apparent to campers, anglers, hikers, mountain bikers, hunters, and equestrians along the surrounding edge of the fenced Mine Area. As the visitor travels away from the mine area, the less noise would be perceived due to distance, topography, and vegetation. Those visitors hiking along the Sundance trail system may not perceive any noise or perceive a low rumbling of background noise from mountain tops without being able to distinguish where it’s coming from. Warren Peak fire tower visitors would likely experience louder changes in noise level (increases by 10 dB(A)) due to open exposure.

Within the fenced Mine Area a direct loss of NFS lands available for recreation activities and road access would occur under all alternatives. Public access to the fenced Mine Area would be prohibited and displaced during the operation phase. An increase in mine related traffic on NFS roads would continue during operation. Hunting, hiking, biking, and other recreational uses within the fenced Mine Area would be eliminated until reclamation is complete.

While the fenced mine area varies by alternative, the open motorized NFS roads include 851, 851.1B, 838.2A, 879.1, and 879.1A. From the list the only road considered a main route is NFS Road 851, while all the rest serve as local roads providing access to smaller areas NFS lands within the mine area. The roads within the fenced mine area would be closed to the public until reclamation is complete. Other roads surrounding the Mine Area would remain open to motorized vehicles, providing access to other parts of the Bearlodge Mountains, including NFS Roads 838, 847, 830.1, and 841. The mine fence would cause local roads, NFS

Roads 879.1, 879.1A, and 838.2A, to dead end. Turn-arounds would be constructed for vehicles at these points. Recreational use of open NFS roads outside of the Mine Area would allow for continued access to other parts of NFS lands.

Motorized dispersed camping as identified on the Motor Vehicle Use Map for the Black Hills National Forest (US Forest Service, 2015b) would be eliminated along those routes that are closed as a result of the Mine Area fence. Each alternative results in a different level of closed roads due to the location of the Mine Area fence and is disclosed under each alternative. Motorized dispersed camping outside of the fenced Mine Area would continue to be available to the public. Visitors may experience increases in noise or dust associated with mine activity as discussed above. Visitors that are dispersed camping in close proximity to the mine fence may be asked to temporarily (half a day) leave their camp sites during blasting events.

Where there is overlap between the snowmobile trail and access route, the snowmobiles trails would be rerouted. Approximately 1.2 mile of Trail D (1 mile on private lands and 0.2 mile on NFS lands) lies predominately within the fenced Mine Area. It would not be rerouted because of the location and would be a permanent loss.

Winter snowmobile trails (Trails A and E) overlapping with proposed access routes would need to be re-routed or completely removed from the system since the proposal includes plowing the access route for winter mining. The Reuter Trailhead is the only designated trailhead for winter activities and only one trail, Trail A leaves the trailhead to access the other winter trails. Depending on the Mine Area fence location under the alternatives, the bathroom at the junction of NFS Road 851 and 838 may be eliminated or it may still be usable; and the warming shelter may be relocated to avoid impacts with mine related traffic under Alternatives C, D and G. Depending on the size and component of a snowmobile, the ambient noise level varies between 70 to 80 dB(A). Within close proximity to the Mine Area, snowmobilers would experience increased background noise to their own machines which would lessen the farther they travel from the Mine Area. Non-motorized winter users would experience higher noise levels in close proximity to the Mine Area, however, those users on the designated Carson Draw trails would not likely perceive any differences in noise except with vehicle passage on the access route proposed in Alternatives D, E, and F.

Users of the non-motorized system trails could experience temporary delays during the construction of the proposed power lines. Closures of trails (1 to 2 weeks) may be necessary for public safety until the construction is complete. Upon completion of the construction, users of the trails may experience temporary delays (30 minutes) for annual maintenance, particularly if hazard trees require removal along the power line. For Alternatives D, E, and F where Warren Peak access route intersects with non-motorized trails, impacts may include delays during construction particularly if the construction equipment is working at a particular junction point. Temporary closures (6 months) may also be established until road construction is completed for public safety. There are no non-motorized trails within the Mine Area (see Section **2.6.13**).

Users of the motorized trails, Trails 1041 and 1042, would not experience any impacts related to mining activity, except possibly during blasting activities. The noise generated from mining activities (100 to 110 dB(A)) is not likely to be any louder than noise generated from ATV or motorcycle riding (varies by machine size and components, 85 to 100 dB(A)). Impacts from noise may be experienced as users stop and turn off their machines for viewshed or wildlife watching. Trails 1041 and 1042 are not directly related to mining activities, but may be used for exploration activities. Temporary impacts with trail users may be experienced as larger equipment and trucks use these routes for access to exploration areas. Motorized trail users would experience greater impacts from mining related traffic, particularly from dust, on connector routes such as roads open to all vehicles. Appropriate signage along trails and roads would reduce any hazards associated with dual usage.

Elevated noise levels resulting from nighttime facility operations would affect campers using dispersed sites adjacent to the Project Area. Nighttime sound inventory recorded averages of 40 dB(A). NFS roads closed to public motorized use would also be closed to dispersed camping opportunities. The increased noise levels (5 to 10 dB(A)) associated with operations may be readily noticeable to motorized recreation users over the

sound of their personal vehicles in areas of direct contact with equipment. Facility and vehicle lights would result in changes to the nighttime recreational setting on lands surrounding the Mine Area by increasing sky glow and direct visible glare. These changes would contribute to displacement of recreation activities and opportunities from NFS lands surrounding the Mine Area.

Hunting is another form of dispersed recreation that would be affected by the Bear Lodge Project. While hunting opportunities would continue to exist outside the Mine Area fence, there would be a loss of available public hunting areas inside the Mine Area fence. Individual hunters who favor these particular lands would be displaced until they found new places to enjoy their activity. Increased human activities may affect the hunting experience outside of the Mine Area fence, however, large impacts on big game are not anticipated (see Wildlife, Section 3.13) so hunting opportunities would likely not be reduced noticeably. Big game would become habituated to the consistent noise generated by mining activities and would not be dispersed away from the area after a short time. Outfitters may notice a difference in areas that big game use from pre-mining conditions but hunter success is not expected to be affected by activities on NFS lands.

The Whitelaw Creek drainage along NFS Road 851 has been used for fishing. Only Alternative C would preclude any opportunity to fish due to the location of the mine fence on the north side of the road. All other alternatives relocated the fence to the south side of the road. A design feature recommends the construction of the fence to within 200 feet of the mine facilities which would provide for continued availability for fishing on Whitelaw Creek.

Effects on recreational users are closely tied to visual quality. The sightseeing experience would be changed through the alteration of natural and scenic landscapes. Sightseers would be affected by a change in expected viewshed to a less natural state. Mining operations, noise, fugitive dust and the increase in human presence would contrast with the natural surrounding landscape. Additional discussion of impacts to visual quality are included in Section 3.5.

The visual and winter recreation design features would address placement of the power line along ridge or likely cross trail systems.

Recreation Opportunity Spectrum

Within the fenced Mine Area, there are no recreational opportunities under any alternative; therefore, the ROS setting does not apply during construction and operation of the mine. Immediately against to the Mine Area but outside of the fence, the NFS lands vary between the roaded natural classification and the rural classification. A rural ROS classification is defined as an area characterized by a natural environment that has been substantially modified by development of structures, vegetative manipulation or pastoral agricultural development. Sights and sounds of humans are readily evident and the interaction between users is often moderate to high. Because of the increase in noise and activity associated with the mine, the ROS classification may be more like the rural setting along the edge of the fence where the mine development is more noticeable.

Special Uses

The fenced Mine Area is approximately 1,700 acres for Alternative C, which includes about 1,065 acres of NFS lands; and varies to fewer acres under the other alternatives as the Mine Area fence is modified. NFS lands would be removed from the outfitter’s designated area and not available for hunting under any alternative until the lands have been completely reclaimed and opened for public entry. At that time, if the outfitter desires to continue his permit, the NFS lands could be available for addition into an outfitters permit through the appropriate analysis.

A second outfitter permit borders the NFS Roads 838, 847 and 854.1 and would be impacted by increased traffic along these roads. This outfitter may experience displacement of animals along the edge of his permitted area where the increased noise from the mine is most prevalent. However, it is not likely to reduce the hunting experience or success of the hunt for the outfitter.

Commercial and organized recreational event permits are issued for the larger Black Hills National Forest area. Specific conditions of the commercial and organized recreational event permits issued for the area would likely be affected by any of the alternatives as holders would be displaced from the Mine Area, but because those permits are issued for broader areas within the Black Hills National Forest; their overall operations may not be affected.

Land Special Use Permit

Land special uses which consist of communication towers and utility corridors on NFS lands, are not expected to be impacted by the project. Blasting activities from the Mineable Pit can be adjusted so as to not impact the communication towers and DOD's property on Warren Peak. Seismic monitors would be established on Warren Peak during blasting sequences to measure any ground vibrations and evaluate any disturbance to the towers and DOD's property (see Geology, Section 3.9).

Sheepnose Trailhead

This trailhead is outside of the Project Area, however, during construction and operation there would be an increase in noise, dust, and human presence in the area. The trailhead is a half mile east of the Project Area and not associated with the proposed access roads to the mine. The increase in noise (5 to 10 dB(A)) would be more noticeable during the construction of the WRF due to the proximity to the trailhead.

Reuter Campground/Trailhead and Sundance Trailhead/Horse Camp

During construction and operation there may be an increase in noise, dust, and human presence in the area near the campgrounds. Where the proposed mine access route is along Warren Peak (NFS Road 838) under Alternatives D, E, and F, an increase in mine related traffic may impact access to Reuter Campground and Trailhead. The proposed route would change to a graveled surface and could result in higher amounts of dust within the Reuter campground. The campground would not be physically disturbed, but the increase in traffic and noise may affect the experience.

The Sundance Horse Camp and Trailhead may be visually affected from the construction of the power line proposed in Alternatives D and F. None of the proposed access routes in any of the alternatives would affect the Sundance Horse Camp and Trailhead.

Mineral Withdrawal

The barbed wire fence around the Mine Area and a 12-foot road adjacent to the fence within the Mine Area would have approximately 3,100 feet of fence and maintenance road within the mineral withdrawal boundary. These activities would not result in any recovery of minerals within the withdrawal area and would only impact the surface resources of the land. The location of the fence in the mineral withdrawal area around the Mineable Pit area is in approximately the same position for all of the alternatives (the Mine Area fence footprint changes for each alternative, but the mine pit is the same for all alternatives). The fence would be constructed using wooden or steel posts that are driven into the ground about 3 feet on a spacing of approximately 4 to 5 feet. The fence serves to define the boundary of the active Mine Area, to restrict public access for safety reasons and to restrict permitted livestock movement.

Mine Pit – the construction of the mineable pit remains the same for all of the alternatives and is not likely to have any effect on the mineral withdrawal or the FS restrictive order. Seismic monitoring is proposed to determine how far the blasting activity associated with the mine construction would travel through the ground. As discussed in the geology section, blasting would be highly unlikely to have any impacts to the DOD property.

Reclamation

Public access would continue to be restricted and displaced until reclamation is complete. An increase in mine related traffic on NFS roads would continue during reclamation. After reclamation is stable and complete the area would return to FS management opportunities including recreation.

Recreation Opportunity Spectrum

Reclamation would restore the PUG Plant area and the portions of the WRF that are on NFS lands to the Roaded Natural ROS. Reclamation would also require the removal of the power line from NFS lands, thus restoring the ROS classification within the proposed location.

As described in Chapter 2, reclamation of the mine pit varies between alternatives. Alternative D and E both have proposals for sloping the constructed highwalls of the mine pit using a variable 3:1 slope that encroach into the mineral withdrawal to varying degrees. Alternative F mine pit reclamation includes components to address public safety as it relates to the constructed highwalls along Section 20 line. The analysis will focus on describing the pit reclamation impacts for only Alternatives D, E, and F as it relates to the mineral withdrawal.

Alternative C

Construction and Operation

The fenced Mine Area, 1,065 acres of NFS lands and 635 acres of private lands (1,700 acres total), would be closed to the public. Alternative C incorporates the most NFS lands within the fenced Mine Area compared to the other alternatives. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, and winter and summer trail activities.

Alternative C would have the greatest reduction of available public hunting when compared to the entire hunt area established by the WGFD; reducing Hunt Area 2 for deer by 0.1 percent, Hunt Area 116 for elk by 0.07 percent, and Hunt Area 1 for turkey by 0.04 percent. In terms of only the available NFS lands in the Hunt Area, restricting public access to the Mine Area would reduce the available NFS lands for hunting by 1.2 percent for Hunt Areas 2 and 116 and 0.6 percent for Hunt Area 1.

There would be 5.0 miles of open NFS roads (see Section 3.4.3.1) (**Figure 12**) that would not be accessible within the fenced Mine Area during construction and operations. There would be turn around areas constructed at the fence for NFS Roads 879.1 and 838.2A.

In addition to the direct loss of NFS roads available for motorized recreation, the experience of vehicle users traveling along the NFS roads that have views of the Mine Area would be changed. Views of the Mine Area would be modified from one characterized by a natural appearing setting to one characterized by increased development (see Aesthetics and Visuals, Section 3.5). Hunting, fishing, hiking and all other recreational uses would be precluded within the Mine Area.

The existing winter safety shelter and 2.5 miles of groomed snowmobile trail system would be eliminated on NFS lands within the Mine Area. Snowmobile trails D, E and F would have 0.3 miles on NFS lands (plus 1 mile on private lands), 0.6 miles and 2.2 miles respectively within the Mine Area. Overland reroutes are a design feature to ensure continued access along these trails except for Snowmobile Trails D and F which would not be rerouted. Winter sports enthusiasts would not have a restroom facility at the junction of NFS Roads 851 and 838 due to the location of the proposed fence; however, there is a restroom available 1 mile south of the junction at the Warren Peak Fire Tower. Where snowmobile Trail E and mine access route intersect, mining traffic could diminish user experience and discourage recreational users from the area. Any overlap of snowmobile trails and access roads would require rerouting.

Special Uses

Recreation event special uses would not be impacted under Alternative C since the proposed project does not involve any of the non-motorized trails. Winter special use permits would be impacted by the loss of trails, however, the permitted activity would be able to continue on other trails.

Mineral Withdrawal

The Mine Area fence would cross a portion of the withdrawn lands (see Figure 4) until reclamation is complete.

Reclamation

The 232 acre Mineable Pit would be permanently fenced to exclude public entry for safety. Reclamation under Alternative C would be concurrent with the 45 year mine life but there would be an additional 2 years for restoration. After reclamation is complete and deemed acceptable and safe by the permitting agencies, except for the mine pit that would be fenced, the Mine Area on NFS lands would be open to the public for recreational activities.

Alternative D

Construction and Operation

The fenced Mine Area, 860 acres on NFS lands and 634 acres of private land (total of 1,494 acres), would not be open to the public during construction and operation of the mine. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, fishing, and winter and summer trail activities.

Alternative D would reduce the available public hunting in the entire hunt area established by the WGFD; by 0.1 percent for Hunt Area 2, by 0.05 percent for Hunt Area 116, by 0.04 percent for Hunt Area 1. In terms of only the available NFS lands in the hunt areas, restricting public access to the Mine Area would reduce the available NFS lands hunting area by 1 percent for Hunt Areas 2 and 116 and 0.5 percent for Hunt Area 1.

There would be 1.6 miles of open NFS Roads, 851, 851.1B and 879.1 (see Section 3.4.3.1) that would not be accessible within the fenced Mine Area. Open NFS roads within the fenced Mine Area would be closed until reclamation is complete and the area is deemed safe for the public by permitting agencies (see Access and Transportation, Section 3.4). On NFS lands outside the Mine Area, public motorized travel would be retained on roads identified as suitable for public travel. Management activities on NFS lands outside the Mine Area would continue in accordance with Forest Plan direction.

Alternative D would result in additional mining traffic on the Warren Peak Road for approximately four miles. Warren Peak Road is a primary recreation access for the Bear Lodge Mountains. The increase in mine traffic on this portion of the Warren Peak Road may cause forest users to use other county, state and NFS roads to access the Bear Lodge Mountains for recreational opportunities.

Snowmobile Trail A and the main access route overlaps for approximately four miles. Snowmobile Trail D has 0.2 miles (plus 1 mile on private lands) and Snowmobile Trail F has 1.4 miles within the Mine Area, for a total of 1.6 miles on NFS lands. A total of 2.6 miles of snowmobile trails within the Mine Area (NFS and private lands) would be eliminated from public use until reclamation is complete. Design features address snowmobile opportunities outside of the Mine Area (fenced boundary) where they would be maintained, where appropriate. Where project activities, like access routes, impact snowmobile trails, over-the-snow re-routes would be identified except for Trail D which is a permanent loss.

Effects on the motorized trails, hunting, fishing, and dispersed camping are discussed in the Effects Common to All section.

Sundance Trails

The proposed power line corridor overlaps with the Sundance Trails 93A (Ogden Creek Trail) and 93I (Ogden Ridge Trail) for approximately 3 miles. Access for the power line maintenance would utilize the existing roads, NFS Road 839 along Trail 93A and NFS Road 899.1A along Trail 93I to the point of the ridge when the road no longer exists. New construction of a power line road would be required for about one mile.

The power line corridor along Trail 93A is currently an existing overhead power line that services Warren Peak communication towers and fire tower. NFS Road 899.1A is an administrative road closed to motorized public use, but would be suitable as a maintenance road for the power line. Construction of the new maintenance route from the NFS Road 899.1A to the private land would encroach on a semi-primitive non-motorized management area.

Impacts to these users depend on their personal desires for the experience. The road may improve the trail conditions by having a wider space to hike or horseback ride, while some users may prefer the narrow 2 foot width of a true trail experience. Some users may be disappointed with a power line and developed road in the viewshed, while others may not notice the development. Over time (six months to several years), vegetation would fill in the corridors and help to soften the new construction which may cause the corridors to blend in with the natural environment providing a more acceptable view of the landscape for users.

As the power line is constructed and vegetation cleared on the corridor, temporary closure of the effected trails may be necessary for public safety. Closure may be up to a year, depending on construction requirements. Motorized maintenance activities may be required annually to check vegetation growth on the power line. Future short-term (6 months) trail closures may be needed if line replacement is required. Users may also find a temporary closure by maintenance workers if a tree needs to be removed in a single location on the trail.

Guideline 9101 for Management Area 3.32 in the Forest Plan recommends prohibiting motorized road travel with the exception for administrative travel. The proposed power line maintenance road (NFS Road 899.1A) is an existing route that would require extending to private lands for about 1 mile. The power company would only use the road for administration, maintenance, and emergencies and keep it closed to public motorized use.

Guidelines 5101 and 5103 for Management Area 3.32 in the Forest Plan address the recreational impacts for this management area. By revegetating the corridors as soon as possible following construction, the disturbance to viewsheds would be minimal. Thus, the power line corridor and maintenance road would be compatible to the recreational experience of semi-primitive non-motorized.

Reuter Campground/Trailhead

Mine related traffic adjacent to the developed site would be higher for Alternative D than Alternative C. The Warren Peak Road, NFS Road 838, is the only access to this year-round developed campground and trailhead. Noise and fugitive dust would likely change the recreational experience and possibly visitor use. Winter recreational conflicts between motorized and non-motorized users may result at the trailhead if suitable snow trails cannot be relocated away from the mine access route.

Special Uses

Recreation event special uses that utilize the paved double land NFS road 838 (Warren Peak) would be impacted by increases in mine related traffic. With the proposal of the route to change to a graveled surface, additional fugitive dust would also be experienced by the two non-motorized recreation events. The design feature to control fugitive dust could reduce the impact during these one-day events. A graveled surface may create more wear and tear on road bikes during the MS bike ride event, which may choose to no longer offer the Warren Peak route as an alternative ride, but would not likely cancel the full event which utilizes the paved highways around the Bear Lodge Mountains.

Minimal impacts on recreational non-motorized special events using Trails 93A and 93I would be expected from construction and maintenance of the power line. Adjustments can be made to the recreational events to minimize disruption.

As compared to Alternative C, winter special use permits would be impacted more due to the access road overlapping with the main Snow Trail A. The Reuter Trailhead serves as the starting point for these events and if the trails cannot be relocated to suitable locations, these events may be lost.

Impacts to lands special uses are the same as Alternative C.

Mineral Withdrawal

A power line is proposed to cross the mineral withdrawal area. A portion of the power line corridor already exists within the mineral withdrawal area from the 1960s and is still is use today. The existing corridor may require some upgrades to ensure suitable power for the mine. About a half mile of new line installation would be needed from Warren Peak to the mine on the north end of the mineral withdrawal. Above-ground power line construction would require posts to be set in the ground to a depth of 5 feet. Since no recovery of minerals would be allowed with this activity, the impacts would only affect the surface resources of the land. Post-mining activities would require the power line associated with the mine to be removed and the land restored.

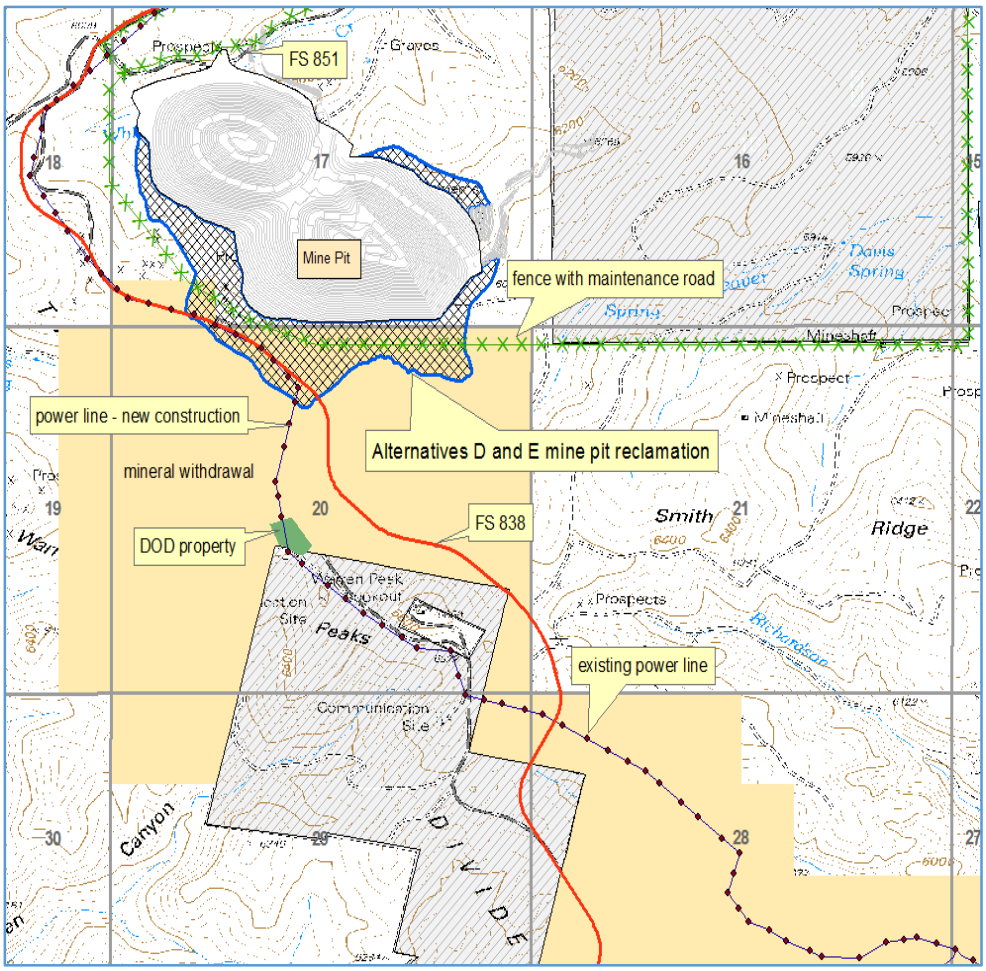
Alternative D proposes to reconstruct the access route in a different location to improve the safety for workers and reduce winter impacts on the road. The new road template would cross the mineral withdrawal for 2 miles and would be on 16 acres. To construct the road, fill and cut activities are expected. The old road template would not likely be removed since it is still needed for access to private land, communication towers and FS facilities. No recovery of minerals would be authorized with the construction of the new road.

