Golden Sunlight Mine
Amendment 015 To Operating Permit No. 00065
Draft Environmental Impact Statement

Montana Department of Environmental Quality

Prepared for:

State of Montana
Department of Environmental Quality

September 2013

Montana Department of Environmental Quality

PO Box 200901
Helena, MT 59620-0901

File Code: 1950

Date: September 17, 2013

Dear Interested Party:

The Department of Environmental Quality (DEQ) has completed a Draft Environmental Impact Statement (draft EIS) on Golden Sunlight Mine's proposed amendment for its operating permit (00065). You can obtain an electronic version of the draft EIS on DEQ's web site http://deq.mt.gov/eis.mcpx. DEQ will accept public comment on this draft EIS until October 20, 2013. DEQ will hold a public meeting and accept public comments on the draft EIS on October 8th from 6 to 8 pm at the Whitehall Community Center.

The Golden Sunlight Mine is an existing open pit mine located near Whitehall, Montana. The state of Montana issued Operating Permit No. 00065 to the mine in 1972. DEQ has previously approved fourteen amendments to the operating permit, several of which have allowed expansion of the gold mine. In September of 2012, DEQ received Golden Sunlight's application for Amendment 15, which would allow further expansion of the Mineral Hill Pit and the mining of a new pit located to the north of the Mineral Hill Pit. On April 30, 2013, DEQ determined that the company's application for Amendment 15 was complete and compliant and, pursuant to Section 82-4-337, MCA, issued a draft permit for the proposed expansion.

Pursuant to Section 82-4-337(1)(f), MCA, issuance of the draft permit as a final permit is the proposed state action subject to the environmental review required by the Montana Environmental Policy Act (MEPA) (Section 75-1-201, *et seq*., MCA). Section 75-1-201(1)(iv), MCA, requires the preparation of an environmental impact statement for state actions that may significantly affect the quality of the human environment. The environmental impact statement must include a detailed statement on the environmental impact of the proposed action, alternatives to the proposed action, and a no action alternative. Pursuant to this statute, the draft EIS analyzed a No Action Alternative, a Proposed Action Alternative (the company's proposed amendment), an Agency-Modified Alternative, and a North Area Pit Backfill Alternative.

ARM 17.4.617 requires DEQ to include in an environmental impact statement an identification of the agency's preferred alternative, if any, and the reasons for the preference. At this juncture, DEQ does not have a preferred alternative. The alternatives that do not require backfill of the North Area Pit (the Proposed Action Alternative and the Agency-Modified Alternative) and the North Area Pit Backfill Alternative each have their respective advantages and disadvantages.

The alternatives that do not require backfill would provide some terrestrial wildlife habitat and habitat for bats and raptors and would allow for the construction of a secondary system to capture impacted groundwater should the proposed perimeter dewatering wells fail. These alternatives would also impact visual resources, although that impact would be mitigated.

The North Area Pit Backfill Alternative would provide terrestrial wildlife habitat and, because the pit would be backfilled and revegetated, would have noticeably less visual impact than the alternatives that do not require backfill. The backfill in the pit, however, would likely foreclose the opportunity to implement secondary systems to capture the impacted groundwater in the event that the perimeter dewatering wells fail.

DEQ will make its decision after reviewing public comments on the draft EIS and the additional environmental analysis that will likely be generated in response to those comments. For more information, or to comment, please contact:

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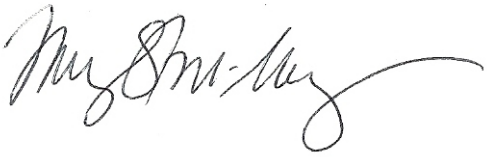
406-444-2813

I welcome and look forward to your participation.

Sincerely,



Tracy Stone-Manning, Director
Montana Department of Environmental Quality

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Summary

S.1 Introduction

This draft environmental impact statement (EIS) has been prepared for the proposed expansion of the Golden Sunlight Mines (GSM) in Jefferson County, Montana (**Figure S-1**). GSM submitted an Application for Amendment 015 to Operating Permit No. 00065 in September 2012 (GSM 2012a). The Department of Environmental Quality (DEQ) provided a first deficiency letter on November 2, 2012 and GSM responded to those comments on December 21, 2012 (GSM 2012b). DEQ sent a second deficiency letter on January 18, 2013 and GSM responded to the comments on February 1, 2013. DEQ issued a draft amendment to the operating permit on April 30, 2013. The mining and reclamation activity described in the Amendment 015 Application is the Proposed Action Alternative.

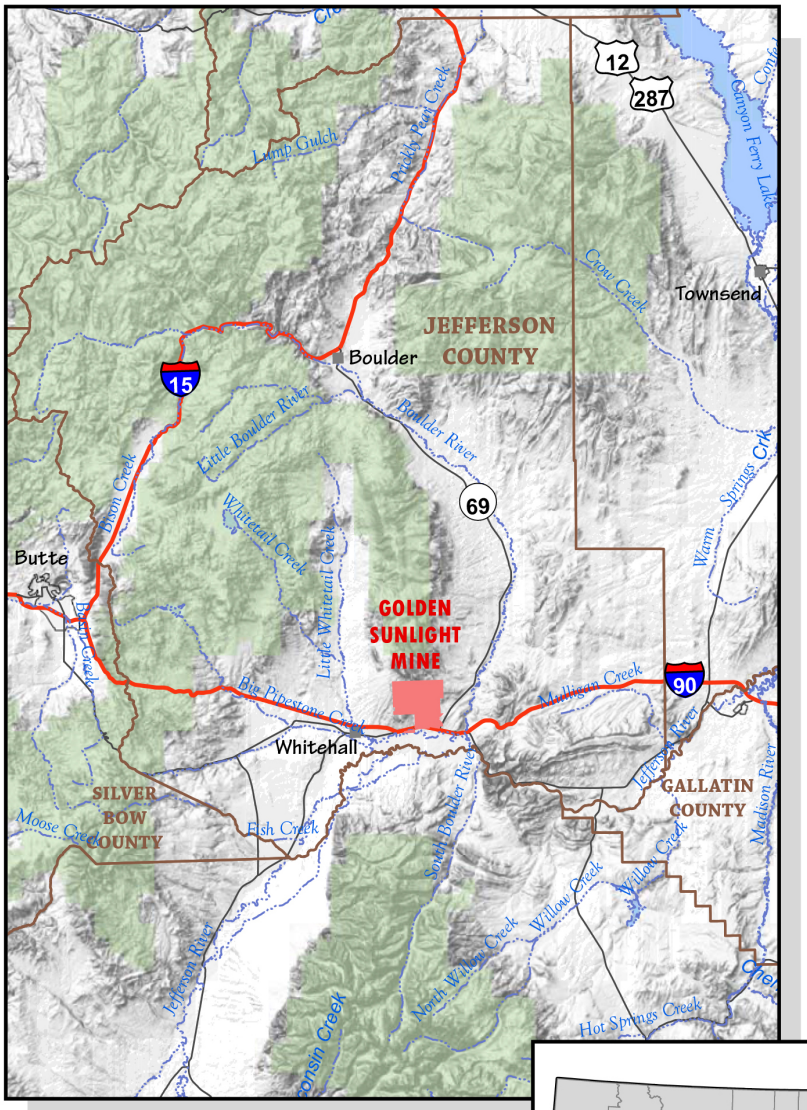
DEQ is the lead agency and prepared the EIS for the mine expansion. The EIS presents the analysis of possible environmental consequences of four alternatives: No Action Alternative, which is GSM current Operating Permit 00065; Proposed Action Alternative (Amendment 015); Agency Modified Alternative which includes mitigations proposed by DEQ, and the North Area Pit Backfill Alternative. The four alternatives are described in detail in Chapter 2. This EIS is tiered to the *Final Supplemental Environmental Impact Statement Golden Sunlight Mine Pit Reclamation* (SEIS) prepared by DEQ and the Bureau of Land Management (BLM) in 2007 (DEQ and BLM 2007).