The construction of the proposed access route and the proposed power line corridor would avoid direct disturbance to the PM-1 site. No potential impacts to this site were identified (see Section 3.9 Geology).

Reclamation

Once reclamation is complete, the Mineable Pit would be accessible to the public and NFS lands would be open for recreational activities. Turn-around points created at dead-end roads at the Mine Area fence may be removed if no longer needed. As the mineable pit is reclaimed, relocation of NFS Road 838 (0.4 miles) would be required to maintain access to the NFS lands.

Figure 36. Alternatives D and E Mine Pit Reclamation



Mineral Withdrawal

Due to the restrictive order preventing the use of explosives in Section 20 (**Figure 37**) only heavy equipment would be authorized for doing reclamation work in this area.

The bedrock in the layback area is composed of the identical rock types as are found within the Mineable Pit. These lithologies are deeply weathered and largely composed of disaggregated surficial materials. Most areas should be readily workable by earthmoving equipment without blasting, and the harder zones encountered left in place and contoured around as part of the natural landscape restoration scheme. This would incorporate geomorphologically-consistent appearing prominences and outcrop bands into the reclaimed landscape, and help eliminate artificial appearing and uniformly recontoured slopes from the final restoration product. Incursions into completely solid bedrock would thus be minimized to entirely avoided, and the process largely undertaken as a redistribution of surface materials.

The farthest most point of reclamation intruding into the withdraaln area is estimated at 1,165 feet from Section 20 line, leaving a distance of 2,085 feet (0.4 miles) between the edge of the reclamation and the DOD's property. The reclamation would require about 55 acres of withdrawal lands. The depth of the reclamation would be deepest at the section line at about 200 to 300 feet and decrease as the reclamation moves into Section 20.

Alternative E

Construction and Operation

The fenced Mine Area, 608 acres of NFS lands and 634 acres of private land (total of 1,243 acres) would not be open to the public. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, fishing, and winter and summer trail activities.

Alternative E would reduce the available public hunting in the entire hunt area established by the WGFD by 0.09 percent for Hunt Area 2 and by negligible amounts for Hunt Areas 116 and 1. Restricting public access to the Mine Area would reduce the available hunting area by 0.7 percent for Hunt Areas 2 and 116, and 0.4 percent for Hunt Area 1 on NFS lands.

There would be 1.4 miles of open NFS Roads 851.1B and 879.1 (see Section 3.4.3.1) that would not be accessible within the fenced Mine Area. Effects from additional mining traffic on the Warren Peak Road would be similar to Alternative D. On NFS lands outside the Mine Area, public motorized travel would be retained on roads identified as suitable for public travel. Management activities on NFS lands outside the Mine Area would continue in accordance with Forest Plan direction.

Under Alternative E the snowmobile safety shelter and restroom may remain in its current location. Design features address snowmobile opportunities outside of the Mine Area (fenced boundary) where they would be maintained, where appropriate. Where project activities impact snowmobile trails, over-the-snow re-routes would be identified. Only Snowmobile Trail D lies within the fenced Mine Area (0.2 miles on NFS lands and 1 mile on private lands) and would not be replaced. Snowmobile Trail F would remain open and usable under this alternative.

Effects on the motorized trails, hunting, fishing, and dispersed camping are discussed in the Effects Common to All section. Effects on Reuter campground and trailhead are discussed in Alternative D. Since there is no power line corridor in Alternative E, there would be no effects on non-motorized trails.

There would be less impact to the mineral withdrawal area as compared with Alternative D since the proposed access route would utilize the existing road template and there is no power line corridor. About 0.4 miles of NFS Road 830.1 lies within the mineral withdrawal that would be upgraded to a double lane road for mine related traffic involving about 3.2 acres.

Special Uses

Recreation event special uses are less impacted by Alternative E than Alternative D since there is no power line construction planned along any of the non-motorized trails. The snowmobile poker run and the MS bike ride are the only events that would be impacted as a result of the proposed access route utilizing FS 838.

Impacts to lands special uses are the same as Alternative C.

Reclamation

Once reclamation is complete, the Mineable Pit would be accessible and a pit lake may form. If the pit lake water quality is good enough, it may become a recreational feature that could be developed through future public involvement and decision making. Turn-around points created at dead-end roads at the Mine Area fence may be removed if no longer needed. Upon final closure of the Mineable Pit, NFS Road 838 (0.4 mile) would require relocation to maintain access with NFS lands.

Mineral Withdrawal

As with Alternative D, due to the restrictive order preventing the use of explosives in Section 20 only heavy equipment would be authorized for doing reclamation work in this area. Alternative E mine pit reclamation extends into Section 20 an additional 35 feet (farthest diostance is 1,200 feet) as compared with Alternative D and requires 57 acres of withdrawal lands to complete the reclamation (see Figure 6). The depth of the reclamation would be deepest at the section line at about 200 to 300 feet and decrease as the reclamation moves into Section 20.

Alternative F

Construction and Operation

The fenced Mine Area, 854 acres of NFS lands and 634 acres of private land (for a total of 1,488 acres) would not be open to the public. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, fishing, and winter and summer trail activities.

Alternative F would reduce the available public hunting in the entire hunt area established by the WGFD; by 0.1 percent for Hunt Area 2, by 0.05 percent for Hunt Area 116, and by 0.04 percent for Hunt Area 1.In terms of only the available NFS lands in the hunt areas, restricting public access to the Mine Area would reduce the available hunting area by 1 percent for Hunt Areas 2 and 116 and 0.5 percent for Hunt Area 1.

There would be 2.7 miles of open NFS Roads 851.1B, 879.1, and 879.1A (see Section 3.4.3.1) that would not be accessible within the fenced Mine Area. On NFS lands outside the Mine Area, public motorized travel would be retained on roads identified as suitable for public travel. Management activities on NFS lands outside the Mine Area would continue in accordance with Forest Plan direction.

Design features address snowmobile opportunities outside of the Mine Area (fenced boundary) where they would be maintained, where appropriate. Where project activities impact snowmobile trails, over-the-snow re-routes would be identified. Only Snowmobile Trail D (0.4 miles on NFS lands and 1 mile on private lands) falls within the fenced mine area and would not be replaced. Snowmobile Trail F would remain open and usable under this alternative.

Effects on the motorized trails, hunting, fishing, and dispersed camping are discussed in the Effects Common to All Action Alternatives. Effects on Reuter campground and trailhead are discussed in Alternative D. The effects on the mineral withdrawal are the same as Alternative E.

Sundance Trails

As with Alternative D, the proposed power line corridor creates the same impacts to non-motorized trails under Alternative F, except to different trails. In Alternative F the proposed power line corridor overlaps with the Sundance Trails 93K and 93L for approximately 2 miles. Access for the power line maintenance would utilize the existing road, NFS Road 858, which also serves as Trail 93K. Only about a half mile of Trail 93L follows the road, which then turns to the north before entering private property. As the road turns to the north (away from the trail), it would require vegetation clearing to function as a maintenance road for the power line. Another difference between Alternative D and F, is this power line corridor follows an existing road for

the entire length, while Alternative D would require construction of a maintenance road for about a mile. All other effects disclosed in Alternative D for the power line corridor would be the same for Alternative F, including the compatibility with Management Area 3.32.

Special Uses

Impacts to recreation event special uses are the same as Alternative D; only the individual trails are different. Recreation events that overlap with Trails 93K and 93L where the proposed power line would be constructed may be temporarily impacted. Adjustments can be made to the recreational events to minimize any disruption in the activity. Alternative F proposes to utilize the same access road as Alternatives D and E and would create the same impacts as described in those alternatives for recreation special events.

Under Alternative F, the construction of the proposed power line corridor would avoid direct disturbance to the snotel site located along NFS Road 858.

Mineral Withdrawal

The Mine Area fence would cross the mineral withdrawal (see **Figure 7**).

Reclamation

Once reclamation is complete, the Mineable Pit would be accessible and a pit lake would form due to less reduction of highwalls proposed. The pit lake would be slightly smaller than identified in Alternative C. The future opportunities of the pit lake would depend on the water quality. Additional public involvement and decision making with regards to future plans for the pit lake may occur at the time of mine closure. Turn-around points created at dead-end roads at the mine fence may be removed if no longer needed. No relocation of the NFS roads would be required at final closure of the Mineable Pit.

Mineral Withdrawal

Alternative F mine pit reclamation would reduce the highwalls using a variable 3:1 slope so long as the reduction does not enter the mineral withdrawal area. Therefore, the only impacts to the mineral withdrawal is the placement of rocks, signs or other barriers at the top of the highwall along Section 20 for public safety.

Alternative G

Construction and Operation

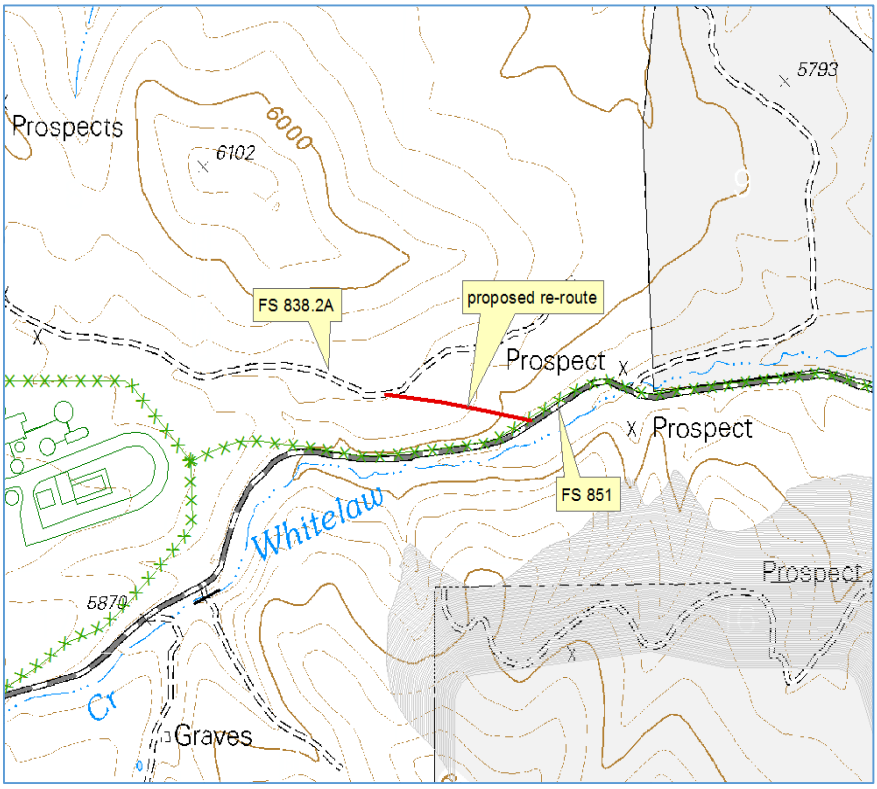
The fenced Mine Area, 864 acres of NFS lands and 634 acres of private land (total of 1,490 acres), would not be open to the public. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, fishing, and winter and summer trail activities.

Alternative G would reduce the available public hunting in the entire hunt area established by the WGFD; by 0.1 percent for Hunt Area 2, by 0.05 percent for Hunt Area 116, by 0.04 percent for Hunt Area 1. In terms of only the available NFS lands in the hunt areas, restricting public access to the Mine Area would reduce the available hunting area by 1 percent for Hunt Areas 2 and 116 and 0.5 percent for Hunt Area 1.

There would be 2.6 miles of open NFS Roads 851, 851.1B, 879.1 and 879.1A (see Section 3.4.3.1) that would not be accessible within the fenced Mine Area. On NFS lands outside the Mine Area public motorized travel would be retained on roads identified as suitable for public travel. Management activities on NFS lands outside the Mine Area would continue in accordance with Forest Plan direction. NFS Road 838.2A could be extended to provide flow-thru traffic around the mine (see **Figure 38**).

Design features address snowmobile opportunities outside of the Mine Area where they would be maintained, where appropriate. Where project activities impact snowmobile trails, over-the-snow re-routes would be identified. There is a total of 2.6 miles of snowmobile trails that would be within the fenced Mine Area on NFS lands. Snowmobile Trail A has about 0.5 miles, Trail D would have 0.2 miles (plus 1 mile on private

Figure 37. Alternative G Reroute of NFS Road 838.2A



lands), Trail E has about 0.6 miles, and Trail F would have 1.4 miles within the Mine Area. Trails A, E and F could be re-routed to avoid mine traffic and the Mine Area. Trail D and the bathroom at the junction of NFS Roads 851 and 838 would be a permanent loss. The warming shelter would also have to be relocated.

Special Uses

Impacts on special uses would be the same as Alternative C.

Mineral Withdrawal

The Mine Area fence would cross a portion of the withdrawn lands (see **Figure 8**) until reclamation is complete.

Reclamation

The period of reclamation and closure would take 32 years for reshaping plus 2 years for revegetation. Once reclamation is complete, recreational access would be restored on all NFS lands in the Mine Area. The upgrade and extension of NFS Road 838.2A would no longer be needed upon final reclamation and would be removed as the main NFS Road 851 is restored to thru traffic. Turn-around points created at dead-end roads at the mine fence may be removed if no longer needed.

Mineral Withdrawal

There would be no effect on the mineral withdrawal from reclamation of Alternative G

Alternative H

Construction and Operation

The fenced Mine Area, 743 acres of NFS lands and 634 acres of private land (total of 1,377 acres), would not be open to the public. The NFS lands outside the fenced Mine Area would continue to be managed for dispersed and developed recreational opportunities including camping, hunting, fishing, and winter and summer trail activities.

Alternative H would reduce the available public hunting in the entire hunt area established by the WGFD; by 0.1 percent for Hunt Area 2, by 0.05 percent for Hunt Area 116, by 0.04 percent for Hunt Area 1. In terms of only the available NFS lands in the hunt areas, restricting public access to the Mine Area would reduce the available hunting area by 1 percent for Hunt Areas 2 and 116 and 0.5 percent for Hunt Area 1.

There would be 2.4 miles of open NFS Roads 851, 851.1B, 879.1 and 879.1A (see Section 3.4.3.1) that would not be accessible within the fenced Mine Area. On NFS lands outside the Mine Area public motorized travel would be retained on roads identified as suitable for public travel. Management activities on NFS lands outside the Mine Area would continue in accordance with Forest Plan direction.

Design features address snowmobile opportunities outside of the Mine Area where they would be maintained, where appropriate. Where project activities impact snowmobile trails, over-the-snow re-routes would be identified. There is a total of 2.2 miles of snowmobile trails that would be within the fenced Mine Area on NFS lands. Snowmobile Trail D would have 0.2 miles (plus 1.0 mile on private lands) and Trail F would have 1.0 miles within the Mine Area. Trail F could be re-routed to avoid mine traffic and the Mine Area. Trail D and the bathroom at the junction of NFS Roads 851 and 838 would be a permanent loss. The warming shelter would also have to be relocated.

Special Uses

Impacts on special uses would be the same as Alternative C.

Mineral Withdrawal

The Mine Area fence would cross a portion of the withdrawn lands (see **Figure 8**) until reclamation is complete.

Reclamation

The period of reclamation and closure would take 12 years for reshaping plus 2 years for revegetation. Once reclamation is complete, recreational access would be restored on all NFS lands in the Mine Area. Turn-around points created at dead-end roads at the mine fence may be removed if no longer needed.

Mineral Withdrawal

There would be no effect on the mineral withdrawal from reclamation of Alternative H.

3.16.3.2 Cumulative Effects

The analysis area for cumulative effects on recreation is the NFS lands within the 5 mile radius area as described in Section 3.3; while the cumulative effects analysis area for land uses is the Project Area. Recreation opportunities in the cumulative analysis boundary include developed and dispersed opportunities on NFS lands, including Cook Lake recreation area that was closed for public safety in May 2014 for an active landslide. Dispersed recreational opportunities are available on state and BLM lands only if public access is provided, otherwise access to these lands must be obtained from surrounding landowners. Some private lands within the 5 mile cumulative boundary are available for public hunting through agreements with the state. Most private land is used for ranching, 2 contain commercial gravel pits, and others may include utility and pipeline corridors and communication towers.

Cumulative Effects of Alternative A

Cumulative effects would not occur under No Action, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Past and present timber harvesting, exploration, and development activities (such as the land exchange completed in 2013) have affected recreation by restricting or altering access for hunting or other recreational opportunities, and by changing an undisturbed viewshed to include disturbance. These effects may alter the user’s experience or cause recreationist to use alternative areas, thus increasing numbers of users in the alternative areas. Future timber harvesting would continue to affect access and the visual experience. Cumulative effects of restricted or altered access and an altered user’s experience may occur temporarily should exploration activities overlap with temporary closures caused by timber harvesting or campground closures. Cumulative effects of restricted or altered access, and an altered user’s experience would also occur throughout the 45 year life-of-mine, but would diminish as reclamation and closure occur. The degree to which the user’s experience may be altered would vary by alternative, but the overall cumulative effects of changes in access and user’s experience would be similar to all action alternatives.

There would not be any cumulative effects on land uses for the project. Current land uses would be monitored during project activities, and if necessary, modifications made to protect structures. Future land uses would be evaluated independent of this project to determine whether the activity would be suitable in relation to the proposed mine.

Cumulative Effects by Alternative

Alternative C would result in the greatest cumulative effect of restricted access and loss of recreational opportunities due to the permanent fence around the pit. This area would no longer be available for recreation including hunting or fishing in Whitelaw Creek. The Mineable Pit at post-closure is estimated to be 232 acres which accounts for about 0.3 percent of the NFS lands within the 65,000 acres of NFS lands within the cumulative boundary.

Alternatives D, E, and F would result in additional mining traffic on the Warren Peak Road. Cumulative effects on access would occur, in particular on users accessing the Reuter Campground and trailhead area. The increase in mine traffic on this portion of the Warren Peak Road may cause forest users to use other county, state, and NFS roads to access the Bear Lodge Mountains for recreational opportunities, thus changing use patterns and increasing pressure on other recreational areas.

Irretrievable and Irreversible Commitment of Resources

Irreversible and irretrievable impacts on recreation discussed in the effect above include the following:

- Loss of access and recreation opportunity on 232 acres due the permanent fence around the pit in Alternative C.
- Loss of 1.2 miles (plus 1 mile on private lands) of Snowmobile Trail D on NFS lands under all Alternatives.

3.17 Social and Economic Conditions

The social and economic impacts analysis considers the effects on populations, income, and employment, housing, education, health care, public safety services, government services, waste disposal, and government revenue (taxes). The costs of the alternatives are compared. Other aspects of the social environment are addressed under recreation, visual quality, public health, livestock grazing, and timber.

3.17.1 Analysis Area and Methods

For economic and social effects, the study area is defined as being within a commuting distance of approximately 60 miles or one hour's drive of the Project Area and has a labor force that would respond to job opportunities, and has housing resources that could accommodate a temporary, non-resident workforce (study area). This area includes communities in Crook, Weston, and Campbell counties in Wyoming and Lawrence and Butte counties in South Dakota (RER, 2014e). The area of analysis encompasses the communities that had populations of 1,000 or more in 2010 in Wyoming (Gillette, Sundance, Moorcroft, Newcastle and Upton, and in South Dakota (Belle Fourche, Deadwood, Lead, North Spearfish, Spearfish, and Whitewood).

The information was largely derived from the Socio-Economic study (RER, 2014e) and federal and state statistics available online. Cost of alternatives were developed based on information provided by the proponent and confirmed by the interdisciplinary team, or in some instances, estimated specifically using standard industry practices.

3.17.2 Affected Environment

Employment and Income

Since 2009, some of the local economies in the study area have recovered from the 2007 to 2009 recession, as indicated by total employment. Total employment measures a local economy's size by the number of full and part-time jobs at work places located in the county. Total employment for the five counties for 2013[9] compared to 2009 and the employee compensation per job (earnings and labor income) associated with total employment by place of work are shown in **Table 78.**

Table 78.
Wyoming and South Dakota Employment and Employee Compensation
2009 compared to 2013

County	Total Number Employees 2013	Percent change from 2009	Annual Earnings and labor Income
Wyoming		+2.6	$52,400
Campbell	32,234	-4.6	$70,500
Crook	4,455	+5.7	$49,100
Weston	5,258	+3.5	$49,400
South Dakota		+3.8	$48,300
Butte	5,151	+2.8	$38,000
Lawrence	15,975	-2.9	$38,500

(U.S. Bureau of Economic Analysis, 2014).

The county-level economies of the study area are small, and the local labor force is small in these counties. Labor force and unemployment measure how many local residents are active in working or seeking work and, among those, how many do not have jobs.

Campbell County, Wyoming, in 2013, average annual labor force statistics were 27,785 people employed with 1,070 unemployed (3.9 percent unemployment rate, down from 5.3 percent in 2009). Comparable statistics were 3,350 people employed and 161 unemployed (4.6 percent unemployment rate, down from 5.7 percent in 2009) in Crook County and 3,319 people employed and 142 unemployed (4.3 percent unemployment rate, down from 6.2 percent) in Weston County (U.S. Bureau of Labor Statistics, 2015). The average unemployment rate in Wyoming as a whole was 4.7 percent in 2013, down from 6.3 percent in 2009 (State of Wyoming, 2014).

In Butte County, South Dakota, in 2013, the average labor force was 5,050 people with 195 unemployed (3.9 percent unemployment rate, down from 5.1 percent in 2009). Comparable statistics for Lawrence County were 12,710 people employed with 500 unemployed (4.6 percent unemployment rate, up from 4.4 percent in 2009). The average unemployment rate in South Dakota as a whole was 3.8 percent in 2013 (U.S. Bureau of Labor Statistics, 2015).

Measured by median household income, the incomes of residents in the Wyoming part of the study area are relatively high, and those of residents in the South Dakota part of the study area are relatively low. Median household income in 2013 for counties in the study area shown in **Table 78** is listed as follows, with the county median expressed as a percentage of the statewide median.[10] In Wyoming, the 2013 median household income in Campbell County was $81,652 (140 percent of the statewide median of $54,424), in Crook County, it was $59,490 (102%), and in Weston County it was $59,314 (102 percent). In South Dakota, the 2013 median household income in Butte County was $41,413 (84 percent of the statewide median of $49,200) and in Lawrence County it was $42,867 (87 percent) (US Census, 2013b).

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[9] The data for 2013 were the most recent available from the Bureau of Economic Analysis in 2015 when this analysis was prepared.

[10] The median is a kind of average that is set at the value that divides a population in half. Unlike the mean the median is not easily raised or lowered by the presence of extreme values in the population.

Population and Housing

Populations in the Wyoming and South Dakota counties within the study area were evaluated for changes from 2000 to show the population trends **Table 79** and **Table 80**.

Population change since 2010 in the study area counties has been positive; however some communities have had less change. The total study area population in 2013 was about 97,700 compared to the 2010 Census population of about 94,600 (U.S. Census Bureau, 2015).

The study area possesses many lodging establishments and recreational vehicle (RV) campgrounds that provide temporary accommodations. These are important for housing a construction work force.

Table 79. 2010 Wyoming and South Dakota County Populations within the Study Area

Area	2010 Population	% Change per year from 2000 to 2010
Wyoming		
Campbell County	46,133	3.2
Crook County	7,083	1.9
Weston County	7,208	0.8
South Dakota		
Butte	10,100	1.1
Lawrence	24,097	1.0

Source: (RER, 2014e).

There are approximately 2,150 motel rooms and 560 RV sites in towns within the Wyoming part of the study area, with most of the lodging in Gillette and the RV facilities more or less evenly distributed around the study area (RER, 2014e).

Table 80. Wyoming and South Dakota Communities with Populations of About 1,000

Community	Population	% Change from 2000 to 2010 per year
Wyoming		1.3
Gillette (Campbell County)	29,087	4.0
Sundance (Crook County)	1,182	0.2
Moorcroft (Crook County)	1,009,	2.3
Newcastle (Weston County)	3,532	1.4
Upton (Weston County)	1,100	2.3
South Dakota		
Belle Fourche (Butte County)	5,594	2.1
Deadwood (Lawrence County)	1,270	-0.8
Lead (Lawrence County)	3,124	0.3
North Spearfish (Lawrence County)	2,221	-0.4
Spearfish (Lawrence County)	10,494	2.0
Whitewood (Lawrence County)	926	0.9

South Dakota also possesses lodging and campground resources. In Spearfish, South Dakota there are 10 lodging establishments and several campgrounds located near I-90.

Capacity at these locations adds up to about 520 rooms and 320 RV spaces (AAA, 2015) (Woodall's/AAA, 2014). The demand for lodging and campgrounds throughout the study area comes from tourists, business travelers, hunters, other recreational visitors, and temporary workers. Base demand for lodging in Sundance includes visitors to Devils Tower National Monument. Many establishments in Deadwood and Lead in South Dakota are associated with casinos. Lodging in the South Dakota part of the study area may be reserved in advance and sold out each year for about 10 days around the annual Sturgis (South Dakota) Motorcycle Rally held in early August. In the fall, hunting attracts visitors to the area.

Available housing for employees at the mine is adequate based on 2013 statistics for vacant, for sale or for rent units in the area (see **Table 81**).

The study area also possesses a housing construction industry that fluctuates with the economy and responds to changes in demand, such as the re-location of people taking new jobs for the long term. The number of single-family building permits issued per year in Campbell County ranged from 129 to 398 between 2004 and

Table 81. 2013 Available Housing Units in Study Area	
Location	**2013 Houses Available for Sale or Rent**
Wyoming	
Campbell County (including Gillette)	600
Weston County (including Upton, Newcastle)	70
Crook County (including Sundance, Moorcroft)	70
South Dakota	
Lawrence County (including Spearfish)	410
Butte County (including Belle Fourche	110
Total	1,260

(US Census, 2013a).

2008 and from 122 to 269 between 2009 and 2013. The number of single-family building permits issued per year between 2004 and 2013 ranged from 4 to 33 in Crook County and from 4 to 19 in Weston County.

The number of single-family building permits issued per year in Spearfish (Lawrence County), South Dakota, ranged from 42 to 150 between 2004 and 2013 (US Census, 2014).

Expectations for the long-term trend in housing demand in the Wyoming part of the study area are robust. A 2015 to 2020 period forecast projects a total demand for new housing of about 1,500 to 2,300 units in Campbell County; about 150 to 200 units in Crook County, and about 125 units in Weston County, with most new households in these counties buying instead of renting. The study also assumes a housing industry that is responsive to demand for new households (RER, 2014e). No similar study is available for South Dakota.

Public Services

Schools

The Crook School District (SD) #1, which serves all of Crook County, has elementary and secondary schools in Moorcroft, Sundance, and Hulett. Enrollment in the fall of the 2014-15 school year was 1,135, which is near the 2001 peak enrollment of 1,142 (Wyoming Department of Education, 2014), (RER, 2014e).

Weston School District #7 serves Upton and Weston School District #1 serves Newcastle with a total of seven schools. Enrollment in the fall of the 2014-15 school year was 1,038 county wide, with 254 in District #7 and 784 in District #1. Since 2001, enrollment has been as high as 869 in District #1 (in 2001) and as high as 291 in District #7 (in 2008) (Wyoming Department of Education, 2014), (RER, 2014e).

Campbell County serves the whole county with 21 schools. Fall 2014-15 enrollment was 9,134, which is the highest enrollment since 2001. Between 2001 and 2008, the district's enrollment ranged between about 7,200 and 8,000. Since then, enrollment has been above 8,000 and has risen (Wyoming Department of Education, 2014), (RER, 2014e).

A 2012 analysis showed eight of ten elementary schools over capacity in Campbell County (Wyoming School Facilities Department, 2013). Campbell County approved construction of a second high school in Gillette (Brown, 2015).

The Crook County School District has replaced an over-capacity elementary school in Moorcroft and there is an elementary school under construction in Sundance. The Weston School District #1 has a high priority for funding to add classrooms to an over-capacity elementary school in Newcastle (Wyoming School Facilities Department, 2014).

In South Dakota, the Spearfish School District operates five schools and had a total fall 2014-15 enrollment of about 2,200. The Spearfish School District totally renovated one elementary school in 2012-13 (Spearfish School District, 2014). The Lead-Deadwood School District operates four schools and had a total fall 2014-15 enrollment of 806 (South Dakota Department of Education, 2014). The Lead-Deadwood School District consolidated in 1971 and served more than 2,500 students in the 1970s (Lead-Deadwood School District, 2008).

Health Care, Public Safety, Fire, and Emergency Services

There are three hospitals in the Wyoming part of the study area: the Campbell County Memorial Hospital in Gillette, Crook County Medical Services District in Sundance, and Weston County Health Services in Newcastle. Crook and Weston counties in Wyoming and Butte County in South Dakota are designated as health professional shortage areas (Health Resources and Services Administration, 2014).

The number of sworn officers per 1,000 population in Wyoming counties in the study area in 2013 was 2.0 in Campbell County, 1.7 in Crook County, and 2.5 in Weston County, counting both county sheriff and local police personnel. Index crimes per officer in 2013 were 13.2 in Campbell County, 7.2 in Crook County, and 7.1 in Weston County. Statewide averages in Wyoming are 2.5 officers per 1,000 population and 9.6 index crimes per officer (State of Wyoming Office of the Attorney General, 2013). The City of Spearfish Police department has approximately 2 officers per 1,000 population (City of Spearfish, n.d.).

The Wyoming Office of Homeland Security has offices in Campbell, Crook, and Weston counties that coordinate planning and preparation between first response organizations in each county for community-wide emergency situations.

The Sundance Volunteer Fire Department (VFD) would provide first-response fire service to the Bull Hill Mine Area. The Crook County Fire Department would provide supplemental fire service.

Serious injuries at any project site or along the access route could be air evacuated via helicopter using Life Flight dispatched from the Wyoming Medical Center in Casper or Black Hills Life Flight, a private service based in Rapid City (RER, 2014e).

Other Government Services

The Wyoming Department of Family Services has offices in the county seats of Gillette (Campbell County), Newcastle (Weston County), and Sundance (Crook County). The South Dakota Department of Social Services has offices in the county seats of Belle Fourche (Butte County) and Deadwood (Lawrence County). Every municipality in the study area offers a range of community and outdoor recreation resources (RER, 2014e).

Two municipal water systems in the study area are at higher than 75 percent capacity utilization: Pine Haven and Newcastle. There appear to be no wastewater treatment system deficits in the study area (RER, 2014e).

Solid waste disposal capacity exists over a 20-year plan horizon at municipal solid waste pits (landfills) covered by the Northeastern Wyoming Planning Group, which covers Hulett, Moorcroft, Newcastle, Sundance, Upton, and the Central Weston County Solid Waste District; the Moorcroft and Upton landfills closest to the project have capacities projected to be sufficient through 2029. Campbell County solid waste disposal facilities near Gillette have capacity to 2027 (RER, 2014e).

Public Revenue

During construction, mineral development projects generate property tax revenue directly, sales and use tax revenue directly and indirectly, lodging tax revenue indirectly, and Wyoming impact assistance payments contingent upon the award by an agency of state government. During operations, mineral development projects generate property tax revenue and severance tax revenue directly and sales and use tax revenue directly and indirectly.

The total property tax levied in 2014 was about $14.9 million in Crook County and about $11.4 million in Weston County (State of Wyoming Department of Revenue, 2014). The property tax revenue predominantly funded schools, with a smaller share funding county-wide services and an even smaller share funding special district and municipal services. The proponent’s property in the Mine Area is taxed by the county for 640 industrial acres. In Crook County the 2015 value is $362,866, for property taxes of $2,566.40. The proponent’s equipment is valued in 2015 at $145,168.00, for property taxes of $1,025.

The total sales and use tax revenue received in fiscal 2014 in Wyoming counties, summed across the county and municipal levels of local government, was about $4.0 million in Crook County, about $3.0 million in Weston County, and about $111 million in Campbell County (State of Wyoming Department of Revenue, 2014).

The total lodging tax revenue received in fiscal 2014 in Wyoming counties was about $500,000 in Campbell County, about $63,000 in Crook County, and about $67,000 in Weston County. All of these revenues came from a county-wide lodging tax (State of Wyoming Department of Revenue, 2014). No municipality in these counties levied its own specific lodging tax. Since the Wyoming Department of Revenue accounts for the lodging tax as a type of sales tax, these amounts also comprise a small part of the total sales and use tax revenue amounts.

The total minerals severance tax revenue distributed in fiscal 2014 to all Wyoming cities, towns, and counties was about $20.4 million, which was about 2 percent of the Wyoming total severance tax revenue of about $1 billion. Local governments state wide receive a distribution of this amount each year that is generally in proportion to population (WY Stat § 39-14-801 [2014]).

Wyoming Statutes provide for counties that have a major construction project under the jurisdiction of the Wyoming Industrial Siting permitting process to receive extra revenue in direct proportion to any increase in their tax collections to help with the impact caused by the project. No study area counties received impact assistance transfers in fiscal year 2014 (State of Wyoming Department of Revenue, 2014).

In South Dakota, the city of Spearfish imposes both a 2 percent local sales tax and the 1 percent municipal gross receipts tax. The receipts in fiscal year 2014 were about $7.6 million (SDDOR, 2014).

Private Property

There are extensive private properties in rural areas outside of the forest boundary devoted mostly to haying operations associated with cattle production and to private timber sales.

There are 10 driveways including five residences within a ¼ mile buffer along the Miller Creek route. Highway 14 (Cleveland Road) is the main road through Sundance. It has both residences and businesses along it, but it is mostly residential. The Vista West Subdivision with an estimated 52 residences use a single driveway access onto Warren Peak Road.

In the town of Upton, Route 116 (Ash Street) and Highway16 are bounded by residences predominantly on the eastern side of Ash Street. From the Government Valley Road to Highway 116 is 2.75 miles. In Upton, the route passes 37 houses and 45 businesses, including the court house, a grocery store, three restaurants, two motels, two schools, and two churches. The majority of residences are concentrated in 2.13 miles. The remaining 0.62 miles has one residence, three commercial uses, and a church.

Quality of Life

Community attitudes in Sundance are the most relevant to assessing the quality of life effects of minerals development in the Black Hills National Forest nearby. The public file (Tetra Tech, Inc., 2014) includes a number of comments that indicate the range of values regarding the sense of place in Sundance and the range of attitudes in the community towards different types of development. The contrasting viewpoints presented here illustrate a range of attitudes. At the same time, even contrasting viewpoints may be held together within a community or community sub-group if there is ambivalence toward a community's image or an issue of community or economic development. There has been no formal study or measurement of community attitudes towards quality of life for this analysis.

As reflected in scoping comments, Sundance's quality as a place for some is closely related to the aesthetics and natural and recreational values found in the Black Hills National Forest. On the other hand, some community viewpoints regard Sundance as a place where the development of natural resources to be found in

the National Forest can provide employment opportunities "close to home" for the current labor force and future generations.

A community attitude toward development, also found in scoping comments, is that mining has a role in revitalizing and broadening the economy of the study area, providing direct and indirect economic and fiscal effects that promote social well-being. In contrast, there are comments in the scoping record that reflect an attitude toward mining that sees it as conflicting with a tourist-base type of economic development, one which capitalizes on the inherent attractiveness of Sundance as a western town and the promotion of its services to tourism and recreation.

Scoping comments also indicate that there is a range in the community's attitudes toward the environmental effects of mining. These go from broad concerns about water and air pollution to the potential for off-site effects to specific concerns about water and air resources and rural enterprises close to mining activities. A contrasting view in the community is that a mining enterprise can manage its environmental and land use effects on-and off-site.

Environmental Justice

By Presidential Executive Order 12898 a Federal agency must identify “disproportionately high and adverse human health or environment effects of its programs, policies, and activities on minority and low-income populations.”

The assessment begins with identifying any specific concentrations of minority and low-income persons who may reside in sub-areas of the study area. The analysis considers small sub-areas because the presence of identifiable minority and low-income populations may not show up in averages calculated for larger geographical or political entities, such as a county or municipality.

The screening for this analysis reviewed percentages for race, ethnicity, and income at the census tract level. For each category a "population" is defined as either 50 percent of the tract population or 10 percentage points higher than the county overall. The two minority categories are defined as persons of a non-white race and persons of Hispanic or Latino ethnicity. The low income category is defined as persons in poverty according to the Census Bureau standard. **Table 82** presents the percentages represented by these categories in the total population of the counties of the study area.

Table 82. Percentage of Non-White, Hispanic or Latino, and Poverty at the County Level

	Non-White Race	Hispanic or Latino of Any Race	Percent in Poverty
Campbell County, WY	7.9%	7.9%	7.7%
Crook County, WY	0.8%	2.4%	6.7%
Weston County, WY	5.2%	3.3%	11.2%
Butte County, SD	5.4%	3.2%	10.2%
Lawrence County, SD	6.4%	2.9%	14.4%

Source: (US Census, 2013a)

Compared to the 7.9 percent of the total population represented by Hispanic or Latino persons in Campbell County, Wyoming, the 19.6 percent of the total population represented by Hispanic or Latino persons in Census Tract 4 of Campbell County comprises a minority population that is about 12 percentage points higher than the county average. Census Tract 4 is inside the City of Gillette. It is the only tract in the study area with a minority or low-income population as defined for the environmental justice analysis.

3.17.3 Environmental Consequences

The primary activity with social and economic effects is the investment in the proposed project and its operations over time.

3.17.3.1 Direct and Indirect Effects

Alternative A – No Action

Under Alternative A- No Action, jobs associated with exploration and environmental studies would end as planned. Some additional contract and local employment would be required for reclamation work.

Effects Common to All Action Alternatives

Data and estimates from a socioeconomic impact analysis report was prepared (RER, 2014e). Additional data was collected for this analysis to update the information and to fill gaps related to the South Dakota part of the study area.

Some estimates have been changed because of changes to the Plan of Operations since the 2014 report was prepared. Section 2.2.1 describes how the alternatives development process has led to a modified Plan of Operations. Section 2.4.2 describes the modified Plan of Operations, which is included now as Alternative C. Other values have been re-estimated for this analysis after consideration of other available information.

Environmental Justice

There are no environmental consequences to disclose related to environmental justice under any of the alternatives. This determination is made in light of the fact that Census Tract 4 of Campbell County within the City of Gillette, 75 miles from the Mine Area and 49 miles from the Hydromet Plant. Effects would not be disproportionately high or adverse on this part of Gillette.

Operations

Employment and Income

Operations employment includes an exploration program that lasts for 10 years instead of the 35 years originally anticipated and included in the Bear Lodge Socioeconomic Impact Analysis (RER, 2014e). Other components of the operations stage of the project would be the same or not substantially different.

The Socioeconomic Impact Analysis (RER, 2014e) predicts about $14 million per year would be spent during the first 35 years of operations. As estimated for this analysis, spending would average about $14 million per year through year 9 while there is ongoing exploration, about $12 million per year in year 10 through year 34 after exploration is discontinued, and about $8 million per year through the end of operations in year 45. This equates to total spending of almost $500 million over 45 years for project operations at the Mine Area and Upton Hydromet Plant in Crook and Weston Counties.

It is expected that some income losses resulting from recreational activities may occur as individuals choose to no longer participate in activities in the area; however, the exact value cannot be determined due to personal choice. Loss revenues could result from commodities offered from communities or licenses issued by WGFD.

Direct operations employment would average about 145 jobs in Crook County and 55 jobs in Weston County through year 9, 115 jobs in Crook County and 50 jobs in Weston County from year 10 through year 34, and 55 jobs in Crook County and 50 jobs in Weston County from year 35 through year 45.[11]

The regional economic effect during operations equates to an annualized average of about 260 total jobs (direct jobs identified above, plus indirect jobs) and about $12 million total employee compensation through year 9, about 215 total jobs and about $10 million total employee compensation from year 10 through year 34,

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[11] Job estimates are rounded to the nearest five. Total annual average jobs include all full-time, part-time, and seasonal jobs for employees and self-employed workers. The number of total annual jobs is equal to the number of workers employed during a year multiplied by the portion of the year they are employed. For example, 36 workers employed for one month account for 3 annual jobs

and about 135 total jobs and about $6 million in total employee compensation from year 35 through year 45. Indirect jobs likely would be in the food services, wholesale and retail trade, real estate, truck transportation, building services, and health care industries. Employee compensation per indirect job would vary by occupation but on average would be similar to employee compensation for direct project operations jobs (RER, 2014e).

The impact to the economies of Crook and Weston Counties combined, measured in terms of the direct employment attributable to project operations would be about 2 percent to 3 percent as an annualized average over the entire project operation. The impact attributable to the economies of the study area as a whole (Campbell, Crook, and Weston Counties, Wyoming, and Butte and Lawrence Counties, South Dakota) measured in total employment attributable to project operations would be less than 1 percent. The employment and associated employee compensation effects are long-term and stable during project operations, assuming that the technical and market conditions occur as the proponent has presupposed in the Plan of Operations.

As with all industries, mining operates based on the economic feasibility of projects and is dependent on the value of the minerals produced, compared to the cost of production. Often, a mining company will decide that the operating costs outweigh the value of the minerals enough to temporarily suspend operations. These cycles may occur frequently or infrequently, and be short-term or long-term. At the time of this analysis, it is not possible to predict the cycles the rare earths market would face or whether, during the life of the project, there would be any temporary shutdown. If economic conditions were adverse enough, a mine may decide to close permanently. Shutdown or suspension[12] would reduce employment and income, depending on when and how long.

Population and Housing

Residents of Campbell, Crook, and Weston Counties, Wyoming would comprise about 80 percent of the operations work force. The local work force is assumed to include Butte and Lawrence Counties, South Dakota, because of their proximity and existing commuting patterns (RER, 2014e).

This analysis (RER, 2014e) assumes 90 percent of indirect jobs would likely be filled by study area residents and that the indirect jobs would not cause populations to change. Although this assumption reflects a possibility, some in-migration is more likely given the ongoing economic recovery and falling unemployment rate in the study area (RER, 2014e).

An estimated average of 45 people through year 9 and about 40 people through year 34 from outside the study area would take the total (direct and indirect) jobs created during project operations. These are assumed to be the number of households moving into the area. Based on the estimated average household size in Wyoming in 2013 (US Census, 2013a) a multiplier of 2.5 persons per household, the associated population increase would be about 100 to 120 on average during operations. This is an increase of less than 1 percent over the total population in 2013. If the entire population increase were to be concentrated in the towns of Sundance, Moorcroft, Upton, and Newcastle, this would be an increase of about two percent.

The estimated 40 to 45 households relocating to Crook and Weston Counties is compared to the 70 vacant houses available for sale or rent in 2013. The demand for 40 to 45 houses is about 4 percent of the estimated 2013 supply for the study area as a whole, including about 600 vacant units in Campbell County, Wyoming, and about 400 in Lawrence County, South Dakota. Over time, housing would likely be built in communities close to project facilities in Crook and Weston County. As noted in Section 3.17.2, as many as about 50 new housing units per year were permitted in Crook and Weston County from 2004 through 2013.

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[12] Design features described in under Reclamation (Section 2.7) provide measures to avoid adverse impacts from temporary shutdowns by requiring stabilization. Employees would be retained to conduct this work. Additionally, a bond will be in place to cover any reclamation costs, if needed.

A temporary or permanent shutdown could reduce the demand for housing and decrease the population if it lasted long enough for people to seek employment outside of the region.

Schools

Existing schools in Crook and Weston Counties accommodated a peak enrollment of around 2,300 in years past, and enrollment in fall of 2014 was 2,173. Current enrollment in Crook and Weston Counties indicates that schools would be able to accommodate an estimated 40 to 45 new students due to workers who would relocate to the study area. It is predicted that project construction jobs would last as long as 13 months but many would be short-term. The non-local construction work force would average 60 and range from 30 to 100, a temporary change of less than two percent compared to the population of communities in Crook and Weston Counties, Wyoming. On the assumption that non-local construction workers would not bring non-working family members with them to the study area, the effect of non-local construction workers to school enrollment would be even less (RER, 2014e).

Health Care, Public Safety, Fire, and Emergency Services

Traffic on public roads could require traffic control and accident response service from the range of public safety, fire, and emergency services providers. In addition, the population associated with the households of workers who move to the study area would have minor impacts on calls for service public safety, fire, and emergency services providers. The impact would be minor and in proportion to the change in population where new residents choose to live, which would be around 2 percent compared to population in communities in Crook and Weston Counties.

Emergency services systems would include training of employees in emergency response and first aid and stationing of equipment at the Mine Area and the Hydromet Plant. The emergency services systems implemented under the Emergency Release Response and Contingency Plan would help to offset potential impacts to local emergency services providers.

Non-local construction workers temporarily residing in the study area could seek emergency and urgent health care at the hospitals in Gillette, Sundance, and Newcastle or at urgent care facilities in Gillette. Construction related traffic could require traffic control and accident response service from the range of public safety, fire, and emergency services providers in the study area. Calls for service for local health and public safety providers could occur in community and county jurisdictions in proportion to the minor population and housing effect attributable to non-local construction workers temporarily residing in the study area.

Other Government Services

Demand for local government services, including social services, recreation facilities, general government and administrative services, water, sewer, and solid waste would increase in proportion to new population (around two percent).

Two municipal water systems are at higher than 75 percent capacity utilization and there appear to be no wastewater treatment system deficits, so water and wastewater capacity would be adequate for the minor impact to these systems, which would be in proportion to the potential population and housing impact of about 2 percent on average in communities of Crook and Weston Counties. It is estimated that the peak impact to a local water and sewer system from non-local construction workers could be about 10 percent compared to current demand but within the capacity the municipalities of Crook and Weston Counties that have lodging and RV campground accommodations for temporary residents.

The project would obtain water for the Hydromet Plant from the Town of Upton. The Mine Area would obtain water on-site. Employment at the Hydromet Plant would be a minor impact to the Town of Upton wastewater system, roughly equivalent to a 5 percent increase in the current service population. Direct project demand for public water, wastewater, and solid waste services all would be within the capacity of the respective service providers (RER, 2014e).

Public Revenue

Severance Tax

An average of about $590,000 per year in Wyoming severance tax revenue would be generated during operations assuming the 2 percent rate for "other miscellaneous minerals" in current law (RER, 2014e). In turn, about 2 percent of the predicted, average annual severance tax revenue could be distributed each year to cities, towns, and counties state wide, based on data from 2014 presented in Section 3.17.2 Public Revenue. The annual distribution of the local government share is generally in proportion to population.

A temporary or permanent shutdown would reduce the severance tax paid during the years if reduce mineral production occurs.

Local Property Tax

Local property taxes directly related to the Bear Lodge Project are the tax on physical plant and equipment and the Wyoming gross products tax, which comes from local property tax rates assessed on the value of minerals extracted. The assessed valuation of private property (land and taxes) would change as operations advance. All plant production will be assessed by the state of Wyoming. The County Assessor would add the valuation to the tax roll and calculate the assessment. The value of the minerals for the gross products tax is the same as for the severance tax.

Sales and Use Tax

The Bear Lodge Project would generate about $20,000 to $25,000 in property taxes during construction in Crook County and Weston County, assuming 2014 mill levies. About 30 percent of the revenue in Crook County and about 40 percent of the revenue in Weston County would fund the respective county governments and special districts (RER, 2014e). These amounts of property tax revenue generated by the project during construction are less than 1/4 percent when compared to the totals of $14.9 million in property revenue in Crook County and $11.4 million in Weston County levied in 2014.

The Bear Lodge Project would generate about $1.4 million in sales and use tax revenue to the state of Wyoming during construction, about $70,000 to Campbell County, about $100,000 to Crook County, and about to $200,000 for Weston County. The project would generate a total of about $50,000 in lodging tax revenue to Campbell, Crook, and Weston Counties combined (RER, 2014e).

Some taxable spending would occur in the South Dakota parts of the study area, including the City of Spearfish, which imposes a local sales and gross receipts taxes. The amount generated for Spearfish from these taxes on the spending of non-local construction workers for the 13 months of construction who reside in South Dakota likely would be negligible.

Project spending is predicted to generate an annual average in sales tax revenue of about $600,000 to the state, about $50,000 to Campbell County, about $25,000 to Crook County, and about $90,000 to Weston County (RER, 2014e). A shutdown would reduce these revenues if one occurs.