S.2 Purpose and Need

GSM currently mines ore containing gold and other metals from the Mineral Hill Pit under Operating Permit 00065, issued by DEQ under the Montana Metal Mine Reclamation Act ([MMRA]; 82-4-301 *et seq.*, Montana Code Annotated [MCA]).

The application for amendment to mine additional ore reserves was developed to extend the life of the mine. The amendment would extend the current mining operation by up to two years beyond the current operating permit.

The Montana Environmental Policy Act (MEPA) requires an environmental review of actions taken by the State of Montana that may significantly affect the quality of the human environment. This EIS was written to fulfill the MEPA requirements. The Director of DEQ will decide which alternative should be approved in a Record of Decision (ROD) based on the analysis set forth in the Final EIS, including the comments received on the draft EIS and the agency's responses to those comments.



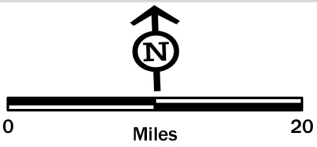


Figure S-1
Location Map

S.3 Issues of Concern

There were no adverse issues of concern raised by the public during scoping for the proposed GSM Amendment 015 expansion. The 118 comments were in support of the mine expansion and continued mining by GSM and included general comments about (1) socio-economic benefits, (2) company environmental stewardship, (3) safety, (4) only minor changes for this amendment, and (5) to not delay the approval timeline. There were 10 comments that contained specific technical aspects about GSM or the Proposed Action Alternative and they are described in the Scoping Report (Tetra Tech 2013).

The issues of concern identified by DEQ while preparing the Draft EIS and agency modifications to the Proposed Action Alternative include:

- **Geotechnical Engineering** - The open pits and rock faces must be reclaimed to stable and structurally competent slopes capable to withstand geologic and climatic conditions without significant failure that would be a threat to public safety and the environment.

- **Water Resources –** Surface water and groundwater from the North Area Pit must be captured and properly handled during mine operation and post-closure. There was some uncertainty of the groundwater flow paths from the North Area Pit toward the Mineral Hill Pit. Mining-related seeps in the EWRDC Expansion area could be contaminated with metals and be acidic and cause off-site surface water and groundwater contamination.

- **Pit Backfill** - Under the Metal Mine Reclamation Act (MMRA), the use of backfilling as a reclamation measure is neither required nor prohibited in all cases. Backfilling the proposed South Area Layback (part of the Mineral Hill Pit) is not an issue needing detailed analysis in this EIS because DEQ previously determined backfilling the Mineral Hill Pit did not provide adequate protection of groundwater and surface water resources. Backfilling the North Area Pit is different from backfilling the Mineral Hill Pit and an independent analysis is required.

- **Social and Economic Considerations** - Beneficial impacts were expressed regarding good-paying jobs provided by GSM.

- **Soils, Vegetation, and Reclamation** - GSM supplements borrow materials for reclamation plant growth medium and these materials may not always provide the necessary fertility for successful reclamation. Also, GSM did not propose to salvage some fine-grained lake bed sediments in the North Area Pit that may be suitable as plant growth medium on level areas.

- **Wildlife –** The reclamation of the open pits and rock faces must provide sufficient measures that afford some utility to humans or the environment.

- **Aesthetics** - The reclamation of the open pits and rock faces must help mitigate or prevent post-reclamation visual contrasts between reclamation lands and adjacent lands.

Through an interdisciplinary team (IDT) review, it was determined that a number of resource areas and associated issues would not be affected or would be minimally affected and therefore would not be discussed further in the EIS. The resource areas considered but not studied in detail included air quality; fisheries and aquatics; noise; cultural and paleontological resources; transportation; wetlands and Waters of the U.S.; areas of critical environmental concern; prime or unique farmlands; wild and scenic rivers; wilderness; water rights, and safety.

S.4 Alternatives Analyzed in Detail

Four alternatives are described and evaluated in detail in this EIS: the No Action Alternative; the Proposed Action Alternative (proposed Amendment 015); the Agency Modified Alternative; and the North Area Pit Backfill Alternative.