Impact Assistance Funds

The award of impact assistance payments to local governments for unmitigated impacts is possible under Wyoming statutes covering industrial siting (Wyoming Statutes 35-12), the sales tax (Wyoming Statutes 39-15), the use tax (Wyoming Statutes 39-16), and recent amendments to the statutes (State of Wyoming, 2015). The determination of eligibility for impact assistance is made by the Wyoming Industrial Siting Council according to these laws.

Quality of Life

Sundance is the community most relevant to an assessment of the quality of life effects of the Bear Lodge Project.

The employment effects of the Bear Lodge Project near Sundance and in nearby Upton would engage those with a view of Sundance as a place where natural resources can be developed to create jobs employing community residents and eventually the next generation. A related attitude would see the Bear Lodge Project as adding diversity to the Sundance economy and supporting social institutions. If no environmental incidents occur over the life of the Bear Lodge Project, a view would be confirmed that exists for some that mining can be managed, reinforcing their acceptance of the project.

In contrast, some in the Sundance community may find it difficult to adjust to the disturbance created by the Bear Lodge Project on NFS lands. Those who see Sundance as a western town focused on recreation and tourism may perceive any project-related activity or personal presence as an undesirable change. Among those whose land uses are in rural settings around Sundance, closer to the mine, and perhaps abutting the access and haul route, there may be an uncomfortable sensitivity to traffic, noise, dust, and other perceived changes in the environment.

Alternative C – Modified Plan of Operations

Construction

Employment and Income

The proponent would spend about $71 million during construction over 13 months. The direct construction workforce is high for most of the time, ranging from 180 to 240 total workers employed on the access road, Mine Area and Hydromet Plant jobs for 10 months out of 13 months (RER, 2014e). The average number of direct construction jobs per month by job site is about 30 jobs for the access road (roughly 15 percent), about 60 (roughly 30 percent) for the Mine Area, and about 85 (roughly 55 percent) for the Hydromet Plant (RER, 2014e).

The regional economic effect during construction equates to an annualized average (12-month basis) of 292 total jobs (including direct and indirect jobs) and about $19 million total employee compensation.[13] Indirect jobs are predicted to be about one-third of the total. Indirect jobs likely would occur in the construction, food services, wholesale and retail trade, truck transportation, and automotive services industries. Employee compensation per indirect job would be about 25 percent lower on average than employee compensation for direct project construction jobs (RER, 2014e).[14]

The impact on the economies of Crook and Weston Counties, combined, from direct employment attributable to project construction would be about 3 percent, as an annualized average. The impact attributable to the economies of the study area as a whole (Campbell, Crook, and Weston Counties, Wyoming, and Butte and Lawrence Counties, South Dakota) from total employment attributable to project construction would be less than 1 percent as an annualized average. The employment and associated employee compensation effects of

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[13] For this analysis, it has been assumed that both direct and indirect labor income would mostly be paid out by businesses as employee compensation, which equates to the labor cost of employers located in the study area. Labor income by definition comprises both employee compensation (also called earnings) and proprietor's income, the latter being payments received by self-employed individuals and unincorporated business owners. Employee compensation includes the wages and salaries paid to employees by an employer, plus the supplements to wages and salaries paid to private and government institutions by employers as employee benefits. In 2013, Wyoming wages and salaries were 66% of employee compensation and wage and salary jobs were 76% of total employment; South Dakota wages and salaries were 58% of employee compensation and wage and salary jobs were 76% of total employment. In the study area from 60 to 70 percent of labor costs are paid out by employers as wages and salaries as opposed to payments for benefits. The percentage depends on the varying character and location of jobs.

[14] For this analysis the term "indirect jobs" includes all of the employment multiplier effects of direct project spending and employment.

project construction would be short-term and they would vary because of turnover during different phases of construction (RER, 2014e).

Private Property

Under Alternative C, there are 10 driveways, with 5 residences within about a quarter mile of the access and haul route to the Mine Area near the Town of Sundance. The access and haul route to the Hydromet Plant follows Ash Street (Route 116) in Upton, which is bounded by residences that are predominantly on the east side of the road. The access and haul routes that would be used for operations and closure under Alternative C are the same as for construction. Use of these routes by project traffic would end after project closure and reclamation are complete.

Closure

Employment and Income

Project closure would occur from year 46 through year 48 under Alternative C. Estimated closure costs are about $10 million at the Mine Area and as much as $9 million at the Hydromet Plant. Beginning in year 46, direct employment associated with closure would be about 70 jobs per year (RER, 2014e).

The earnings associated with jobs during closure would likely be similar on average per job to earnings for running the equipment fleet during construction and mining (Golder Associates, 2014d). However, no estimate is made of earnings for jobs associated with closure.

Direct spending and employment for project closure would likely stimulate secondary employment and income in the study area. No estimate is made of the secondary employment and income, which would occur perhaps 50 years in the future.

The employment and income changes after complete closure and reclamation would likely occur as the reverse of change from project operations. The changes would be about the same in magnitude as described under operations but reversed. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Population and Housing

Population and housing effects would occur from year 46 through year 48 under Alternative C. Population in local communities could change due to employees and households leaving Crook and Weston counties. Population change could affect the housing market as well, creating vacancies in the absence of other demand for housing.

The population and housing changes after complete closure and reclamation would likely occur as the reverse of project operations with the same magnitude, though housing stock stimulated by the project likely would remain. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Schools

Effects to school enrollment would occur from year 46 through year 48 under Alternative C if there is population change in local communities due to employees and households leaving Crook and Weston counties. The changes to school enrollment after complete closure and reclamation would likely occur as the reverse of change from project operations. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Health Care, Public Safety, Fire, and Emergency Services

Effects to health care, public safety, fire, and emergency services would occur from year 46 through year 48 under Alternative C if there is population change in local communities due to employees and households leaving Crook and Weston Counties. The changes to these services after complete closure and reclamation would likely occur as the reverse of change from project operations. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Other Government Services

Effects to other government services would occur from year 46 through year 48 under Alternative C if there is population change in local communities due to employees and households leaving Crook and Weston Counties. The changes to these services after complete closure and reclamation would likely occur as the reverse of change from project operations. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Taxes and Impact Assistance

Effects to public revenue would occur from year 46 through year 48 under Alternative C as minerals extraction ceases, project assets are dismantled and removed, and if there is population change in local communities due to employees and households leaving Crook and Weston Counties. The changes to public revenue after complete closure and reclamation would likely occur as the reverse of change from project operations. The impact, relative to the economic and social background 50 years in the future, may be less if growth continues in the study area for other reasons or more if other sources of growth and change do not materialize.

Private Property

The most studied effect of traffic to private residential property is the potential negative effect on value due to traffic noise (Bateman, 2001; Hughes, 1992; Nelson, 2008; Swoboda, 2015; Wilhelmsson, 2000). Such an effect is possible without estimating it. The potential for such an effect exists where access routes go through areas with houses adjacent to the road. The traffic attributable to the project on the access and haul routes is described in Sections 3.4.3.

Quality of Life

Though far in the future and unlikely to be seen for a generation or two, current anticipation of change to the landscape after project closure and reclamation under Alternative C could affect acceptance of the Bear Lodge Project among some in the community. The post mining pit configuration and permanent closure under Alternative C could disaffect those whose sense is of Sundance as a place predominantly connected to forest esthetics, agriculture, habitat, and recreation.

Alternative D

Construction

Employment and Income

The effect to employment and income for construction under Alternative D would be the same as for Alternative C except that the Mine Area access road would follow the Warren Peak Road route. Under Alternative D access road construction would cost about 30 percent less than under Alternative C. This equates to an estimated total cost of about $6.0 million for access road construction under Alternative D, including about $1.4 million in labor cost, and an annual average of about 20 jobs during access road construction under Alternative D (annual average of 160 to 220 workers) compared to about 30 under Alternative C. Less spending on access road construction would also mean commensurately less indirect

employment generated at study area businesses under Alternative D compared to Alternative C. The proponent would spend about $65 million during construction over 13 months.

Private Property

Under Alternative D, the haul route would still pass the residences near the Town of Sundance and in Upton, so the impacts to property are the same as under Alternative C.

Closure

Employment and Income

Under Alternative D project closure would include the additional activity of partial backfilling of the pit to eliminate the pit lake and of reducing the slope of exposed walls. The estimated cost of the additional pit closure activity under Alternative D would be about $165 million over a period of about 18 years beginning in year 45 of the project. The additional pit closure activity would be followed by two years to reclaim the pit and Mine Area, which would be the same as under Alternative C.

Additional pit closure activity under Alternative D that would not occur under Alternative C would equate to an average cost of about $9.2 million per year for 18 years, about 50 to 55 direct jobs per year, and about $2.0 to $2.5 million per year in direct employee compensation. The additional pit closure activity would sustain about 15 to 20 indirect jobs in the study area for 18 years under Alternative D that would not be sustained under Alternative C.

Population and Housing, Public Services, Other Government Services, and Public Revenue

Similar to Alternative C, there would be a lowering of population and demand for housing, public services, and other government services; and of public revenue from year 46 through year 48 under Alternative D. The effect would be just about half of what it would be under Alternative C, and it would mostly occur in Weston County as jobs are retained for 18 more years for the alternative pit closure activity in Crook County. The rest of the effects sustained by the project would occur after complete closure and reclamation at the Mine Area.

These impacts, expressed in relation to the total economy and social background that might be encountered 50 to 70 years in the future, may be different from what they would be when they are compared to recent levels of the study area's economic and social characteristics. The impact of closure decades in the future might be lower if growth continues in the study area or it might be the same or higher if growth does not occur or growth recedes, as sometimes has happened to small, resource-dependent economies in the past.

All of the effects of closure under Alternative D would be similar to the effects that would occur under Alternatives E and F because the project spending on the alternative closure activity, the duration of the alternative activity, and the employment and income effects would be similar.

Quality of Life

Reduced pit slopes and allowance of post-closure access for wildlife and the public could promote more acceptance of the Bear Lodge Project among those in the community similar to Alternatives E, F, and H.

Alternative E

Construction and Operation

Employment and Income

The effect to employment and income for construction under Alternative E would be the same as for Alternative D except that the Mine Area access road would follow the NFS Roads 879.1 and 830.1. Under Alternative E access road construction would cost 35 to 40 percent less than under Alternative C. This equates to an estimated total cost of about $5 million for access road construction under Alternative E, including about $1.2 million in labor cost and an annual average of 20 jobs during access road construction under Alternative E (annual average of 160 to 220 workers) compared to 33 under Alternative C. Less spending on

access road construction would also mean commensurately less indirect employment generated at study area businesses under Alternative D compared to Alternative C. The proponent would spend about $66 million during construction over 13 months.

Private Property

Under Alternative E, the haul route would still pass the residences near the Town of Sundance and in Upton, so the impacts to property are the same as under Alternative C.

Closure

Employment and Income

Under Alternative E, project closure would include the additional activity of reducing the slope of exposed pit walls to permit public access to the pit lake; this would be at an estimated cost of about $177 million over a period of about 18 years beginning in year 45 of the project. The pit closure activity under Alternative E would be followed by two years to reclaim the pit and Mine Area, which would be the same as under Alternative C.

Additional pit closure activity under Alternative E that would not occur under Alternative C would equate to an average cost of about $9.9 million per year for 18 years, about 55 to 60 jobs per year, and about $2.0 to $2.5 million per year in labor cost. The additional pit closure activity would sustain about 15 to 20 indirect jobs in the study area for 18 years under Alternative E that would not be sustained under Alternative C.

Population and Housing, Public Services, Other Government Services, and Public Revenue

A lowering of population; of demand for housing, public services, and other government services; and of public revenue would occur from year 46 through year 48 under Alternative E as it would under Alternative C. The effect would be just about half of what it would be under Alternative C, and it would mostly occur in Weston County as jobs are retained for 18 more years for the alternative pit closure activity in Crook County. The rest of the effects sustained by the project would occur after complete closure and reclamation at the Mine Area.

These impacts, expressed in relation to the total economy and social background that might be encountered 50 to 70 years in the future, may be different from what they would be when they are compared to recent levels of the study area's economic and social characteristics. The impact of closure decades in the future might be lower if growth continues in the study area or it might be the same or higher if growth does not occur or growth recedes, as sometimes has happened to small, resource-dependent economies in the past.

All of the effects of closure under Alternative E would be similar to the effects that would occur under Alternatives D and F because the project spending on the alternative closure activity, the duration of the alternative activity, and the employment and income effects would be similar.

Quality of Life

Reduced pit slopes and allowance of post-closure access for wildlife and the public could promote more acceptance of the Bear Lodge Project among those in the community similar to Alternatives D, F, and H.

Alternative F

Construction and Operation

Employment and Income

The effect to employment and income for construction under Alternative F would be the same as for Alternative C however the access route would follow the one proposed in Alternative E (annual average of 160 to 220 workers). The proponent would spend about $65 million during construction over 13 months.

Private Property

Under Alternative F, the haul route would still pass the residences near the Town of Sundance and in Upton, so the impacts to property are the same as under Alternative E.

Closure

Employment and Income

Under Alternative F, project closure would include the additional activity of exposed slope reduction above the pit lake at an estimated cost of about $106 million over a period of about 15 years beginning in year 45 of the project. The pit closure activity under Alternative F would be followed by two years to reclaim the pit and Mine Area, which would be the same as under Alternative C.

Additional pit closure activity under Alternative F that would not occur under Alternative C would equate to an average cost of about $9.0 million per year for 12 years, about 50 to 55 jobs per year, and about $2.0 to $2.5 million per year in labor cost. The additional pit closure activity would sustain about 15 to 20 indirect jobs in the study area for 12 years under Alternative F that would not be sustained under Alternative C.

Population and Housing, Public Services, Other Government Services, and Public Revenue

A lowering of population; of demand for housing, public services, and other government services; and of public revenue would occur from year 46 through year 48 under Alternative F as it would under Alternative C. The effect would be just about half of what it would be under Alternative C, and it would mostly occur in Weston County as jobs are retained for 12 more years for the alternative pit closure activity in Crook County. The rest of the effects sustained by the project would occur after complete closure and reclamation at the Mine Area.

These impacts, expressed in relation to the total economy and social background that might be encountered 50 to 70 years in the future, may be different from what they would be when they are compared to recent levels of the study area's economic and social characteristics. The impact of closure decades in the future might be lower if growth continues in the study area or it might be the same or higher if growth does not occur or growth recedes, as sometimes has happened to small, resource-dependent economies in the past.

All of the effects of closure under Alternative F would be similar to the effects that would occur under Alternatives D and E because the project spending on the alternative closure activity, the duration of the alternative activity, and the employment and income effects would be similar.

Quality of Life

Reduced pit slopes and allowance of post-closure access for wildlife and the public could promote more acceptance of the Bear Lodge Project among those in the community similar to Alternatives D, E, and H.

Alternative G

Construction

Employment and Income

The effects to employment and income for construction under Alternative G are the same as for Alternative C except: 1) installation of an under-liner system and cap on the WRF, and 2) backfilling the pit with waste rock and capping it with an impermeable liner at closure.

The effects to employment and income for operations under Alternative G are the same as for Alternative C.

The effects to employment and income for closure under Alternative G differ from Alternative C because the pit would be backfilled completely and capped and the remaining WRF would be capped.

Alternative G has been analyzed by extrapolating changes to employment and income in proportion to similar activities under Alternative C.

Access road construction activity under Alternative G would cost about 20 percent less than the access road under Alternative C because of the narrower easement. This equates to an estimated total cost of $6.7 million for access road construction under Alternative G, including about $1.5 million in labor cost, down from $8.4 million under Alternative C. This could mean 26 jobs as an annual average attributable to the different access road if the activity is spread over the 13 month construction period instead of 33 jobs, as estimated under Alternative C. Less spending on access road construction would have a small, short-term effect and stimulate a little less indirect employment among businesses in the study area.

The construction of an under-liner for the WRF under Alternative G would cost an estimated $37 million dollars. This would raise total spending on construction to about $106 million (net of the lower cost for the access road), which is an increase of about 49 percent in construction costs over the $71 million under Alternative C. Assuming proportionality, this equates to about 93 more direct jobs (annual average 270 to 333 workers) under Alternative G than under Alternative C and $3.6 million more in direct labor income. The additional jobs would be at the Mine Area in Crook County.

Under Alternative G, there would be 50 more indirect jobs and about $2.6 million in indirect employee compensation generated in the study area compared to Alternative C.

The net annual average impact to total employment in Crook and Weston Counties during construction would be about 4 percent under Alternative G, compared to 3 percent under Alternative C. The net annual average impact to total employment in the Wyoming and South Dakota study area as whole would be less than 1 percent under Alternative G than under Alternative C.

Public Revenue

About $30,000 in property taxes would be generated during the construction phase in Crook County under Alternative G because of lining the WRF; this is instead of about $20,000 under Alternative C. This amount of property tax revenue generated by the project during construction would be about 1/4 percent when compared to the totals of $14.9 million in property revenue in Crook County in 2014. Property taxes in Weston County would be the same as Alternative C.

About $2.1 million in sales and use tax revenue to the state of Wyoming would be generated during construction under Alternative G, compared to $1.4 million under Alternative C. The project would generate about $150,000 to Crook County under Alternative G compared to $100,000 under Alternative C for Crook County.

Other sales and use and lodging taxes would be about the same as Alternative C elsewhere in the study area under Alternative G.

Private Property

Under Alternative G, the haul route would still pass residences near the Town of Sundance and in Upton, so the impacts to property are the same as under Alternative C.

Reclamation/Closure

Under Alternative G, the effects to employment and income to close and reclaim the Hydromet Plant would be the same as Alternative C.

However, under Alternative G closure of the Mine Area would include the additional activity (**Table 83**) of backfilling the pit and installing an impermeable cap at an estimated cost of $381 million over a period of about 32 years. Pit backfilling would be followed by two years to reclaim the Mineable Pit and Mine Area.

Pit backfilling and capping the WRF would raise total spending on closure and reclamation to $391 million, assuming the higher estimate of $9.4 million for closure of the Hydromet Plant. Under Alternative G, the total cost of project closure would be about 20 times the cost under Alternative C and would take about 12 times as long.

Average annual employment and income during closure and reclamation under Alternative G would be the same as under Alternative C for the first two years. Pit backfilling, installing caps on the WRF and Mineable Pit and site reclamation in the final 32 years would average annual employment of about 40 to 45 jobs at the Mine Area.

Table 83. Additional Cost of Reclamation and Mitigation Activities in Alternative G

Reclamation/Mitigation Activity	Cost of Activity[1, 2, 3]
Under-liner on WRF	$39 Million
Cap on WRF	$6.2 Million
Backfilling the Mineable Pit to original topography	$365.9 Million
Cap on backfilled Mineable Pit	$15.3 Million
Total	$426.4 Million

Sources:
1 (Tetra Tech, Inc., 2015b)
2 (Golder Associates, 2014d)
3 (Tetra Tech, Inc., 2015c)

Population and Housing

Under Alternative G closure and reclamation at the Mine Area would include the additional activity of backfilling the pit. Average annual employment of 40 to 45 jobs at the Mine Area would be extended for 32 years, so about half the out-migration of population and lowering of housing demand would occur when most mining activity is discontinued and the rest would occur after the pit is backfilled and the Mine Area is finally reclaimed.

Public Services and Other Government Services

Closure and reclamation under Alternative G would result in a demand for services commensurate with 40 to 45 jobs being retained at the Mine Area in Crook County for an additional 32 years past the closure date anticipated under Alternative C.

Quality of Life

Two features of Alternative G (the WRF liner and cap and the pit backfill) may promote more acceptance of the Bear Lodge Project among those in the community with concerns that environmental risk of the project will detract from the quality of life in and around Sundance by minimizing exposure of waste rock to water (and subsequent contamination), reducing the size of the WRF and resulting visual impacts, and returning Bull Hill to more of its pre-mining condition.

Alternative H

Construction

Employment and Income

Access road construction activity under Alternative H would cost about 20 percent less than the access road under Alternative C because of the narrower easement. This equates to an estimated total cost of $6.7 million for access road construction under Alternative H, including about $1.5 million in labor cost, down from $8.4 million under Alternative C. This could mean 26 jobs as an annual average attributable to the different access road if the activity is spread over the 13 month construction period instead of 33 jobs, as estimated under Alternative C. Less spending on access road construction would have a small, short-term effect and stimulate a little less indirect employment among businesses in the study area.

Private Property

Under Alternative H, the haul route would still pass residences near the Town of Sundance and in Upton, so the impacts to property are the same as under Alternative C.

Closure

Employment and Income

Under Alternative H, project closure would include the additional activity of exposed slope reduction above the pit lake on a portion of the pit at an estimated cost of about $106 million over a period of about 12 years beginning in year 45. The pit closure activity under Alternative H would be followed by two years to reclaim the pit and Mine Area, which would be the same as under Alternative C.

Additional pit closure activity under Alternative H that would not occur under Alternative C would equate to an average cost of about $9.0 million per year for 12 years, about 50 to 55 jobs per year, and about $2.0 to $2.5 million per year in labor cost. The additional pit closure activity would sustain about 15 to 20 indirect jobs in the study area for 12 years under Alternative H that would not be sustained under Alternative C.

Quality of Life

Effects on quality of life would be similar to Alternatives E and F.

3.17.3.2 Cumulative Effects

The cumulative analysis area for economic and social effects is the same as the direct and indirect effects study area.

Alternative A – No Action

Cumulative effects would not occur under Alternative A, as there would be no direct or indirect effects. The Plan of Operations would not be approved.

Cumulative Effects Common to All Action Alternatives

Social and economic factors have been and continue to be beneficially affected by timber harvesting and exploration and minerals development activities, commercial developments, WDOT road improvements, recreational opportunities, and special use permits. These activities have provided employment opportunities, generated revenue, supplied resources, and improved public access. Other than the Upton Regional Development Park, these activities have been relatively small and resulted in minor, short-term improvements in economic and social factors. There have been minimal impacts to public services, as these past and present projects have not resulted in a major population increase. Cumulative effects to economic and social factors would be minor.

3.17.3.3 Irretrievable and Irreversible Consequences

No irretrievable or irreversible impacts on social and economic conditions were identified for any alternative.

3.18 Health and Safety

The health and safety issues discussed here are primarily related to exposure to radioactive and non-radioactive hazardous materials via airborne, waterborne and direct contact exposure pathways. Both mine worker and general public exposures to such hazardous materials are considered here.

Mine worker occupational safety is governed by the Mine Safety and Health Administration (MSHA), and by the Occupational Safety and Health Administration (OSHA). Transportation of product materials, after processing at the Hydromet Plant, would be regulated by the US Department of Transportation under 49 CFR 173.

Impacts from traffic on safety are addressed in Access and Transportation (Section 3.4.3). The Public Health section incorporates the analysis of the impacts on Air Quality Section 3.6.3 and Water Section 3.10.2.

3.18.1 Analysis Area and Methods

The area of analysis is the Project Area which includes the fenced Mine Area, the exploration boundary, the combined 80-foot easement on the Miller Creek Road, 66-foot easement on all other access roads, and 30-foot right-of-way on all of the power line routes and the WDEQ Permit boundary.

The exposure assessment estimates the type, timing and magnitude of receptor (humans, wildlife, or livestock) exposures to chemicals of concern (COCs). These include:

- Characterization of the site setting
- Identification of potentially exposed receptors
- Identification and evaluation of potentially complete pathways that may result in exposures
- Assessment of inhalation and ingestion intakes using either measured or predicted chemical concentrations, or via qualitative evaluation if concentrations are not available

3.18.2 Affected Environment

An exposure pathway is complete when there is transport to a location at which uptake by a human, wildlife or livestock receptor may occur. For an exposure pathway to be complete, all of the following elements must be present:

- a contaminant source and mechanism for contaminant release
- an environmental transport medium
- an exposure route
- an exposure location

The ore to be mined contains uranium and thorium, naturally radioactive materials which were present when the planet was formed. These materials, and their naturally occurring radioactive decay products which are also present, are the radioactive contaminant source. The nonradiological potentially hazardous contaminants include aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, and the rare earths.

Potential exposure routes include air (released particulates), and water (particulates and dissolved materials). There is also a potential for direct exposure to gamma radiation, from the ore and waste rock. This exposure pathway only occurs at relatively short distances from the source material (it is only measureable, with sensitive instruments, at distances up to 100 feet, but can produce radiation exposures over long periods (days or weeks) for workers or others near the sources.

Potential receptors include nearby members of the public, facility workers, and more remote members of the public along the ore haul roads, and wildlife and livestock. Although air and water may transport materials to exposure locations at greater distances, concentrations at those distances are expected to be too low to measure, and would not represent significant risks.

Contaminant Source

All media at the site could contain both nonradioactive constituents and radioactive materials. Risks to workers, members of the public, wildlife, and livestock from exposure to these materials are directly related to the concentrations of these materials at the exposure locations. In general, risks at locations remote from a source are too low to measure. Risks at closer locations depend on factors including air or water dispersion of particulates or dissolved materials, shielding (materials that absorb gamma radiation before it can interact with animal tissue) and other factors. For radioactive materials, risk is related to the radiation dose which can be measured. This risk is controlled by setting dose limits for members of the public (very low limits) and for

radiation workers (higher limits, but still well below the doses known to cause any health effects). For nonradioactive hazardous materials, allowable human exposure limits are material-specific (each toxicant has its own specific limits, often also specific to the chemical form in which it is occurring). Risk for nonradioactive toxicants can also be very dependent on total dose to individuals, making the process more complex. Health effects may be linked to exposures to any of these constituents, depending on exposure concentration and duration.

One way to evaluate risks associated with such materials is by comparison to state or federal standards for human or environmental quality. For example, of the 86 samples collected from Bull Hill Mine seeps and springs, 27 showed one or more exceedances of the Wyoming water quality standards. Surface water from the site that re-emerges as springs does not appear to pose a health hazard to humans, wildlife, or livestock: contaminant levels are below the tap water risk-based screening levels (with the exception of manganese in one sample) (RER, 2014a).

Mineralized area baseline radiological monitoring of air, soil, and water indicated that "the mineralized areas exhibit higher levels of radioactivity due to near surface expressions of naturally occurring radioactive material" (RER, 2014a). The Plan of Operations also states that, on average, radon levels measured are within the range of reported worldwide ambient background radon concentrations and particulate radionuclide concentrations in air are consistently low.

Exposure Locations

NFS lands are managed for multiple uses, therefore recreationists, wildlife, and livestock may be near the mine site for short periods. The nearest longer-term human receptor location would be a regularly-used campsite adjacent to the fenced Mine Area near the proposed PUG Plant. In addition, several permanent residences occur along the proposed haul routes. The campsite location is assumed to exhibit the highest contaminant exposure scenario for a potentially complete pathway. For the purpose of estimating maximum exposure and risk associated with mine operations, a receptor was assumed to exist at the boundary of the Mine Area, where exposure to wind and dust generated during operations could occur.

3.18.3 Environmental Consequences

Environmental Transportation Medium

Contaminant transport from the Mine Area may occur by air dispersion or by water transport through surface seeps, groundwater movement or runoff.

Exposure Routes

Exposure of humans, wildlife, or livestock to transported contaminants may occur through inhalation of airborne particulates, dust particles settling to surface soil that is then directly contacted, use of groundwater that has been impacted by seepage, contact with surface water that has been impacted by seepage or runoff, or direct contact with waste rock. Exposure to radioactive materials may also occur through direct exposure to gamma radiation. There may be locations outside of the controlled Mine Area that would be potentially subject to airborne/waterborne releases from the proposed project.

3.18.3.1 Direct and Indirect

Alternative A

Under Alternative A- No Action, the previously completed environmental assessment (US Forest Service, 2009a) for the approved exploration did not identify any added or increased risks of exposure that may occur as part of the ongoing reclamation. If no new surface disturbance occurs, no additional dust or waste would be generated. Short-term dust exposure potential may be created during road use, with some, likely very minor, potential for contaminant release. Surface and ground water would not be affected; no risks above background would be associated with use of seeps/springs or wells. No changes to concentrations of metals or

radionuclides in soil along existing roadways would occur. All risks from exposure to radionuclides and metals would remain at current levels.

If the mine is not developed, human health risks from exposure to radionuclides and metals would remain at current, near-background levels in air, soil, and water. This exposure potential would diminish with time, especially as these relatively small exposure sources from past exploration activities would be covered as part of the No Action alternative. As no additional surface disturbance would occur, no additional ore, waste rock or particulate material would be exposed/generated. Without these exposure pathways, no significant risk above background would occur.

Effects Common to All Action Alternatives

Exploration

No impacts on public health are expected from exploration activities under any alternative.

Construction

Public safety that may be affected by increased traffic is discussed in Section 3.4.3.

Construction risks including accident potential would likely be similar to risks associated with other large construction projects that include blasting.

Activities would include:

- Work at the pit, PUG Plant, sediment storage ponds, dewatering pond;
- Power line construction from Sundance or other access point;
- Development of access roads, secondary roads and the haul road; and
- Development of the WRF.

Operations

Exposures

Radiation exposure rates at test excavations on Bull Hill, and at the small ore piles created at the Bull Hill site for test purposes, have been observed to cause gamma radiation fields indicating a potential need for worker radiation protection. Workers health and safety would be protected by the dose limits specified by OSHA regulations 29 CFR 1910.1026 or any limits set by MSHA.

Potential risks to workers and wildlife would exist from exposure to contaminated dust generated by blasting, excavator mining and mine haul trucks, and as wind-driven dust from ore and waste rock piles. The PUG Plant process of crushing, grinding, and screening ore is also a potential source of contaminated dust. Ore, waste rock and pre-concentrate represent gamma radiation exposure potential to workers. The Pug Plant area would be secured by a fence, access-controlled by a staffed security gate. The presence of this fence would restrict potential direct exposures to PUG materials by members of the public, wildlife, and livestock. Therefore, such direct exposures at the PUG Plant would be negligible.

Members of the public and livestock would be excluded from the Mine Area during operations by a wire fence. The presence of this fence would restrict potential direct exposures to ore and waste rock by members of the public and livestock. Public and livestock direct exposures would be negligible during operations.

The area surrounding the proposed Mine Area is currently used for recreation and grazing. Exposures could occur via air (airborne particulates or radon and radon decay progeny) and after airborne particle deposition. There would also be potential for measurable gamma radiation exposure to members of the public standing just outside the fence. Air, water, and radiation monitoring would be conducted (see Section **2.9**). Concentrations in soil outside the Mine Area from airborne particles depositing to soils would increase over

time, but would be relatively low. Initial soil measurements can be compared to measurements taken during operations to determine whether significant build-up occurs during operations.

Meat from beef, sheep, or wild game would not likely contain significant concentrations of radioactive or hazardous elements, because of the limited amount of time spent grazing in the area of an active mine as well as the dilution in air-dispersed particulates. It is not expected that meat ingestion from beef, sheep, or wild game would be a significant exposure pathway. Biota concentration guides from the Department of Energy indicate that up to 2,000 pCi/g of Th-232 or U-238 in soil, or 50,000 pCi/L and 40,000 pCi/L of U-238, are not significant in this context (US Department of Energy, 2002). Such levels are in fact higher than those found in the ore bodies; air dispersed particulate concentrations in soil would not approach these levels. Surface water that passes through the Mine Area would be redirected to eliminate surface or spring water potential exposure pathways to livestock or wildlife (Whitetail 02).

Dispersion and deposition of dust from transportation of pre-concentrate between the PUG Plant and the Hydromet Plant would be minimized by covering the transport trucks. However, it is likely that some particulate matter from each load could be released and; some would settle on or near the roads. Over time, these releases would accumulate. Therefore, the truck transport pathways that can be considered complete are; inhalation of particulates released during haul truck transport, incidental ingestion of soil, dermal contact with soil, and resuspension of haul truck releases.

Small amounts of dust may be transported out of the Mine Area creating exposures for the public, wildlife, and livestock. Truck transport of pre-concentrate also presents potential dust exposure to residents, the public, wildlife, and livestock along the haul road and the highway. Gamma radiation exposure to nearby residents and others from truck transport would be expected to be negligible, probably too low to measure. Transport truck dust generation could be minimized by pre-cleaning of vehicles, scanning of vehicles upon exit from the site, and tight covering of haul loads to prevent ore release during transport. Regardless, road-side soils would be monitored for releases during transport, and the most-highly-exposed residence(s) would be monitored for air particulate exposures (see Section 2.9.1).

Radiation Dose Evaluation

A radiation dose assessment was completed for workers (ERG, 2014) and for members of the public (RER, 2014a), and used here to estimate project impacts. The dose assessment for members of the public assumed two exposure pathways: residential exposure to dust generated during operations and radon/progeny exposures. The worker dose assessment did not consider radon exposures. Depending on NRC decisions concerning potential licensing requirements for the Upton facility and the PUG Plant, determination of worker dose from radon and its decay progeny may be necessary. The following tables, discussions and conclusions are based on the provided dose assessments.

Table 84 summarizes the thorium and uranium content of the Bull Hill ore and the PUG Plant pre-concentrate (fenced from access to the public), as used in the evaluation of potential dose to workers (ERG, 2014). The pre-concentrate meets the definition of source material 10 CFR 20.1003[15], therefore, an NRC license would be required for operations there. The rest of the mine operations would be regulated by OSHA or MSHA for worker safety.

The following potentially complete pathways to members of the public were evaluated in the dose assessment (RER, 2014a):

- Internal dose from particulate inhalation - exposure to dust created during blasting or processing of ore
- Inhalation of radon (radon-222 and radon-220) and their decay products

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[15] Source material: (1) Uranium, thorium or any combination of uranium and thorium in any physical or chemical form; or (2) Ores; that contain, by weight, one-twentieth of 1 percent (0.05 percent), or more, of uranium, thorium, or any combination of uranium and thorium (per 10 CFR §20.1003).

Table 84.
Thorium and Uranium Content in Ore and PUG Plant Pre-Concentrate

Process	Material	Thorium Content (wt%)	Uranium Content (wt%)	Total Radionuclide (wt%)	Concentration in mg/kg	
					Thorium	Uranium
Bull Hill Mine	High Grade Oxide Ore	0.036	0.01	0.046	3.6	1
	OXCA ore	0.11	0.008	0.118	11	0.8
	Oxide stockwork	--	--			
	Low grade ore	--	--			
PUG	Waste Rock	0.005	0.001	0.006	0.5	0.1
	Pre-concentrate	0.21	0.016	0.226	21	1.6

Source: (RER, 2014a), Appendix F
OXCA - oxide carbonate
WT% - weight percent

The AERMOD environmental transport modeling system[16] was used to estimate doses to members of the public associated with proposed operations in the Mine Area (RER, 2014a). Based on the model it was determined that external radiation dose from the mine and PUG areas were not likely to be an important pathway to members of the public, because gamma radiation external dose is inversely related to distance from the source. The public would not have access to operational areas during mine operations, so this exposure pathway was not evaluated. Direct gamma radiation exposure from related sources, including dust generated during mining, processing or truck transport, would be minimal since the total mass of such material deposited in soils outside of the Mine Area would be small compared to naturally occurring uranium and thorium in such soil. Based on regulatory limits, ingestion of dust containing thorium and uranium was not considered to be potentially significant, due to the insoluble nature of the chemical forms known to be present. The dose assessment did not address exposures that may occur post-closure, and did not evaluate exposures associated with particulate matter potentially released during transport of the pre-concentrate. Such exposures would be insignificant, given engineering controls in effect during operations and after closure (RER, 2014a).

The sources of Mine Area dust and radon that were modeled using the AERMOD code were: 1) the Bull Hill mine and ores, and 2) the low grade ore stockpile. Each source was assigned dust and radon emission rates in the model, based on generally accepted values, and known concentrations of uranium and thorium in the ore, as presented in **Table 85**. The dose assessment did not include evaluation of emissions from PUG Plant stacks or mine overburden; emissions from those sources are anticipated to be minimal (RER, 2014a).

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[16] As described in Appendix F of the RER Plan of Operations (RER 2014a): AERMOD is a steady-state plume model that incorporates air dispersion calculations based on planetary boundary layer turbulence structures, scaling concepts including treatment of surface and elevated sources, and both simple and complex terrain approximations. The RER assessment used BREEZE AERMOD Version 7.6 air dispersion modeling software, which couples the AERMOD computer code to a user-friendly graphical interface.

Table 85. Thorium-232 and Uranium-238 Concentrations in Ore and Low Grade Ore Stockpile				
Material	**Th-232 concentration (pCi/g) (a)**	**U-238 Concentration (pCi/g) (a)**	**Notes from RER Appendix F, Table 4.1**	**Maximum Thorium/Uranium Concentrations, mg/kg (b)**
Bull Hill Ore	55	41	Natural thorium weight % adopted at 0.05% to represent cutoff for source material. Uranium content based on Tables 8.1 and 8.2 in RER 2012.	240.9 / 103.3
Low Grade Ore Stockpile	5.5	7.1	From mass balance process flow sheet.	73.9 / 81.8

(a) Per Table 4.1, Appendix F, RER 2014.
(b) From ore and waste rock concentrations in Tables 5a and 5b of (Golder Associates, 2014e). (Thorium in ore = 2190 mg/kg in Whitetail ore; Thorium in low grade ore = 672 mg/kg, Bull Hill ore, iron-manganese oxide); (Uranium in ore = 313 mg/kg Whitetail Sulfide Zone; Uranium in low grade ore = 248 mg/kg, Bull Hill ore, iron-manganese oxide).

Dust emissions from blasting, truck loading, equipment operations and Mine Area haul vehicle traffic, using the uranium and thorium concentrations from **Table 85,** were calculated following EPA methods (USEPA, 1995) (RER, 2014a). Radon emissions were similarly calculated. Results are summarized in **Table 86**.

Table 86. Particulate and Radon Emissions: Bull Hill Mine and the Low Grade Ore Stockpile					
Source Name	**Emissions Activity**	**Dust Emission Rate (kg/yr)**	**Modeled Dust Emission (g/m^2-sec)**	**Radon-220 Emission (g/m^2-sec)**	**Radon-222 Emission (g/m^2-sec)**
Bull Hill Mine Open Pit	Blasting	3,627			
	Truck Loading	323,400			
	Dozer Operations	28,080			
	Hauling	3.75E6			
	TOTAL	4.1E6	1.36E-4	3.83E-17	3.47E-16
Low Grade Ore Stockpile		12,565 (a)	1.36E-6	3.83E-19	1.84E-17

Source: (RER, 2014a) Appendix F
(a) Estimated for this table, using surface area data provided by RER

Annual radiation dose estimates during facility operation are presented in **Table 87**.

Doses from the low grade ore stockpile in the Mine Area were calculated by assuming that dust emissions would be 10 percent of those calculated for the Upton tailings pile (NRC, 1987), resulting in an emissions rate of roughly 13,000 kg/yr. These dose estimates do not consider dust emissions from the WRF, which, using the same assumptions as above, would produce emissions of 33,000 kg/year per acre, assuming a wind speed of 5.1 m/sec. However, waste rock radionuclide concentrations would be significantly lower than the Bull Hill ore and low-grade ore values used in the assessment of public dose. The modeled dose to a member of the general public, calculated after including WRF emissions, would be at least somewhat higher than the **Table 87** values. Information is not available to determine the estimated dose increase, which would be very small.

Table 87. General Public Radiation Dose Estimates						
Area	**Radiation Dose Estimate (mrem/yr)**			**Average % Contribution**		
	Mean	**Median**	**Maximum**	**Dust**	**Rn-220**	**Rn-222**
Mine	0.92	0.52	15.8	84.6	0.65	14.8
Low Grade Ore Stockpile	0.14	0.02	66.4	0.50	92.1	7.42
Total Bear Lodge Mine	1.06	0.52	82.1	73.3	12.9	13.8
NRC Public Dose Limit			100			

Source: (RER, 2014a), Appendix F

Reclamation/Closure

Exposure conditions in the post-closure phase of the mine for most alternatives include:

- Cessation of many of the dust-generating activities;
- Covering of the waste rock and low grade ore stock pile;
- Return of seeps and springs to their natural flow pattern, but with residual potential impacts from covered pile leachate;
- Removal of control fencing, allowing access to any residual contamination.

The cessation of major dust generating activities would reduce impacts from inhalation of particulates, although some resuspension potential would remain. Seeps and springs could be affected by leachate from the WRF, and humans and other receptors could be exposed to affected water (see Section 3.10.2). WRF seepage water quality estimates were developed (Golder Associates, 2014f) and used to select constituents of concern for the post-closure surface water exposure scenarios. These concentrations, adjusted for the uncertainty (Golder Associates, 2015a), were used to estimate conservative (upper-level) water concentration estimates, which were then compared to Wyoming water quality standards (WDEQ, 2015b).

Fluoride, molybdenum, and radium were selected as COCs because the predicted upper-level values exceed the surface water quality standards (**Table 88**). Aluminum, antimony, arsenic, beryllium, boron, cadmium,

Table 88. Water Quality of WRF Seepage and Contaminants of Concern					
Analyte	**Maximum Reported (mg/L)**	**Average of all depths (mg/L)**	**Uncertainty related to max (log)**	**Estimated Concentration (mg/L)**	**WY surface water standard (mg/L)[1]**
Fluoride	2	2	1.0	20	2
Molybdenum	0.09	0.06	0.9	0.71	0.01[2]
Radium (pCi/L)	3	2	0.6	11.94	5

Source: (Golder Associates, 2014f)
1Wyoming Water Quality Standards 2015.
2 Human-health based standard for tap water (USEPA, 2015). No surface water quality standard available.

cerium, chromium, cobalt, copper, erbium, europium, lanthanum, lead, lithium, manganese, mercury, neodymium, nickel, praseodymium, samarium, selenium, silver, thorium, vanadium, yttrium, and zinc were either not detected in short- or long-term leach testing of waste rock (below screening levels) or were below the water quality standard (Golder Associates, 2014f).

Seepage water quality concentrations (adjusted by selecting the higher values in the uncertainty ranges) do not account for dilution in the shallow groundwater to which they are released.

Alternative C

Construction and Operations

Construction of Alternative C would be similar to those under Effects Common to All Alternatives.

Reclamation

Alternative C includes the formation of a pit lake. This lake would be closed off with a permanent fence to prevent access by the public or wildlife.

Pit Lake

Estimated water quality of the pit lake has been evaluated (Golder Associates, 2014g). Contaminants of concern were identified similar to that discussed above. Upper-level concentration estimates were calculated using the predicted concentrations plus an uncertainty value (Golder Associates, 2015a) and compared to Wyoming water quality standards (WDEQ, 2015b), or to regional screening levels (USEPA, 2015) for residential drinking water, when a Wyoming water quality standard for a contaminant of concern (**Table 89**)

Table 89. Pit Lake Quality

Analyte (mg/l except as shown) (1)	Pit Lake Water Quality (mg/L)			Adjusted for Uncertainty (2)	Site-Specific Wyoming Water Standards[5]
	Bull Hill Pit	Whitetail Pit	Mixed	Max of Range	mg/L
Fluoride	0.8	2	1.6	12.6	2(4)
Aluminum	0.6	9	5	56.8	5
Antimony	0.004	0.009	0.007	0.057	0.0078(3)
Arsenic	0.003	0.009	0.006	0.071	0.2
Boron	0.3	0.5	0.4	3.97	5
Cobalt	0.009	0.01	0.01	0.079	1
Lead	0.004	0.0007	0.003	0.016	0.1
Manganese	0.2	0.1	0.2	0.63	1.462(4)
Molybdenum	0.02	0.04	0.03	0.32	0.1 (3)
Selenium	0.005	0.009	0.007	0.057	0.05
Vanadium	0.02	0.03	0.03	0.19	0.1
Radionuclide					
Radium (pCi/L)<0.07		<0.07	<0.07	146.2	

Source: (Golder Associates, 2014g).

(1) pH, alkalinity, and TDS are reported in (Golder Associates, 2014g), but are not listed here as they do not impact human health.

(2) Maximum of range adjusted for uncertainty = maximum value from concentration ranges provided in Golder 2014b, adjusted for the uncertainty provided in the same document by adding one uncertainty factor.

(3) USEPA Regional Screening Level for Tap Water for molybdenum and antimony in the absence of Wyoming groundwater or surface water standards (WDEQ 2015). These are to screen for potential health effects only and are not enforceable water quality standards.

(4) Surface water standard used as no groundwater standard was issued for the project. For fluoride, the human health standard is 1.2 mg/L for soluble fluoride (USEPA 2015).

(5) Wyoming Water Quality Standards 2015

was not available. Fluoride, aluminum, antimony, arsenic, cobalt, selenium, vanadium, and radium-226 were identified as contaminants of concern, using these upper-level estimated concentrations. Boron, lead, and manganese estimated concentrations were below the screening levels. Based on the comparison of estimated pit lake concentrations (adjusted for uncertainty) to the site-specific Wyoming quality standards (or EPA

screening values for tap water where Wyoming values were not available), it appears that fluoride, aluminum, antimony, manganese, molybdenum, selenium, and vanadium could exceed standards. These analytes are considered noncarcinogenic to humans and each may have different effects; however, the more that an analyte exceeds a concentration, the more likely it is for an effect to occur. Wildlife and livestock would be affected differently than humans, particularly aquatic organisms.

Drinking water standards are assumed to be protective of fish, wildlife, and livestock. Radium-228 and thorium were not detected in the test cells (Golder Associates, 2014b). Uranium concentrations were below Wyoming water quality standards and therefore would not affect human health. Iron is above the standard, but does not pose a human health concern. Beryllium, cadmium, chromium, mercury and thorium were not detected in either short- or long-term leach testing of waste rock and were not evaluated further (Golder Associates, 2014g) and would not have health effects.

It is possible that illegal trespass of the pit lake could occur and create a physical hazard if someone were to fall into the lake and not be able to exit due to steep slopes. A portion of the pit will have a slope of 1:52 to 1, which a person could climb, if they can get to it. The Mine Area fence, signs, berms, and rocks should discourage trespass.

Alternative D

Construction and Operations

Construction of Alternative D would result in effects similar to those noted above under Effects Common to All Alternatives.

Reclamation

Alternative D would also include removal of the pit lake during the closure process. Human or wildlife potential exposures associated with pit lake water seepage would no longer be present. Although pit access would be possible, ore or waste rock used for backfill would not be exposed or accessible for direct contact, because it would be covered with topsoil (at least 2 feet). There would be no increased risk to humans, from contact, direct radiation, or exposure to suspended particulates.

Disturbance created by closure of the pit in this alternative would involve additional dust generating activity as compared to Alternative C, as the pit wall would be sloped (involving additional blasting and other related dust-generating activities). Additionally, some portion of the waste rock pile would be used to backfill the pit above the static water level. The blasting and activities to regrade the slopes, and movement of the waste rock to backfill the pit, would generate airborne particulate material, containing concentrations of radionuclides and metals as tabulated in the Static Testing Report (Golder Associates, 2014c). This action prolongs the period that inhalation of airborne particulates may be a complete pathway to humans. Annual emissions associated with these activities have not been estimated, but would be lower than those estimated for the facility's operational period. Airborne particulate and gamma radiation exposures to members of the public accessing the pit area after final closure would be determined by the pit cover design, and could be similar to current, pre-mining conditions.

Alternative E

Construction and Operations

Operationally, both Alternatives D and E propose a modified access route to the Mine Area (as compared to that proposed in the Plan of Operations). This would change the specific receptors along the transport route, however there would be no change in the expected exposure or risk.

Effects from construction of Alternative E are described in the Effects Common to All section, above.

Reclamation

Alternative E's primary modified characteristic would involve the development of an accessible pit lake, with mine pit walls modified to allow public access. Most potential impacts to human health would be similar to those described in Alternative C. Laying back the pit walls expands the surface area of the pit, and involves additional blasting and hauling (within the pit) described under Alternative D. This creates additional potential for exposure via airborne particulates. Given that the pit walls would be covered with topsoil, the potential for direct exposure to ore/waste rock, the potential for airborne particulate suspension, and the likelihood of external exposure to radiation are all decreased under this alternative compared to Alternative C.

Alternative F

Construction and Operations

Effects from construction and operations of Alternative F are described in the Effects Common to All section.