Brief summaries of the four alternatives are presented below. Detailed descriptions of the alternatives are provided in Chapter 2.

S.4.1 No Action Alternative

The No Action Alternative reflects the current operations conducted under Operating Permit 00065 (through Amendment 014), including mining of the 5B Optimization Project in the Mineral Hill Pit. The main mine facilities consist of the Mineral Hill Pit, the East Pit, the milling and ore processing complex, two tailings storage facilities (TSF-1 and TSF-2), and five waste rock disposal areas. The mine would continue to operate 24-hours per day, 7 days per week, through the end of 2014 or early 2015. GSM is currently approved for mining and associated facilities disturbance on 3,104 acres in a permit boundary of 6,125 acres.

S.4.2 Proposed Action Alternative

Under the Proposed Action Alternative, GSM would expand their current mining operation with the addition of one new pit called the North Area Pit, and an expansion to the existing Mineral Hill Pit known as the South Area Layback. The expansion would allow GSM to mine an additional 4.2 million tons of gold ore that would be processed at the existing mill facility. Mining would be consistent with current mining operations using conventional open pit mining methods.

Approximately 52.6 million tons of non-ore waste rock would be generated from the proposed new mining areas and would be primarily placed in the East Waste Rock Dump Complex (EWRDC) Expansion area (Section 2.3). Amendment 015 would increase the size of the permitted disturbance boundary by approximately 68.1 acres and would extend current mining operations by about two years.

S.4.3 Agency-Modified Alternative

The Agency-Modified Alternative is the same as the Proposed Action Alternative with modifications developed by DEQ to mitigate the environmental impacts from the Proposed Action Alternative. These modifications include the following:

1. The capture and routing of mining-related seeps in the EWRDC Expansion area that could contaminate groundwater and off-site surface water;

2. The capture and routing of North Area Pit surface water runoff and groundwater after mine closure;

3. The implementation of closure geodetic and ground-movement monitoring for the North Area Pit and EWRDC Expansion area to ensure safe access and to keep reclamation cover systems working;

4. The salvage of available fine-grained lakebed sediments in the North Area Pit and incorporation of organic amendments in the sediments when the sediments are used as growth media in reclamation cover systems.

5. The documentation of loss of bat and raptor habitat in the Mineral Hill Pit and plan for replacement of habitat.

6. The identification of replacement areas for the portion of the 37 acres of designated revegetation for the Mineral Hill Pit that would be eliminated by the South Area Layback.

S.4.4 North Area Pit Backfill Alternative

Up to 9.2 million tons of waste rock from the South Area Layback would be used to backfill the North Area Pit rather than being hauled to the EWRDC Expansion area or the Buttress Dump Extension area.