Reclamation

Alternative F would involve similar layback of the pit walls as Alternative D. A pit lake may form and be accessible to the public. This alternative involves an extensive movement of dirt and rock blasted to create the desired gentle slopes. This work would generate additional dust and particulates, but contaminant concentrations should be lower than those estimated for the operational period.

Alternative G

Construction and Operations

Alternative G has the same potential effects of construction as described in Effects Common to All.

A bottom liner system would be constructed under the WRF and it would be capped with an impermeable geomembrane. The placement of a liner and geomembrane on the WRF should minimize seepage to springs, seeps, or groundwater from the facility.

Reclamation

Alternative G would involve transporting as much of the waste rock pile as possible to the pit, to be used as fill, eliminating a large portion of the waste rock pile. This would require approximately 32 years of materials movement. A geomembrane and engineered cover would be used to cap the backfilled pit. Exposure from the WRF would be essentially eliminated under this alternative. Transport of waste rock during the extended pit fill period would produce airborne particulates, but at concentrations and total annual quantities lower than estimated for the operational period.

Alternative H

Construction and Operations

Alternative H would have the same effects of construction as described in Effects Common to All.

Reclamation

Impacts from reclamation in Alternative H would be the same as Alternative F for the Minable Pit and Effects Common to All for the WRF.

3.18.3.2 Cumulative Effects

The cumulative analysis area for human health and safety includes activities within a 5-mile buffer of the project.

Alternative A – No Action

Cumulative effects on health would not occur under Alternative A - No Action, as there would be no direct or indirect effects.

Cumulative Effects Common to All Action Alternatives

The human health risk from exposure to dust has been minimized with BMPs incorporated into exploration and timber harvesting plans. Construction activities would contribute to this exposure risk, but cumulative effects would be minimized with the forest policy and BMPs in place to control fugitive dust. Worker exposure to radioactive dust would be regulated by the OSHA. Long-term exposure following reclamation would vary by alternative, depending on the plans for the WRF and pit. Cumulative effects to human safety due to increases in truck traffic would be minimized by proposed road improvements.

3.18.3.3 Irretrievable and Irreversible Consequences

There were no irretrievable commitments of resources or irreversible consequences identified in the analysis of public health and safety effects.

Chapter 4
Consultation and Coordination

4.1 List of Preparers and Reviewers

Table 90. Agency Reviewers			
Name	**Responsibility on EIS**	**Education**	**Experience**
Jeanette Timm	Project Manager	BS Forest Management	26 years
Steve Kozel	Line Officer	BS Wildlife and Fisheries Science MS Zoology and Physiology	28 years
Melissa Dempsey	Hydrologist	MS Geology	12 years
Steve Keegan	Landscape Architect	BS Landscape Architecture & Environmental Studies	34 years
Julie Schaefers	Regional Economist	BS Forest Resource Management MS Agriculture and Natural Resource Economics	24 years
Nicholas Drozda	Botanist	BS Biology	17 years
David Plummer	Engineer		
Peter Werner	Physical Engineer	BS Geology MS Mining Engineer	24 years
Joseph Gurrieri	Hydrologist	MS Geology	14 years
Roger Congdon	Hydrogeologist	BS Geology MS Historical Volcanology PhD Geology, magma physics	24 years
Matt Stefanich	Wildlife Biologist	BS Wildlife MS Zoology and Physiology	18 years
Marissa Karchut	Archeologist	BA Anthropology MA Applied Anthropology	20 years
Marc Moore	Safety Manager	BS Industrial Hygiene	39 years
Julie Wheeler	Range Specialist	BA Range Management	19 years
Mike Hilton	Tribal Liaison	Ph.D. Archaeology	20 years
Steve Hirtzel	Fisheries Biologist	BS Fisheries and Wildlife Sciences	28 years
Kara Dunlap	Timber Management Assistant	MS Forestry	16 years
Ed Fischer	Planner	BS Forest Management	37 years
Karl Emanuel	Geologist	MS Geochemistry	25 years
Sarah Shoemaker	Geologist	BS Geology MS Geosciences	9 years
Elizabeth Krueger	Planner	BS Forest Resources	26 years
Deanna Reyher	Soils Specialist	BS Agronomy	25 years
Debra Miller	Air Quality Specialist	BS Aerospace Engineering MS Forest Sciences	17 years

This EIS was prepared under the direction of the Forest Service and Cooperating Agencies by a third party contractor and subcontractors. All contractors and subcontractors signed a financial disclosure statement

declaring that they did not have any financial interest in the outcome of the EIS or the decision to be made by the agencies.

Table 91. Preparers

Name/Company	Responsibility on EIS	Education	Experience
Cameo Flood Tetra Tech, Inc.	Project Manager, Timber, Fire	BS Forestry	30 years
Emily Cohen Tetra Tech, Inc.	Writer/Editor, Recreation, Range	MS, Natural Resource Planning BA, English Literature	12 years
Theresa Lopez Tetra Tech, Inc.	Human Health Risk Assessment - nonradiological	MS, Public Health BS, Nutritional Science	22 years
Robert Meyer Tetra Tech, Inc.	Radiation Protection	Ph.D., Radiation Biology M.S., Health Physics Graduate, US Navy Officer Candidate School B.A., Physics	39 years
Mark Karpinski Tetra Tech, Inc.	Cultural Resources	MA, Project Management MA, Anthropology BS, Anthropology, Minor: Spanish	15 years
Keith S. Thompson, CPG, PG Tetra Tech, Inc.	Groundwater	MS, Hydrogeology BS, Geology	29 Years
William H. Craig Tetra Tech, Inc.	Surface Water	MS, Geology (Hydrogeology) BS, Geology	20 Years
David M. Richers Tetra Tech, Inc.	Geology, Minerals, Geochemistry	PhD in Geology/Geochemistry MS in Geology/Geochemistry BS Geology	40 years
Lisa A. Harloe Tetra Tech, Inc.	Wetlands	BS, Biology and Public Administration and Policy Analysis	15 years
Richard Dombrouski, PE, PG Tetra Tech, Inc.	Geotechnical Stability	MS, Engineering Geology BS, Engineering Geology	25 years
Edwin Lips, PE	Engineering Technical Review	BS, Mining Engineering Professional Mining Engineer	28 years
Henry Sauer	Design Features, Cost Estimating	BS, Range Management, Minor: Soil Science	32 years
Martin Chenoweth, PE	Alternative Feasibility Analysis, Cost Estimating	BS, Mining Engineering	35 years
Lyle King Shell Valley Consulting	Soils and Wildlife	Ph.D. Soil Science BS Range Science BS Wildlife Conservation and Management	30 years
Jeff Petty Shell Valley Consulting	Range and Vegetation	MS Range Ecology/Water Resources BS Range Management	25 year
Jeff Johnson Shell Valley Consulting	Recreation and Visuals	BS Forestry	35 years
Lloyd E. Levy Lloyd Levey Consulting	Social and Economic	M.B.A., Finance B.A. History	29 years

Table 91. Preparers			
Lynn M. Olsen Trihydro, Inc.	Air and Climate	B.S. Chemical Engineering	30 years
Claudia Torrence, PE Trihydro, Inc.	Transportation and Access	BS Civil Engineering	25 years
Tyson Markham, P.E. Trihydro, Inc.	Transportation and Access	BS Civil Engineering	8 years
Thad Jones	GIS Analysis	MS, Forestry BS, Forestry	11 years
Mark Asoian	Air and Climate	BS, Atmospheric Sciences Masters Course Work in Mechanical/Environmental Engineering	35 years

4.2 List to Whom Notification of the Availability of the DEIS was Sent

Agencies

Acquisitions & Serials Branch National Agricultural Library

Advisory Council on Historic Preservation Director, Planning and Review

APHIS PPD/EAD Deputy Director

Associate Regional Director Intermountain Region, NPS

California Regional Water Board Lahontan Region (6)

Campbell County Board of Commissioners

Chief of Naval Operations (N45) Energy and Environmental Readiness Division

City of Newcastle

Crook County Board of Commissioners

Crook County Land Use Planning and Zoning Commission

Crook County Natural Resource District

Federal Aviation Administration, Regional Director, Northwest Mountain Region

Johnson County Commissioners

National Park Service

Natural Resource Advisor, Office of Governor Matthew H. Mead

Natural Resources Conservation Service, National Environmental Coordinator

Nuclear Regulatory Commission

OEPC Director

Office of State Lands & Investments

Pine Haven Town Council

US Army Corps of Engineers

US Army Corps of Engineers Northwestern Division

US Coast Guard, Commandant CG-47, Offc. Of Environ Mgmt

US Department of Defense

US EPA Office of Federal Activities, EIS Filing Section

US EPA Region 8 NEPA Compliance and Review Program

US EPA, Region 8

US Fish and Wildlife Service

Weston County Commissioners

Weston County Natural Resource District

Weston County School District

Wyoming (HDA-WY) Division Administrator

Wyoming Business Alliance

Wyoming Department of Agriculture

Wyoming Department of Agriculture, Natural Resources Division

Wyoming Department of Environmental Quality, Air Quality Division

Wyoming Department of Environmental Quality, Land Quality Division

Wyoming Department of Revenue, Ad Valorem Tax

Wyoming Department of Transportation

Wyoming Game and Fish Department

Wyoming Livestock Board

Wyoming Oil and Gas Conservation Commission

Wyoming State Engineers Office

Wyoming State Engineers Office, Ground Water Division

Wyoming State Engineers Office, Water Planning Coordinator

Wyoming State Forestry

Wyoming State Geological Survey

Wyoming State Historic Preservation Office

Wyoming State Parks and Cultural Resources, Historic Sites Division

Wyoming State Parks Cultural Resources & Trails

Wyoming State Trails Program

Tribes

Cheyenne River Sioux Tribe, Tribal Chair

Cheyenne River Sioux Tribe, Cultural Program Administrator

Cheyenne River Sioux Tribe, Tribal Historic Preservation Officer

Cheyenne/Arapaho Tribes of Oklahoma, Governor

Cheyenne/Arapaho Tribes of Oklahoma, Tribal Historic Preservation Officer

Crow Creek Sioux Tribe, Chairman

Crow Creek Sioux Tribe, Tribal Historic Preservation Officer

Eastern Shoshone Tribe, Tribal Chairman

Eastern Shoshone Tribe, Historical Preservation Officer

Flandreau Santee Sioux Tribe, Tribal Chairman

Flandreau Santee Sioux Tribe, Tribal Historic Preservation Officer

Kiowa Ethnographic Endeavor for Preservation,

Lower Brule Sioux Tribe, Tribal Chair

Lower Brule Sioux Tribe, Acting Director of Cultural Resources

Mandan, Hidatsa & Arikara Nation, Tribal Chairman

Mandan, Hidatsa & Arikara Nation, Tribal Historic Preservation Officer

Northern Arapaho Tribe, Tribal Chairman

Northern Arapaho Tribe, Tribal Historic Preservation Officer

Northern Cheyenne Tribe, President

Northern Cheyenne Tribe, Tribal Historic Preservation Officer

Northern Cheyenne Tribe, EPA Director

Oglala Sioux Tribe, President

Oglala Sioux Tribe, Tribal Historic Preservation Officer

Rosebud Sioux Tribe, President

Rosebud Sioux Tribe, Tribal Historic Preservation Officer

Santee Sioux Nation, Tribal Chairman

Sisseton-Wahpeton Sioux Tribe, Tribal Chairman

Sisseton-Wahpeton Sioux Tribe, Tribal Historic Preservation Officer

Spirit Lake Sioux Tribe, Tribal Chairperson

Standing Rock Sioux Tribe, Tribal Chairman

Standing Rock Sioux Tribe, Tribal Historic Preservation Officer

Yankton Sioux Tribe, Tribal Chairman

Yankton Sioux Tribe, Tribal Historic Preservation Officer

Organizations and Individuals

Ackerman, William

Adams, Ethel

All Raw Materials, Inc.

Alsaker, Dayton

Am West Petroleum

American Exploration & Mining Association

Anderson, Paul

Audubon Dakota

Ayers, John and Maggie

Barrasso, Senator John

Barton, Tony

Bear, Theodora Bird

Bell, Jeffrey

Black Hills Regional Multiple Use Coalition

Black, Shelley

Bokhari, Neil and Cat

Bosco Damon, Paula

Brown, Delmer

Budd-Falen Law Offices

Burgers, Cheryl

Burgers, Mark

Chatfield, Ed

Chatham, Cheryl

Clean Water Alliance

Colorado Mining Association

Comeau, Maldegen, Templeman& Indall, Llp

Cowger, Eben

Crawford Fink, Kara

Crook County Farm Bureau Federation

Crook County Museum

Daigle, Dave

Dan Hart Patrol

Darnell, Nancy and Donley

Davis, Alison

Davis, Jeremiah J.

Davis, Jim

Davis, Ted

Defenders of the Black Hills

Disney, Matt

Dowers, Dan

Driskill, Senator Ogden

Durrum, Kathy

Eekhoff, Thomas and Patricia

Engelhaupt, Glenn

Everard, Terry

Fisher, Donna

Flynn, Roger

Fort Berthold Community College Science, Environmental Science and Native American Indian Studies

Gaughenbaug, Woody

Gleaves, Holly

Goolsby, Finley & Associates, Llc

Gregory, Nancy

Grumstrup, Phil

Hageman Law P.C.

Hart, Dan

Hines, Mark

Horne-McIntyre, Carmen

Ienerville, Herb

Ingram, Bobby

Izaak Walton League

Jackson, Stu

K&M Energy Services, Inc.

Knoblock, Keith

Knudson, Rodney

Lambert, Mark

Larson, Janet

Lazy Y Quarter Circle

Leinen, Randy

Leroy Schloredt Trust

Marshall, Carla Rae

Marshall, Lance

Marshall, Utah and Diane

Mathes, Dave

Materi, Janet

Mayor, Town of Hulett

McLean, Linsey

Mignery, Ed and Barb

Mining & Metallurgical Society of America

National Wild Turkey Federation

NAWO

North East Wyoming Economic Development Coalition (NEWEDC)

Nucor Oil & Gas, Inc

Petera, Carol

Peterson, Doug & Barb

Plains Justice

Powder River Basin Resource Council

Prairie Hills Audubon Society

Provost, Deanna

Public, Jean

Rare Element Resources

Ree, Mark

Reinhold, Ernest

Richards, Chester

Robertson, Carol

Rocky Mountain Audubon Society

Rogers, Linda

Russell, Randy

Schwindt, Tommy

Seal, Thom

Semlek, Representative Mark

Simmons, Vernon and Anna

Smoot, Martha & Bob

Society For Mining, Metallurgy & Exploration

Stacy, Warren and Cynthia

Star Lane Center School

Stefanich, Matt

Stover, Don

Sunset Amigos

Swenson, John and Verda

Swenson, Mikkelina

Tokarczyk, Linda

Tokarczyk, Michael

Tope, Wilma

Travel and Tourism

Turgeon, Karen

Turgeon, Les

TYVO, LLC.

Utah Mining Association

Vail, Dennis

Vista West Improvement & Services District

Vore, Ron

Water Development Commission

Webley, Jared

Weston Engineering

Williams, Eric

Wright, Tom

Wyoming Earthmoving Corp.

Wyoming Mining Association

Wyoming Outdoor Council

Wyoming Refining Company

Yellow Horse, Jake

Zeli, Jim

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Appendix A
Proponent Committed Environmental Protection Measures

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Environmental Protection
Applicable to All Action Alternatives

Proponent Committed Environmental Protection Measures

The proponent's Plan of Operations and its 15 appendices contains Environmental Protection Measures that they have committed to implementing and details on plans for specific resources. These measures are summarized below and in Section **2.8**. These measures would apply to all action alternatives, unless specifically stated for specific action alternatives or if the alternative design precluded the measure. For example, reclamation of the WRF in Alternative G precludes the concurrent reclamation. For the period this EIS is available for public review, the Plan of Operations and its appendices are available online[17].

Air Quality

The Plan of Operations Section 5.1.4 includes the following measures to reduce potential impacts on air quality:

- The entire length of the Miller Creek access road, secondary road, and haul roads will be watered on a regular basis to control dust. If necessary, additional chemicals will be used such as calcium or magnesium chloride or other natural dust suppressant chemicals to provide longer term dust suppression.
- Maximum speed limits on haul roads will be 20 mph to reduce fugitive dust generation and provide for safe travel.
- The PUG Plant will be contained inside a building at the facilities area. A wet suppression system comprised of standard water suppression sprays at the dump hopper or transfer points will be installed to control fugitive dust.
- Dust from the Low Grade Ore Stockpile and other ore stockpiles will be controlled using water truck spray turrets on an as-needed basis.
- Dust from placement of waste rock will be controlled by watering the roads and pile areas where truck traffic occurs. If needed in particularly dusty conditions, turrets on the water truck will be used to direct water sprays to dust-generating sources during truck unloading.
- Disturbed areas around the PUG Facility (fueling island, mine shop, truck wash station, PUG Plant, guard house, and the explosives magazines) will be covered with coarse gravel or crushed rock to control fugitive dust from vehicle traffic in the area. Other disturbed areas will be revegetated as soon as practicable to assist in dust control.

Roads

Appendix C of the Plan of Operations includes the following measures for access route upgrades to improve safety and minimize environmental impacts.

…….

[17] http://www.fs.usda.gov/wps/portal/fsinternet/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gDfxMDT8MwRydLA1cj72BTUwMTAwgAykeaxRtBeY4WBv4eHmF-YT4GMHkidBvgAI6EdIeDXIvfdrAJuM3388jPTdUvyA2NMMgyUQQAyrgQmg!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfS000MjZOMDcxT1RVODBJN0o2MTJQRDMwODQ!/?project=37875.

- Intersections will be constructed or improved to include a minimum of an 80-foot radius to allow trucks to navigate the intersection without encroaching on the other lane.
- Two, 12-foot driving lanes with 4-foot shoulders would allow for safe travel of two-way traffic. The existing 66-foot right-of-way would be followed where possible to minimize disturbance.
- Side slopes of 6:1[18] would allow for driver correction.
- A blowing snow analysis was conducted using WYDOT standards. A flat bottom ditch used below the 6:1 side slopes would allow for snow storage and improve visibility.
- Guard rails would be placed where side slopes are 3:1.
- Horizontal and vertical geometry of the roadway has been designed to meet 40 mph requirements. Areas of grade and curve radii concern have been identified and would be eliminated.
- Drainage structures have been designed for the 25-year, 24-hour storm event. The drainage will be designed such that the water level does not rise above the bottom of the crushed base. Culverts will be designed to maintain a minimum of 2 feet per second velocity during the minor 2-year storm event to minimize silt accumulation and allow culverts to be self-cleaning.
- Tree removal and foliage disturbance will be minimized by only disturbing areas where it is necessary for road construction. Disturbed areas will be revegetated as construction and weather allows. Seed mixes and mulching material will be certified weed-free. Disturbed areas will be inspected annually for weeds; areas of weeds will be sprayed in a timely manner.
- Best Management Practices (BMPs) for sediment and erosion control will be used to minimize stream degradation. BMPs used during and after construction of the road are silt fence, erosion control logs, bales, temporary berms, outlet traps, rock check dams, gabion baskets, sediment basins, drainage channels, erosion control blankets, and revegetation with ditch linings.

– Silt fencing will be installed prior to construction at the toe of cut and fill slopes. Silt fencing will be inspected and maintained during construction.

– Erosion control logs will be placed along cut and fill areas and in ditches, and inspected throughout construction to insure that logs have not been installed in a trench, log edges extend to contain run-off, logs are adequately staked, no gaps exist between logs, and the material is in continuous contact with the ground. Maintenance will include replacement, reinforcement, and removal of trapped sediment.

– Temporary berms will be used as diversion structures along cut and fill slopes and to protect water bodies. They will be inspected and maintained to ensure they are not eroded or do not allow water to flow through.

– Bales are used during construction in ditch bottoms or at the toe of cut and fill slopes. Bales will be inspected and maintained to ensure that water is not flowing under, through or around the bales.

– Outlet traps will be used as part of a long-term erosion plan. They are placed at the outlets of culverts, sediment traps, or channels to prevent any high velocity discharge from causing erosion. Outlet traps are made by placing appropriately sized riprap to reduce water velocities before discharge.

– Rock check dams will be used in channels to slow water velocities and prevent erosion by allowing the water to flow through riprap. They will be placed on steep grades for temporary erosion control. Proper installation is important, thus, inspections will occur at the time of installation.

…….

[18] Throughout the EIS, slopes referred to such as 6:1 mean there is a horizontal run of 6 times as much as the vertical run of 1. For every one foot of elevation, there is 6 feet of length to the slope.

– Gabion baskets are rectangular wire mesh baskets filled with rock to form permeable structures. They will be used in conjunction with a variety of other BMP's as permanent structures to stabilize slopes and slow water velocities.

– Drainage channels are permanent structures which can collect water and direct flow offsite. They will be used in cut and flat sections of the road to collect runoff and prevent ponding. To prevent erosion and channel failure, proper use of rock check dams, ditch liners, and bales should be implemented.

– Erosion control blankets and channel liners are a temporary method used on sloped areas of disturbed soil. Shaping, finishing, seeding and fertilizing shall be completed before blankets are installed. Blankets are effective in increasing re-vegetation in disturbed areas by protecting the seedbeds, and promoting germination. They will be installed with perimeter anchor trenches to prevent failure.

– Sediment basins are small water detention basins which allow sediment to settle out before the water is allowed to enter streams or ditches. The sediment basin design depends on the flow rate of the runoff and the size or amount of sediment in the flow. All sediment traps installed will have a controlled discharge method to avoid embankment failure.

– Revegetation will be conducted as soon as construction activities and weather allows.

- Topsoil will be stockpiled and protected for reclamation purposes. Seed mixes will comply with WDEQ regulations, Guideline No. 2 - Vegetation. The seed mixture will:

– Contain no fewer than four herbaceous species, unless the proposed land use requires fewer species.

– Contain the native dominant herbaceous species which support the post-mining land uses.

– If needed, contain additional species native to the region which support the post-mining land uses.

– Contain naturalized, introduced species only if additional herbaceous species are needed, or if suitable, native species are unavailable or if naturalized species are superior for a specialized land use.

– Contain full shrub and/or sub-shrub species when these species will support the post- mining land uses. If appropriate, to increase post-mining species diversity, shrub mixtures may be developed and seeded separately from the herbaceous mixtures.

– Contain native forb species if natural reinvasion of forbs will be limited by site-specific conditions.

– Seed mixtures for all post-mining communities which will be jointly used by livestock and wildlife should include full shrub and/or sub-shrub species.

– The closure objectives for the areas which do not currently have existing roads will be to remove the road surfacing, re-grade the road corridor to preconstruction contours and to re-vegetate. The reclamation will also include the planting of trees within the road corridor.

– Dust suppression would be achieved through applications of water or chemical suppressants (on unpaved sections).

Visual Quality

The Plan of Operations Section 5.5.2 includes the following measures to reduce potential impacts on scenic values:

- To the greatest extent feasible, reclamation of disturbed lands will be completed as soon as possible and in accordance with the Reclamation Plan described in Section 5.22 of the Plan of Operations which provides for progressive reclamation, where possible.
- Felled trees and slash generated during preparation for road construction on NFS lands will be handled following direction from the Forest Service. On private lands, the Wyoming Division of Forestry

guidance will be followed. Slash may be used for sediment control, revegetation/mulch, and/or stockpiled.

- Temporary disturbances that occur during the life of the mine will be reclaimed as soon as practicable to reduce and prevent erosion and assure that scenic values are maintained.
- Waste rock areas associated with mining operations will be reclaimed in accordance with the Reclamation Plan described in Section 5.22 (of the Plan of Operations). Regrading, contouring, revegetation, and topsoil placement will occur progressively with the WRF development to minimize reclamation time after the end of the mine life and reduce the total time that topsoil will be stockpiled.
- Eighty percent downward illumination lighting will be used.

The proponent submitted a lighting plan in May 2014 committing to the following measures:

- When not operating, the mine lights will be turned off; the lights on conveyors will be turned off when the plant is not in operation
- Pit lighting, top of ramp lighting, and waste dump lighting will include light abatement shielding to block light from shining up
- Light abatement shields will be used on all outdoor lighting fixtures on the PUG and Hydromet site
- Lights will utilize warmer color options and be mostly facing to the southeast to minimize luminesce towards Devils Tower to the northwest

Cultural Resources

The Plan of Operations Section 5.7.3 includes the following measures to reduce potential impacts on cultural resources:

- Proponent will, if at all possible, avoid identified cultural resources that are deemed "eligible" under the National Historic Resources Protection Act. If these resources cannot be avoided, they will be mitigated prior to construction. Mitigation means doing something to either preserve the actual cultural resource itself or to recover information about the cultural resource before it is destroyed through construction. Resolving adverse effects to eligible historic properties will be done in consultation with the state Historic Preservation Officer, Tribal Historic Preservation Officers, and others by developing a Memorandum of Agreement, which will outline agreed-upon measures that the agency will take to avoid, minimize, or mitigate the adverse effects. Guidance on when data recovery is appropriate mitigation and how to carry it out can be found in the Advisory Council on Historic Preservation's Recommended Approach for Consultation on Recovery of Significant Information from Archeological Sites.
- Proponent will follow their Unanticipated Discovery Plan (see Appendix J) which will outline the procedures needed to identify, record, and evaluate any buried cultural resources detected during construction as well as procedures to be followed in the event of the discovery of human remains.
- Proponent will inform all persons who are associated with the project that they will be subject to prosecution for knowingly disturbing historic or archeological sites or for collecting artifacts. If historic or archaeological materials are uncovered during construction, work will stop immediately in the area and proponent will implement the Unanticipated Discovery Plan.
- Proponent will notify the Forest Service by telephone, with written confirmation, immediately upon the discovery of any cultural resource. Construction in the vicinity of the discovery will stop and the discovery will be protected until further directed by the Forest Service.

Proponent's Unanticipated Discovery Plan would require consultation with Wyoming SHPO and THPOs before being acceptable for implementation for the Bear Lodge Project on NFS lands. FS and proponent discussed the various options to address cultural resources and proponent was acceptable to using the FS

design features as identified in Section 2.6.4 for NFS lands. Proponent would continue to follow their environmental protection measures for private lands.

Soil

The Plan of Operations, in Section 5.9.3 identified measures to reduce potential impacts to soils:

- Any long-term surface disturbances will have useable topsoil and subsoil removed and stockpiled for later reclamation use. Topsoil piles will be clearly marked and kept separate from spoil piles. Stockpiles will be designed to minimize erosion from wind and water.
- When small disturbances occur on sloped areas, topsoil and spoil piles will require special placement. Spoil piles will be located uphill of the disturbance to prevent surface water contamination, and to retain any pile losses within the disturbance area. When possible, spoil piles will be placed on or near disturbed ground. Topsoil piles will be located downhill of the disturbance so that any translocation of the topsoil from the stockpile will be away from the disturbed area.

Paleontological Resources

The Plan of Operations, Section 5.11.2, included the following measures to reduce potential impacts on paleontological resources:

- Proponent will notify all persons associated with operations that any objects or sites of paleontological or scientific value, such as vertebrate or scientifically important invertebrate fossils, shall not be damaged, destroyed, removed, moved, or disturbed. If in connection with authorized operations any of the above resources are encountered, all activities that might further disturb such materials will be suspended and the Forest Service will be notified.

Hydrology and Water Quality

The Plan of Operations Section 5.3.7 includes the following measures to reduce potential impacts on hydrology and water quality:

- Protection of natural drainage channels using check dams and riprap. The installation of channel protection will aid in dissipating the energy of the stream flow and may reduce stream bed and bank scouring related to the increased flow volume in the channels and/or changes in flow velocities.
- Implementation of rapid stabilization practices for disturbed areas to reduce erosion and the movement of sediment. Techniques such as the application of organic mulches on disturbed slopes may also increase the efficiency and effectiveness of future revegetation efforts.
- Implementing physical technologies for stabilization, especially on steep slopes where erosion is excessive. Practices such as surface scarification, placement of silt fences, cross-slope barriers constructed of straw bales, and the use of surface coverings such as nettings or plastic coverings may be used as-needed to control the movement of sediment down slopes.
- Recovering the uppermost soil horizon from the Waste Rock Facility foundation during construction and stockpiling it for use in revegetation. This practice will be used in conjunction with the establishment of a short-term vegetation cover, consisting of fast-growing plant species, for the protection of the stockpiles against erosion. Containment berms will be constructed around and/or downstream from topsoil stockpiles.
- Implementation of rapid revegetation techniques for disturbed areas where practical, especially on constructed elements such as road cuts and fills, borrow areas, and rock and other disposal areas. The vegetation will be seeded prior to the onset of the next growing season in order to prevent excessive loss of material. Local vegetation species that grow rapidly may be used in order to maximize the development of a self-sustaining vegetative cover. Such a mix could contain species such as Canada wildrye (*Elymus canadensis*), thickspike wheatgrass (*Elymus lanceolatus*), western wheatgrass (*Elymus smithii*), slender

wheatgrass (*Elymus trachcaulus*), and applicable, commercially available bluegrasses or fescues. A vegetative cover protects the surface against erosion and provides long-term stabilization of the area. Proponent will consult with the Forest Service to determine a desirable seed mix.

- Maintenance of erosional features will be conducted until long-term surface stabilization is achieved. Annual maintenance may include repairing and seeding erosional featuressuch as rills and gullies that develop on newly revegetated slopes, recontouring problem slopes, and the installation of additional channel protection in natural drainage channels located down-gradient of sediment control structures, if erosion is evident.

Section 5.12.2 of the Plan of Operations included measures to protect water supply wells.

- Proponent will design and construct the water supply wells with isolation packers intended to prevent the wells from depleting shallower groundwater that could be connected to local springs.

Wildlife and Fish Resources

The Plan of Operations Section 5.6.3 includes the following measures to reduce potential impacts on fish and wildlife:

- Bear-proof containers, approved by the WGFD, will be used for temporary storage of all garbage; however, trash and garbage will not be allowed to remain within the Mine Area for an extended period (e.g., greater than one week) to discourage attracting scavengers, including corvids, coyotes, and bears.
- Speed limits and caution signs will be posted to the extent allowed by surface owners, federal and state regulations, local governments, and land use policies, as appropriate to minimize potential for vehicle and wildlife collisions/interaction.
- Employees and subcontractors will not be allowed to carry firearms while on the job or riding in company vehicles. These provisions will be included in subcontractor agreements limiting the use of firearms to the same standards applied to company operations.
- Employees and subcontractors will be instructed to avoid walking away from vehicles or facilities into view of wildlife, especially during winter months and breeding (courtship, nesting) seasons.
- Employees and subcontractors will receive environmental awareness training during orientation that will inform and educate employees and subcontractors about laws and wildlife conservation practices, including no harassment or feeding of wildlife.
- Known bat roosts (day and/or night) will be protected in accordance with Black Hills National Forest Plan in order to maintain bat habitat, nurseries, or hibernacula.
- Traffic routes will be restricted to established roads to protect wildlife habitat unless authorized by the Forest Service.
- The removal of snags will be restricted to only those that pose a safety concern or when absolutely necessary for project activities. Forest Service personnel will be notified prior to the cutting of any snags in order to inspect the snag and determine if an alternate solution is feasible. Where possible, any snags cut as safety hazards will be left on site.
- To protect important upland game bird (i.e., grouse and turkeys) breeding and nesting habitat, project activities and surface use will be avoided near identified leks or nest sites during the breeding and nesting periods. Any newly documented winter grouse concentration areas or wild turkey roost sites will also be avoided during the appropriate seasonal and daily periods (i.e., winter and early morning/late evening).
- All known raptor nests or any newly documented nests will be protected in accordance with the Black Hills National Forest Plan and the FWS Wyoming Ecological Services Office's Recommended Spatial and Seasonal Buffers for Breeding Raptors (2009). Potential effects of disturbance, nesting phenology,

human activities existing at onset of nest initiation, species, topography, other sensitive species and plant species of local concern, forest cover, nest protection standards, and other appropriate factors, as well as recommendations used by state or federal agencies will be considered when designing protection measures. The USFWS will review the Avian Protection and Mitigation Plan every five years as part of the mine permit renewal.

- The Avian Protection and Mitigation Plan will detail the next five years of proposed surface disturbance as annual disturbance blocks (e.g., topsoil stripping; overburden, waste rock, and topsoil stock piles; facilities, road, pipeline, power line, and reservoir construction; and fencing) within the permit area. The disturbance blocks (rather than the actual mining timeline blocks) are used to identify sources of potential disturbance to avian species in the affected area over that period, conflicts or concerns, avoidance, minimization and mitigation measures. Upon approval by the USFWS, the Avian Protection and Mitigation Plan will be followed for the subsequent 5-year period, unless revisions or changes to the mine plan are proposed or required, and approved by WDEQ, before then. If such revisions or changes do occur during that period, the applicable section(s) of the avian mitigation plan will also be revised and resubmitted to the USFWS for approval.
- Surface-disturbing activities will be avoided from April 1 through August 15 to minimize impact on active goshawk nests from additional human-caused noise and disruption beyond that occurring at the time of nest initiation (e.g., road traffic, timber harvests, construction activities, drilling) within 0.5 mile until the nest has failed or fledglings have dispersed.
- Surface disturbance will be avoided within 0.5 mile of winter roost sites for bald eagles that are within line-of-site. If any roost sites or additional habitat for bald eagles is found within the survey area, they would be protected from disturbance in accordance with the Black Hills National Forest Plan.
- As per the Memorandum of Understanding between the Forest Service and the FWS (Forest Service Agreement #08-MOU-1113-2400-264) to promote the conservation of migratory birds pursuant to EO 13186, 2001), mitigation efforts for bird species observed during breeding bird surveys will include the protection of important riparian habitats and any other unique features identified (e.g., cliffs that may serve as colonial nesting sites).
- Nesting migratory birds will not be physically disturbed between May 1 and July 15 to avoid illegal take of birds, eggs, young, and nests under the Migratory Bird Treaty Act.
- Riparian areas (including the Whitelaw Riparian Improvement Project) or wetlands where populations of sensitive species are located will be avoided during ground disturbance. Project activities will avoid the creation of barriers (e.g., new open roads) between redbelly snake hibernacula, wetlands and riparian areas. Sufficient overstory and ground litter will be emphasized to the extent possible in order to maintain moisture regimes, ground level temperatures, and humidity.
- Disturbance to snail colonies in wetland and riparian areas will be avoided in order to minimize impacts to sensitive and species of local concern. Sufficient overstory and ground litter will be emphasized to the extent possible in order to maintain moisture regimes, ground level temperatures, and humidity.
- Forest Service-approved buffers delineated for particular site conditions will be applied around water sources, wetlands and riparian areas, and streams to avoid concentrations of Forest Service-approved chemical herbicides in waterways that may harm aquatic life and non-targeted vegetation.

Vegetation

The Plan of Operations Section 5.13.3 includes the following measures to reduce potential impacts on vegetation:

- Native vegetation will be retained to the maximum extent possible during construction.

- Disturbed soil will be re-vegetated in a manner that optimizes plant establishment for that specific site or vegetation community.
- Revegetation will include one or more of the following: topsoil replacement, planting, seeding, fertilization, liming, and placement of weed-free mulch, as necessary.
- Revegetation will be initiated as soon as practicable, after termination of ground disturbing activities.

Threatened and Endangered and Special Status Plants

The Plan of Operations Section 5.14.2 includes the following measures to reduce potential impacts on Threatened and Endangered and special status plant species:

- Areas that are considered potential sensitive plant species habitat will be avoided to the extent possible. Where avoidance is not possible, disturbance will be limited to the smallest area required for the given activity.
- Erosion control devices will be installed to reduce or eliminate sediment deposition within areas of potential sensitive plant species habitat. Seeding will be accomplished with an approved seed mix, as soon as possible following disturbance to reduce erosion and prevent noxious and invasive weed establishment.
- Noxious and invasive weeds will be controlled to prevent establishment within areas of potential sensitive plant species habitat. Herbicides used in control of noxious and invasive weeds will be used as directed in the Weed Management Plan.

Wetlands, Riparian, and Streams

The Plan of Operations (Section 5.16.2) identifies the following measures to reduce potential impacts to wetlands:

- Sediment control structures will be installed during construction and slopes will be stabilized to reduce erosion. Sediment control structures, such as weed-free straw bales, will also be used on mineral exploration activity sites within water influence zones to reduce sediment and erosion into creeks as determined by the Forest Service.
- Construction activities will be timed accordingly to minimize erosion by restricting operations during extreme rainfall. Flows will be diverted around construction sites to minimize downstream sedimentation.
- Stream bank protection (primarily riprap – 6 to 18 inches) will be established to minimize sediment production from stream banks and structural abutments in natural waterways.
- Bridges and culverts will be installed to minimize sedimentation and turbidity resulting from excavation for in-channel structures. Wet drainages will have temporary crossings and cross at right angles to keep temporary roads from unduly damaging streams or disturbing channels. Culverts will be maintained annually or as necessary.
- The Bear Lodge Project Weed Management Plan will be followed during implementation of the Project.

Invasive Plants

The Plan of Operations (Section 5.15.2 and Appendix O) identify the following measures to reduce potential impacts resulting from invasive non-native species:

- Proponent will implement measures identified in the Weed Management Plan (Appendix O). The plan will outline all other protection measures listed below and will include a weed treatment schedule and describe methods of treatment.

- Wyoming state designated noxious weeds and Crook County declared weeds will be dealt with in accordance with the Weed and Pest Control Act of 1973, the Wyoming Seed Laws, and the Crook County Weed Control Supervisors.
- Monitoring for noxious, declared, or non-native species will continue during project implementation. If new noxious weed infestations are found during implementation, actions to minimize spread will be taken.
- To prevent importation of noxious or declared weed and/or invasive non-native seed:
  - All equipment will be washed free of all mud and vegetative debris prior to being moved into the Project Area.
  - Washing will occur at either a commercial truck wash or at a private facility where the water and debris are collected for treatment or disposal in an appropriate landfill.

– Seed will be tested for noxious weeds at the time of purchase (Forest Plan Standard 4306).

- Noxious and declared weeds will be eradicated consistent with the Forest Service Weed Management Plan (2003) and Bear Lodge Project Weed Management Plan during operation and for 3 years after disturbance; until noxious weeds are eliminated from disturbed areas or at pre-disturbance levels.
- Herbicide use in the treatment of noxious weeds will be conducted in accordance with EPA guidelines and as specified by the product label. Approved herbicides for the Black Hills National Forest are listed in the Forest Service Weed Management Plan (Forest Service, 2003).
- Buffers will be used around water sources, lakes, wetlands and riparian areas, and streams to keep concentrations of chemical herbicides in water well below those harmful to drinking, irrigation, aquatic life, and non-target vegetation as outlined by the EPA and WDEQ. Treatment of individual plants with aquatic-labeled chemical agents may occur in buffers (Forest Plan Standard 4308).
- Herbicide-free buffer widths will be developed based on herbicide labels and site-specific criteria. A minimum buffer of 25 feet will be used for vehicle application and a minimum buffer of 10 feet will be used for hand spraying application, when the product label does not specify buffer width.

Proponent will implement the integrated weed management strategy described in Appendix O of the Plan of Operations throughout construction and operation of the Bull Hill Mine project, and for at least five years after project completion.

- All proponent's project personnel, including construction, maintenance, and operations workers, will be trained to recognize and document weed populations. Weed identification handbooks will be made available to all RER field personnel.
- Proponent will incorporate Forest Service BMPs for revegetation and soil protection.
- Disturbance will be minimized, and pre-disturbance treatments will be implemented if weed populations occur in areas planned for disturbance.
- Treated areas will be seeded with desirable plant species.
- Disturbed areas will be seeded with approved seed mixes containing certified weed-free seed (blue tags). Seed will be tested at time of purchase.
- Proponent will use only certified weed-free hay, straw, and mulch.
- Equipment and vehicles will be inspected before entering and leaving the Bull Hill Mine permit area. All equipment will be washed at either a commercial truck wash or private facility to remove and collect mud and vegetative debris prior to deployment into the permit area.

- Hand-pulling, cutting, or digging may be used for removal. Removed vegetation will be bagged and disposed of properly. Mowing, plowing, disking, tilling, or burning may also be used.
- Treatments may include grazing by domestic livestock, release of insects, or inoculation with pathogens.
- Herbicides will be EPA and Bearlodge Ranger District approved, target-species specific, and labeled for rangeland/forested lands use.
- Applications will be spot-specific and use handheld equipment where possible. Use of spray booms will be determined on a site-by-site basis.
- Only commercially licensed pesticide applicators will be hired following submittal of the license to proponent and the Black Hills National Forest-BRD. A General Permit for Minor Pesticide Discharges (WYG260000) will be obtained by the applicator and available on-site.
- Waterways, lakes, wetlands, and riparian areas will be buffered. Treatment of individual plants with aquatic-labeled chemicals may occur.
- Adjuvants approved by the Black Hills National Forest-BRD may be used.
- Daily logs of herbicide use will be kept, and use will be monitored and reported on an annual basis.
- Proponent will collect and maintain all records pertaining to the control and management of weeds within the Bull Hill Mine permit area and along Miller Creek Access Route. Weed inventory and management information will be included in the Bull Hill Mine Annual Report. Documentation will include, but not be limited to: inventories; treatments ((including pesticide application records (PAR) and pesticide use reports (PUR)); monitoring; and re-infestation trends. Results will be recorded annually, generally in the fall after the treatment season. Reports will be provided to Black Hills National Forest-BRD by proponent (or proponent contractor) as required or requested.
- Monitoring for invasive and noxious weeds in the Bull Hill Mine permit area and along Miller Creek Access Route will be conducted throughout the life of the project, for three years following disturbance, and for at least five consecutive years after project completion.

Grazing

The Plan of Operations (Section 5.19.2) identifies the following measures to reduce potential impacts to range management:

- Native vegetation will be retained to the maximum extent possible during construction.
- Current range conditions will be maintained (outside of the disturbance area) by limiting vegetation disturbance and through control of noxious weeds and fugitive dust.
- A fence will be constructed around the Mine Area consisting of 5-strand barbed wire conforming to NRCS and/or Forest Service specifications. The Mine Area fence will be maintained throughout the life of the mining operations. Fences damaged from cutting of vegetation or other activities associated with the project would be repaired to prevent livestock movement. The PUG Plant will be fenced with a 6-foot chain link fence with a "V" top, 6-strand barbed wire configuration at the top of the fence for additional security. There will be no grazing within the Mine Area.
- Any cattle guard damage resulting from the project will be repaired immediately.
- Coordination may be required with range permittees for relocation of salt licks within close proximity to the Mine Area fence or near access routes.
- Livestock water sources located within the Mine Area will be moved. It is anticipated that Davis Spring and Allread Spring in Section 16 will need to be relocated south to Section 21. The spring source

(Whitetail 02) within the footprint of the pit (Map 5.3-2) will most likely be lost as a potential livestock water source. Location of new water sources will be coordinated with the Forest Service.

- Any conflicts with pipeline and fence locations will be coordinated with the Forest Service.
- Re-vegetation practices will be designed to establish vegetation communities capable of supporting livestock grazing levels similar to pre-mining conditions. To increase re-vegetation success, livestock will be excluded from reclaimed areas for 2 years.
- Allotment fences removed during the mining operation will be replaced and the Mine Area fence will be removed.

Forests

The following design features/environmental protection measures would reduce potential impacts to forest management:

- Prior to surface disturbance, proposed disturbance areas will be flagged to allow the Forest Service to conduct a site assessment of forestry resources.
- Forest Service approval will be obtained before the cutting or removal of trees.
- All saw timber trees identified for cutting or removal will be cut and removed from the Black Hills Forest, unless the Forest Service determined that the trees should remain on site.
- If left on site, the trees will be cut into 6-foot pieces and limbs of the trees will be scattered and lay less than or equal to 18 inches from the ground surface.
- For trees cut/removed, residual stumps will be left in accordance with Forest Service requirements.
- Proponent will compensate the Forest Service for timber removed in accordance with Forest Service requirements.
- Following reclamation, trees will be planted, if reestablishment from surrounding seed sources is deemed insufficient by the Forest Service.

Solid Wastes

Appendix M - Wastes created on-site may include: solids from sewage, truck washing wastes, laboratory wastes, and spill cleanup residues.

- Proponent will treat wastewater generated by the project using a portable wastewater treatment facility. The facility would be placed within the footprint of the PUG Plant and sized to meet daily domestic needs. Final effluent will meet WDEQ effluent standards for recycled use, including dust suppression within the mine area. The portable facility will be maintained by commercial providers.

Recreation

The Plan of Operations (Section 5.17.2) includes measures to reduce potential impacts to recreation:

- Non-motorized trails will remain open, to the extent possible, to public use for hikers, mountain bikers, and horseback riders outside of the fenced Mine Area.
- The PUG Plant will be fenced and signed for public safety and the plant area will be enclosed with a 6 foot chain link fence with a "V" top, 6-strand barbed wire configuration at the top of the fence for additional security. There will be a security gate manned 24 hours per day, 7 days per week.
- Roads and non-motorized trails within the Mine Area will be closed for the life of the mine.

Exploration

Appendix N incorporates the Plan of Operation for the exploration activities and includes design features for implementation of the proposed drilling, trenching, and geotechnical activities, which includes:

- For Air Quality: Fugitive dust from the use of existing and newly constructed roads will be minimized by limiting speeds to 20 miles per hour and by watering roads on a regular basis.
- For Water Quality: Sumps will be constructed to contain drill cuttings and manage drill water overflow. The following measures will be implemented to minimize impacts to water quality:
  - BMPs for sediment control will be utilized during drilling operations to minimize sedimentation and erosion.
  - Proposed drilling activities will avoid springs, seeps, and perennial streams. If proximal to drainages, sumps will be lined to control potential seepage.

– Chemicals and equipment will not remain on site during seasonal closures.

- For Management of Solid Wastes: All refuse generated during exploration activities will be removed and disposed of in an authorized landfill facility off site, consistent with applicable regulations. No refuse will be disposed of or left on site. Garbage will be collected and hauled off site daily during drilling operations.
- For Scenic Values: Disturbances associated with exploration activities will be reclaimed within 2 years, and therefore, any visual impacts would be temporary and short term.
- For Wildlife and Fish Resources: The environmental protection measures mention above for the mine development would implemented for exploration activities to minimize impacts on wildlife and fish habitats.
- For Cultural Resources: The following measures will minimize impacts to cultural resources:

– Any identified eligible or unevaluated cultural resource sites will be avoided by project activities.

  – If previously undiscovered cultural resources are exposed as a result of exploration operations, proponent will cease operations, leave discoveries intact and notify the District Ranger. Work will not resume until notified in writing by the District Ranger that compliance with the provisions for mitigating unforeseen impacts have been satisfied.

- For Hazardous Materials: Hazardous substances will include diesel fuel, gasoline, and lubricating grease. Diesel fuel will be transported in a truck-bed mounted external tank and in internal vehicle fuel tanks. Gasoline will be transported in hand-held containers and in internal vehicle fuel tanks. Lubricating grease will be transported in 5-gallon tubs. The following measures will be implemented to minimize impacts:
  - Material Safety Data Sheets will be available for all substances.
  - All containers of hazardous substances will be labeled and handled in accordance with Wyoming Department of Transportation and Mine Safety and Health Administration (MSHA) regulations.
  - Proponent will prepare and follow a Spill Prevention Plan.
- For Invasive Weed Management: The environmental protection measures mention above for the mine development would implemented for exploration activities to minimize the spread of invasive weeds.

Exploration Reclamation

All drill holes will be abandoned in accordance with WWQRR. The goal of the phased exploration/reclamation process is to limit the total active disturbance acreage at any one time. Reclamation of drill pads and sumps will be conducted concurrently with other project activities in areas that are no longer needed for mineral exploration following completion or abandonment of the drill site. Concurrent reclamation

would be conducted on roads that are no longer needed for access. The remaining temporary and reopened roads and drill sites would receive final reclamation within 2 years after completion or abandonment and will include the following: a) closure to normal vehicular traffic; b) construction of cross drains, dips, or water bars where needed; c) shaping road surface to as near a natural contour as possible, stabilizing with windrowed topsoil; and d) seeding all regraded areas with the reclamation seed mixture in **Table A-1**. The Forest Service would be notified prior to the commencement of annual reclamation work.