S.5 Summary of Impacts

Table S-1 summarizes and compares the impacts of the four alternatives considered and evaluated in detail.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Disturbed Acreage				
Permit Boundary and Permitted Disturbance Boundary	Disturbance area = 3,104 acres Permit area = 6,125 acres	Increase permitted disturbance boundary by 87.4 acres (55.1 acres outside permitted disturbance boundary + 32.3 acres in Buffer Area)	Similar to the Proposed Action Alternative but would increase permitted disturbance boundary by 19.3 acres to include the Buffer Area around the southeast portion of the EWRDC Expansion area.	Same as Agency Modified Alternative.
North Area Pit	No acres of disturbance	Expand1,000 feet northeast of Mineral Hill Pit Total disturbance = 49.4 acres; New disturbance = 15 acres	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
South Area Layback	No additional acres of disturbance	Layback along southern wall of Mineral Hill Pit Total disturbance = 69.4 acres; New disturbance = 10.9 acres	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
East Waste Rock Dump Complex (EWRDC) Expansion	EWRDC permitted for 174 million tons of waste rock with a disturbed area of about 683 acres. Includes 5B Optimization. Maximum elevation is 5,850 feet which is approximately 520 feet above the natural topography.	Increase EWRDC dump size to permitted disturbance boundary 721 acres; Total new disturbance = 179.6 acres; Disturbance within permitted disturbance boundary = 141.9 acres; Disturbance outside permitted disturbance boundary = 37.7 acres; Up to additional 48.6 million tons of waste rock; Maximum height above natural topography is approximately 290 feet. Up to 6 Mt of waste rock could go to permitted Buttress Dump Extension.	Similar to the Proposed Action Alternative with modification to add additional seep monitoring and to define collection and routing methods for water from mining-related seeps in the EWRDC Expansion area.	Same as Agency Modified Alternative except dump may be not as tall if South Area layback waste rock backfills the pit rather than going to EWRDC Expansion area.
Tailings Disposal	TSF-1 ceased in 1995 and has been reclaimed. GSM would continue to treat drainage water from TSF-1 at 8 to 23 gpm. TSF-2 began receiving tailings in 1993. Approved for storage of 42 million tons of tailings at an embankment elevation of 4,770 feet. Includes 5B Optimization.	Increase TSF-2 tailings height by 4 feet with a corresponding 4.5 acres of additional disturbance. Approximately 5.0 million tons of tailings (4.2 million tons from mine + legacy mine materials) would be stored with a new ultimate embankment elevation of 4,774.5 feet.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Haul and Access Roads	Mine contains an extensive network of access and haul roads from 100 feet wide to two-tracks. Road disturbances are included in the 198.5 acres approved for "Stockpiles, borrow areas, roads, and miscellaneous".	Construction of new access road in East Waste Rock Dump Complex across Sheep Rock Creek Drainage. The road across Sheep Rock Creek has been approved and permitted but portion of road on the 37.7 acre EWRDC Expansion would be bonded under Amendment 015.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative with no access road to the bottom of the pit.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Reclamation	GSM is currently approved for mining and associated facilities disturbance on 3,104 acres in a permit boundary of 6,125 acres. As of December 31, 2012 (2012 Annual Report), the actual disturbance was 2,361 acres. GSM reports 1,168 acres of reclamation successfully revegetated (2012 Annual Report).	About 75.4 acres (91 - 15.6) of previously reclaimed land would be redisturbed by the North Area Pit, South Area Layback, and East Waste Rock Dump Complex Expansion. GSM would revegetate 22 acres of South Area layback and 12 acres of the east wall of the North Area Pit. EWRDC Expansion would be reclaimed at 2H:1V slope angles.	Same as Proposed Action Alternative except GSM would provide plans for bat and raptor habitat in new pit highwalls and how visual contrasts with adjoining areas would be mitigated in the new pits.	Same as AMA except the North Area Pit would be backfilled and all acres would be covered with growth medium and revegetated.
General Plant Operations				
Mill Processing	May be completed in early 2015	Continuous through 2017.	Same as the Proposed Action Alternative.	Same as Proposed Action Alternative.
Ore Recovery and Processing	Same as current until closure.	4.2 million tons added; Processes same as No Action until closure.	Same as the Proposed Action Alternative.	Same as Proposed Action Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mining and Geotechnical Engineering				
North Pit Area	Would not be constructed	Some erosion of the North Area Pit highwall and raveling of material onto benches would likely continue during the life of mine. The North Area Pit would expose zones of poor rock quality within some of the highwalls resulting in more potential small highwall instability problems, especially in and around the Range Front Fault. Bozeman area clay seams could potentially be encountered in the east wall locations. If this layer is extensive and prevalent over large horizontal extent in stratigraphy it could affect stability of benches in local areas and require adjusting the pit wall design.	Similar to the Proposed Action Alternative with modifications to design method to convey water to the water treatment plant at closure; grade, cover with low-permeable materials, cover with soil, and seed a portion of the pit; and line the sump area in the bottom of the pit.	North Area Pit would be backfilled and all acres would be covered with growth medium and revegetated eliminating any instability problems.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	Some erosion of the Mineral Hill Pit highwalls and raveling of material onto benches would likely continue during the life of mine and after mining. GSM has to maintain access into pit by maintaining 5,700-foot pit bench. GSM has to maintain access to underground workings to repair water collection and routing equipment to get underground pit sump water to treatment plant.	Structure is favorable for pit highwall stability. However, some areas would be developed in the hanging wall of the Corridor Fault, the Telluride Fault, and the Splay Fault which are associated with poor rock quality. Careful controlled blasting and scaling should mitigate rockfall concerns and stability risks associated with lower rock mass quality. After mining, GSM would have to maintain Mineral Hill Pit access the same as No Action.	Similar to the Proposed Action Alternative with modifications for additional ground movement monitoring to identify potential for mass movement after mining in the South Area Layback if needed to access the Mineral Hill Pit after closure.	