Drill sites adjacent to existing roads would be scarified if compaction occurs. Drill sites adjacent to the existing roads would then be reseeded with the approved certified weed-free seed mix in Table 2 at the appropriate time of year and at an application rate for optimum seed sprouting and plant growth. The seeding would be completed using a broadcast method. The reclaimed surfaces would be left in a textured or rough condition in order to provide protection of the seed and retain moisture. Constructed sumps would be reclaimed when dry, which may take one or two months, and would be backfilled with spoil material, smoothed to match the contours, and the surface would be seeded in accordance with the methods described above. Seeded areas would be monitored for stability and revegetation success, during the spring or fall, for a minimum of 3 years until attainment of the revegetation standards established by the WDEQ-LQD and the Forest Service.

Table A-1.
Proponent Proposed Reclamation Seed Mixture for Exploration

Common Name	Scientific Name	Percent of Mixture
Annual rye	*Lolium multiflorum*	13
Slender wheatgrass	*Elymus trachycaulus*	25
Prairie junegrass	*Koeleria macrantha*	2
Western wheatgrass	*Pascopyrum smithii*	30
Canada wildrye	*Elymus Canadensis*	30

Source Table 2 from Plan of Operation, Appendix N. (RER, 2014b).

Reclamation Plan for the Mine Development

Forest Service Manual (FSM) 2840.3 - All reclamation requirements included in a Plan of Operations shall include measurable performance standards. Reclamation requirements shall be those reasonable, practicable, and necessary to attain standards. The Plan of Operations includes reclamation plans for resources and facilities.

Soil Salvaging

- Prior to mining, all suitable topsoil and subsoil will be salvaged and stockpiled in separate areas for use during the site reclamation. Soil and subsoil will be removed from all disturbed locations within the PUG Plant Site, in the Mineable Pit footprint, and within the Waste Rock Facility footprint. A soil cover of approximately 16 to 18 inches composed of suitable soil is required for reclamation to enable vegetative success.
- The upper 6 inches of suitable topsoil will be salvaged and stockpiled separately from the subsoils also stripped from the site area. All vegetation stripped with the topsoil will be incorporated directly into the topsoil stockpile to augment organic matter content and seed source availability.
- Next, suitable subsoil will be salvaged (average depth of 16 inches) depending on the specific soil conditions encountered. Salvage depths will be determined based on test pits excavated during a preconstruction survey. Suitable soil encountered at lower depths will be stockpiled as necessary to provide an adequate volume of soil for reclamation.

Reclamation Plan Soils

- Unsuitable subsoil will be added to excess material/spoil piles (namely the Waste Rock Facility) and will not be used for revegetation. All practical precautions will be taken to avoid mixing the unsuitable soil with the suitable topsoil and subsoil. WDEQ-LQD Guideline No. 1, Topsoil and Overburden provides

the parameters, analytical procedures, and suitability criteria for topsoil and subsoil evaluation. The radiological criteria for topsoil stockpile and replacement is the natural background concentration of the soil material. According to WDEQ Guideline No. 1, topsoil may consist of the A, B, and C soil horizons or any combination thereof and which has been determined through soil surveys, laboratory analyses, and field trials to be suitable as a plant growth medium for post mining land use. Soil is unconsolidated mineral material in the immediate surface of the earth that serves as a natural medium for the growth of plants and differs from the material from which it was derived in many physical, chemical, biological, and morphological properties and characteristics.

- Subsoil may contain any subsurface earthen materials, excluding any material within the topsoil layer, which is capable of supporting plant life.
- The topsoil and subsoil stockpile locations will be flagged before beginning earthworks (see Map 4.2-2 – map pocket). Suitable topsoil is assumed to be stockpiled in two locations: (1) within the PUG Plant Site and north of the PUG Plant, and (2) east of the Waste Rock Facility. Suitable subsoil will be salvaged and stockpiled separately but in similar locations. Each stockpile will be marked with signs designating it as "Topsoil for Revegetation" or "Subsoil for Revegetation." Unsuitable soil will be placed in the Waste Rock Facility or used to balance cut/fills associated with construction. The excess material/spoil stockpile will be clearly marked with a sign designating it as "Unsuitable for Revegetation."
- Soil stockpiles will be constructed with slopes no steeper than 3H:1V. Surface runoff will be diverted away from the stockpiles. Suitable topsoil and subsoil stockpiles will be seeded to provide erosion protection, discourage weed invasion, and maintain microbial populations.

Soil Stabilization

Appropriate measures will be applied to prevent wind and water erosion using short- and long-term soil stabilization techniques. The following soil stabilization techniques will be used when appropriate:

- No surface disturbing activities will occur when soils are wet or frozen.
- Apply appropriate compaction during placement of soil.
- Manage storm water run-on and control storm water run-off to prevent erosion.
- Dozer-track all fill slopes immediately after construction.
- Properly place and compact berms.
- Promptly seed, mulch, and revegetate.
- Monitor and repair erosional features.
- Use a soil tackifier where appropriate.

Vegetation Surface Preparation

- Existing, in-place materials will first be spread to conform to pre-disturbance contours to the extent practical in all areas to be reclaimed. After regrading, a disk, harrow, or scarifier will be used to alleviate compaction and provide a roughened contact for redistributed topsoil.
- Soil Redistribution. Suitable subsoil will be spread uniformly across the prepared surface to a depth of approximately 10 to 12 inches. The topsoil will then be placed over the subsoil to a depth of approximately 6 to 8 inches. Prior to seeding, the topsoil will be prepared by disking or harrowing to an approximate depth of 6 inches.
- Seeding. Ideally, seeding will be done in the fall prior to freeze-up. Fall seeding provides a cold period for seeds that require vernalization to germinate and allows the seeds to absorb winter moisture, which assists germination in the spring. While spring seeding is possible, it is normally discouraged due to

challenges with early spring weather and site access as well as the likelihood of soil compaction from equipment usage on saturated soils.

- Wherever possible, seeding will be done along constant elevation contours using a drill-seeder equipped with an agitator and depth bands to help make seed distribution and seeding depths more consistent. Seeds will be planted just below the surface as appropriate for the seed mix provided at the time of reclamation. When drill seeding is not practical, broadcast seeding will be employed. For broadcast seeding, the seeding rate will be adjusted as agreed upon with the appropriate agencies, and the area will be raked or chained to cover seeds as appropriate.
- The seed mix will be designed to establish vegetation communities similar to the pre-disturbance vegetation. The seed mix will include native, perennial species recommended by the Forest Service that are adapted to the eco-region. The mix will include appropriate grasses to provide erosion control and wildlife habitat. A suitable seed mix will be determined in conjunction with the Forest Service for use over the entire site at the time of reclamation. The appropriate application rates for this seed mix will also be determined at that time.
- Mulching. After seeding, noxious weed-free-certified hay, straw mulch, or hydromulch will be applied and crimped parallel to the contours at a rate agreed upon with the Forest Service. If equipment access is too difficult in areas, then suitable alternatives will be agreed upon with the Forest Service (such as wood fiber mulch applied hydraulically- i.e. hydromulching).
- Amendments. It is anticipated that no soil amendments will be required during revegetation. Additional studies may be required to verify this assumption and soil amendments, or lack thereof, will be approved by the Forest Service.

Reclamation of Diversion Systems and Hydrologic Restoration

- The major surface drainages within the mine area are Beaver Creek and Whitelaw Creek. Some diversion ditches and culverts will be designed and constructed in order to manage surface water in and around mine facilities and to manage erosion and control sediment (see Appendix D). These drainage structures will remain intact to the extent they are required after mining operations are complete. Any unnecessary diversion systems will be re-graded, scarified, and revegetated during reclamation. Shown on Figure 1 of Appendix D (in the Plan of Operations) are the surface drainage structures that will remain in place following the completion of closure and reclamation (in Alternative C).

Reclamation Regrading and Contouring Plans

- In general, exposed soil and overburden (fill, waste rock, etc.) slopes will be re-graded to an overall slope no steeper than 3H:1V where practical. Due to the hard rock nature of the pit walls, these slopes will remain exposed and in a stable configuration. The remaining exposed slopes will be graded to conform to surrounding topography to the extent practical and to create terraces, uneven surfaces, and pockets to promote the capture of windblown and broadcast seeds and moisture. This contouring will facilitate revegetation, slope stability, erosion protection, and a reduction of visual impacts from un-natural manufactured slopes.

Mineable Pit Reclamation

The Plan of Operation, section 5.22.5.1, applies to Alternative C. All other alternatives propose different reclamation alternatives for the Mineable Pit and are described in Chapter 2.

- **Pit Slopes.** The Mineable Pit has a total approximate footprint of 232 acres. Pit slopes are assumed to be founded in hard rock. Pit slopes will be designed and constructed as part of operational mining activities based on ongoing slope stability assessments and MSHA guidelines. Pit walls will be stabilized during operational mining activities by terracing (benching) or other acceptable engineering techniques. Pit walls are assumed to occupy the entire circumference of the pit and backfilling, grading, and contouring will

not be required. The slope of the pit walls extending above the projected water level within the pit area are anticipated to be stable and therefore, will not be reduced. Pit wall slope and high wall stability will be evaluated during the course of mine operations and long-term stability evaluations will yield satisfactory Factors of Safety after closure.

- **Pit Lake and Groundwater Quality.** Groundwater recharge into the pit will form a permanent pit lake following the cessation of mining. Pit lake water quality will be assessed in additional studies to adhere to LQD Rules and Regulations for Non-coal Mines, Chapter 3.
- **Pit Access.** Pit access will be blocked by a permanent fencing system and berms surrounding the Mineable Pit. In addition, vehicle access to the pits will be blocked by large rock berms placed across the access roads leading into the pits. Prominent safety signs will be erected along the fence line around the pits as well as in front of the access roads leading into the pit area. Fencing will be designed according to WDEQ-LQD Guideline 10 as to not affect wildlife in the area.
- **Groundwater/Surface Water Interaction.** No interaction between groundwater and surface water has been assumed. Groundwater hydrology pumping tests were conducted during 2013 to determine hydrologic characteristics.
- **Revegetation.** Revegetation of the pit area will be limited due to the nature of the hard rock in which the pit will be excavated. Natural revegetation may occur over time in areas along the benches.

Waste Rock Facility Reclamation

The Waste Rock Facility will be located to the east of the Mineable Pit. The material in the Waste Rock Facility is assumed (based on waste characterization studies) to be non-acid forming and thus an engineered cover system will not be required. Reclamation of the Waste Rock Facility will be completed by regrading and recontouring operational side slopes to an overall 3H:1V slope. The total reclamation area for the Waste Rock Facility, including side slopes and the top area, is estimated at 426 acres. The current Waste Rock Facility design incorporates the Low Grade Ore Stockpile in the southwest corner of the facility. The Low Grade Ore Stockpile may be re-mined and processed at the end of the mine life.

- **Grading and Erosion Control.** Regrading, contouring, revegetation, and topsoil placement will occur progressively with the Waste Rock Facility development to minimize reclamation time after the end of the mine life and reduce the total time that topsoil will be stockpiled. Reclaimed slopes will be graded to reflect existing topography, as practical, to allow for natural water collection and enhanced revegetation.
- Grading will include techniques to mitigate wind and water erosion of the slope during revegetation and to provide non-erosive runoff controls. Erosion techniques will be mitigated during operations by the use of mulch, silt fences, and temporary channels. During reclamation, appropriate surface water controls including positive drainage from intermediate benches and cross contour channels to minimize the length of flow paths will be utilized. Mulch will be placed and maintained to promote revegetation and guard against erosion.
- **Revegetation**. The surface of the Waste Rock Facility will be revegetated. If equipment access is difficult along the side slopes of the Waste Rock Facility, then wood fiber mulch will be applied hydraulically (i.e., hydromulched) and broadcast seeding will be employed.
- **Access**. Vehicle access to the Waste Rock Facility will continue to be restricted following revegetation by placing large boulders across the access road at the base of the facility.

Low Grade Ore Stockpile Reclamation

- The Low Grade Ore Stockpile will be buttressed against the southwest corner of the Waste Rock Facility. The total design footprint is approximately 35 acres. The material in the Low Grade Ore Stockpile is assumed to be re-mined and processed prior to closure and reclamation of the Mine Area. Reclamation of the Low Grade Ore Stockpile will be completed by regrading and recontouring the footprint of the

stockpile to reflect pre-mine topography to the extent practical. Subsoil and topsoil will be distributed over the area. The total reclamation area for the Low Grade Ore Stockpile is approximately 35 acres. Assessment of the long-term environmental behavior of Low Grade Ore Stockpile material is part of the current geochemical program.

- **Grading and Erosion Control.** Once the material has been re-mined from the Low Grade Ore Stockpile, the native ground will be re-contoured to reflect original topography as practical and to allow for natural water collection and enhanced revegetation. Grading will include techniques to mitigate wind and water erosion of the slope during revegetation and to provide non-erosive runoff controls. Regrading, contouring, revegetation, and topsoil placement will occur progressively as the Low Grade Ore Stockpile is re-mined to minimize reclamation time following the end of the mine life, to reduce the time for subsoil and topsoil to be stockpiled and to minimize erosion of the exposed surfaces.
- **Revegetation**. The footprint of the Low Grade Ore Stockpile will be revegetated. Special care will be taken to assure that the native ground is properly scarified prior to subsoil and topsoil placement to allow for good contact between the soil strata.

Plant Site and Mine Support Facilities Reclamation

- **Dismantle and Salvage.** Following the completion of mining activities, and assuming that no future mining or mineral recovery is planned, the buildings, facilities, and equipment will be decommissioned and removed from the site. Some buildings or portions of buildings may be required to remain after mining in order to support reclamation and post-mining activities. The proposed use of these buildings and facilities will be documented and provided to the WDEQ-LQD and the landowner for approval. Equipment, surplus materials, and fuel and water tanks will be removed and disposed off-site and/or recycled in accordance with applicable regulations. Pipelines, power lines, culverts, building foundations, and building pads will be removed in accordance with applicable regulations. Debris may be buried on-site as allowable by closure guidelines and regulatory approval at the time of closure.
- **Site Cleanup Requirements.** Scrap material, refuse, unwanted equipment, and surplus materials will be removed and disposed at an appropriate landfill site. Any closed waste management units and/or sewage facilities will be cleaned and all hazards will be remediated in accordance with applicable rules and regulations. Any seepage collection ponds, storm water collection ponds, and/or waste ponds will be closed in accordance with applicable Wyoming rules and regulations. Typical closure will include water testing and drainage (if clean) or treatment (if contaminated), re-grading and re-contouring, and revegetation. Any unused chemicals, oil, greases, and solvents will be cleaned up. The fuel station will have a lined area with gravel which will be removed and remediated for hydrocarbons, if necessary.
- **Surface Water Management.** Surface water will be controlled and managed around the plant area and mine facilities by the use of culverts and diversion ditches (see Appendix D). Following the demolition and dismantling of all facilities and equipment, all unnecessary surface water management structures will be removed and reclaimed. Grading and revegetation of the site will occur as soon as is practicable in order to help control surface runoff and erosion of affected areas and to promote positive drainage from the PUG Plant Site.
- **Grading and Reclamation.** Following dismantling and demolition, all disturbed and compacted areas will be regraded for positive drainage, scarified, and revegetated. Fill slopes will be graded to a maximum of 3H:1V and contoured as necessary. Retaining walls around the crusher location will be removed and exposed soil/fill slopes re-graded as needed to no steeper than 3H:1V. Exposed rock cuts will be reclaimed as practical, however, these slopes will be treated similarly to the pit slopes and are assumed to be stable for the long-term, and layback of rock slopes may be economically unfeasible or detrimental to the overall site reclamation and preservation of natural topographic features. All disturbed areas in and around the PUG Plant site will be revegetated.

- **Area Surface Roads.** All roads deemed non-essential for access, maintenance, and other future uses will be scarified, contoured, and revegetated. In addition, roads that were upgraded to secondary road standards (80 feet width) on Forest System Lands will be returned to their original pre-mining widths. Upgrades to some roads may be suitable for and consistent with previous land use and access, and therefore will remain after mining operations are complete, if approved by the Forest Service. Haul roads will be reclaimed.
- Surface water will be controlled and managed around roads during operation with culverts and diversion ditches as necessary (see Appendix D). Following the regrading and revegetation of surface roads for reclamation, all unnecessary surface water management structures will be removed and reclaimed. Grading and revegetation of the site will occur as soon as practical in order to help control surface runoff and erosion of affected areas and to promote positive drainage.

Reclamation Schedule and Phases

- Mining will span 40 or more years based on the current mine plan. Reclamation and closure are expected to take place progressively during mining operations as practical. Namely, the Waste Rock Facility will be re-graded, contoured, and revegetated during operations following the completion of each Waste Rock Facility lift, refer to Section 5.22.5.2 for additional details. The WDEQ-LQD will be notified periodically as reclamation and revegetation activities take place on site in accordance with the annual status report. It is assumed that all closure and reclamation activities (excluding monitoring) will be completed within two years following the completion of mining activities. Final closure is expected to commence following the cessation of mining operations. Monitoring will continue following closure and reclamation until suitable conditions concerning water quality and revegetation uptake have been reached.

Reclamation Monitoring Plan

- Monitoring of reclamation efforts will occur according to the monitoring plan approved by the WDEQ-LQD. Monitoring stations used during normal mining operations will continue to be monitored post mine closure as directed by the WDEQ-LQD. Monitoring will continue following closure and reclamation until suitable conditions concerning water quality and revegetation uptake have been reached.

Appendix B
Emergency Response Plan Applicable to All Action Alternatives

Emergency Response

Proponent developed the Bull Hill Mine Emergency Release Response and Contingency Plan (Appendix A) (Knight Piesold and Co. , 2012) to minimize the potential for spills and to respond quickly and efficiently should accidental releases or spills occur during construction, operation, or closure.

Proponent designated the chain of authority and responsibilities in the event of an emergency.

- In the event of a spill, the spill observer will contact the General Manager (as the Primary Contact), who is responsible for: contacting the Health, Safety, Social, and Environmental Manager or Technical Services Manager; and directing the spill assessment, spill clean-up team assembly, and spill clean-up.
- If the Primary Contact is not available, the Secondary Contacts, including the Health, Safety, Social, and Environmental Manager or Technical Services Manager, are then responsible for fulfilling the duties of the Primary Contact and ensuring all personnel are safe.

Health, Safety, Social, and Environmental Manager is responsible for:

- Development, implementation, and updating the Emergency Release Response and Contingency Plan, including maintaining the emergency contact list.
- Organization, training, and oversight of the Emergency Response Team and emergency supplies and equipment.
- Handling communications with the public and reporting to regulatory agencies and stakeholders.

The Emergency Response Team

- Will be comprised of site employees trained in first aid, fire rescue, evacuation, use of a self-contained breathing apparatus, working in closed and/or oxygen deficient spaces, and spill response. Fire rescue training will be conducted annually.
- Provide safety training to staff at the time of hire and as annual refresher courses. Contractors and site visitors will undergo an orientation program that covers site safety procedures, emergency signals, and evacuation routes.

General Emergency Response Procedures

In the event that a leak, spill, rupture, or other accident associated with fuel, oil, or chemical storage areas, the response should include the following general procedures:

- Avoid danger to people (i.e., stop working, shut off power sources and any moving machinery and equipment, extinguish smoking materials or other spark or flame-making devices, and alert others in the area of danger).
- Move people upwind of the emergency scene.
- Identify the product that has been spilled, as well as immediate potential hazards.
- If it can be done in a safe manner, prevent the spill from entering waterways.
- Assess spill volume and characteristics.
- Notify County dispatch with as much information as possible.
- Arrange for a safe and timely cleanup of spilled material by contacting the Health, Safety, Social, and Environmental Manager.

Only trained personnel should enter areas that are not well ventilated. Trained personnel should only enter these areas with appropriate respiratory protection and should always employ the “buddy system.”

Employees will undergo formal safety training and task training, which will include hazard recognition specific to a mine working environment and job tasks. Weekly safety meetings will be held.

Proponent will develop and use an emergency response checklist based on guidelines developed by Mine Safety and Health Administration (MSHA).

Spill and Leak Prevention - Storage Tanks and Fuel and Bulk Oil Storage Facilities

Proponent will inventory and map chemicals at Bull Hill Mine, including locations and contents of storage tanks. Personnel will be assigned by the Technical Services Manager to inspect fuel and oil storage facilities as part of the normal dispensing and tracking of fuel consumption duties. Above-ground tanks will be inspected for leaks, damage, or unusual conditions. The Technical Services Manager will keep an inventory of inputs and outputs to each tank and will reconcile the balance monthly to detect any fuel or oil losses.

All storage tanks and bins will be constructed with surrounding berms to provide adequate secondary containment capacity to contain 110 percent of the largest vessel. All tanks and bins will be located so as to be easily visible to mobile equipment operators. Inspections will occur on at least a monthly basis to evaluate integrity of tanks, piping, and containment structure. During filling, BMPs will be mandatory to reduce potential for spills.

Below-ground storage tanks will be constructed to resist corrosion and to limit the potential for accidental spills, and will be equipped with overfill/spill buckets. Annual leak testing will be performed on all non-consumptive tanks, and volumes will be reconciled regularly in both consumptive and non-consumptive tanks.

All employees who handle chemicals will be trained in proper use and storage procedures. Good housekeeping procedures will be mandatory for all employees who handle or use chemicals and fuels.

Spill Containment

In the event of a spill, the Emergency Response Team (ERT) will be dispatched immediately to the spill location. The spill containment contingency plan would be implemented. All spills and spill clean-up actions will be documented. A follow-up report will make recommendations on future preventative measures; lessons-learned will be integrated into operation and emergency response plans.

The General Manager and HSSE Manager are responsible for filing a spill report to the appropriate regulatory agencies within the prescribed amount of time. Spills will be documented using a Spill Reporting Form.

Fires and Explosions

Bulk fire protection will be provided from the water distribution system via a hydrant distribution system in the administration area. Firefighting equipment will be maintained on site. Chemical fire extinguishers will be located in higher risk areas such as control rooms, mineral processing areas, and on mobile equipment. Smoke detection equipment may be used in higher risk facilities such as personnel areas and offices. Trained employees will perform inspections of higher risk areas and equipment.

Upon detection of a fire or explosion, the fire emergency response procedure will be followed, which includes assessing severity of the situation and notifying responsible authorities, calling the ERT for assistance if needed, activating the emergency warning system, and restricting access. Firefighting equipment and an emergency response vehicle will be dispatched to the area immediately. Employees will be trained on the dangers associated with fires and explosions, including oxygen-deficient atmospheres and generation of toxic gases.

Medical Emergencies

The ERT will respond to medical emergencies and follow medical emergency response procedures of the ERRCP. The HSSE will track and report medical emergencies to the appropriate regulatory authorities.

Transport and Storage of Hazardous Materials

- Hazardous materials will be stored in facilities designated for hazardous materials storage.
- Designated shipping containers will be used to transport hazardous substances, including chemicals, fuels, and other materials contaminated by hazardous substances.
- All suppliers of hazardous materials will be required to have their own emergency response procedures in place as part of their contractual agreements.
- Supply contractors will be required to provide the following applicable information corresponding to the regulatory requirements of the material being supplied: environmental liability insurance; evidence of employee and driver training in safety and emergency response; spill prevention, control, and clean-up plans; sensitivity maps for driving route; and contingency plans for responding to emergencies, including response equipment and third-party contacts to assist with response actions.
- Supplier's emergency response and contingency plans must be in compliance with corporate, local, national, and international standards.

Communications During Emergencies

An internal communication system will be used to alert workers to dangers, convey safety information, and maintain site control. The system will include alarms or other audible signals. Workers in remote areas will be equipped with radios or field telephones. All employees will be trained on the communication system as part of the employee orientation program and annual refreshers.

The dispatch station will be contacted immediately in the event of an emergency, and will transmit information to the rest of the mine. A notification chain of command will be established to disseminate information to local communities.

Regulatory Reporting

Reportable incidents and the associated required actions will comply with regulations established in Chapter 4 of the Wyoming Water Quality Rules and Regulations.