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	Pit highwall stability would continue to be monitored using the existing system of survey prisms and extensometers. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and to minimize potential damage to mining equipment.	During operations, effective groundwater depressurization would be required and controlled blasting techniques would be used in the South Area Layback mine pit development to maintain the integrity of the benches and minimize raveling to ensure the benches remain capable of containing future rock falls. No additional monitoring is proposed after closure	Same as the Proposed Action Alternative	Same as PAA
	Discuss monitoring currently approved after closure if any		GSM would be required to do additional monitoring if South Area Layback affects access into the Mineral Hill Pit at closure.	Same as AMA

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	There would be the potential for smaller scale slope failures on pit highwalls and release of rock into the mine pit during operations. SEIS discussed potential raveling and failures after mining.	Discuss how new pit would affect operational smaller scale slope failures on pit highwalls and release of rock into the layback. Discuss how new pit layback would affect SEIS prediction for failures and raveling after mining. The proposed mine pit development should relieve loading pressures in the head area of the Swimming Pool Earth Block thus likely relieve loading pressures in the head area and is not predicted to instigate further movement in the block.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Tailings Storage Facility-2 and Embankment	The final surface of the tailings would have a 0.5-percent to 5-percent slope toward the east end of the embankment to facilitate surface water drainage to the spillway. The outside slope of the tailings storage facility embankment would be reclaimed by reducing the slope to 2.5H: 1V.	The final surface of the tailings storage facility and outside slope slopes would be graded the same as the No Action Alternative.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Soil, Vegetation, and Reclamation				
Soil and Other Growth Medium Resources	Loss of soil development and horizons, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. Reclamation and revegetation would minimize long-term effects.	Impacts to soils, vegetation, and reclamation would be similar to those described under the No Action Alternative but would apply to a larger area of disturbance. An additional 302.9 acres would be disturbed or redisturbed as a part of this action. 152.1 acres of new disturbance outside of permitted disturbance boundary and not previously disturbed and 150.8 acres in permitted disturbance boundary and previously disturbed.	Similar to the Proposed Action Alternative with modification to salvage and stockpile fine-grained lakebed sediment materials for reclamation of gently and flat slope areas.	Same as the Agency Modified Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Vegetation and Reclamation	Reclamation seed mixtures have been developed for various slope configurations and facilities. Mine operations have not successfully reclaimed any areas to Douglas-fir or mixed shrub plant communities. Noxious weed infestations are monitored and treated every year, 159 acres of the Mineral Hill Pit would be regraded to 2H:1V slopes, covered with soil, and revegetated. The remaining 158 acres of the pit would be left unvegetated as rock faces with some bat and raptor habitat.	The seedbed preparation and revegetation plans for the additional areas under the Proposed Action would be similar to the No Action Alternative. Same as the No Action Alternative. Approximately 30 acres of the North Area Pit and 22 acres of the South Area Layback would be regraded to 2H:1V slopes, covered with soil, and revegetated.	Same as the Proposed Action Alternative	Same as Proposed Action except the North Area pit would be completely backfilled and all 49.4 acres of the North Area Pit would be covered with growth medium and revegetated.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Water Resources				
Surface Water	There are minimal environmental consequences to surface water under this alternative. Surface water drainage patterns and runoff volumes and rates would remain as approved. Over the long-term and as more project facilities are reclaimed and vegetation on reclaimed surfaces becomes more dense, ephemeral surface water runoff rates would decrease.	The increased pit disturbance areas would capture more rainfall and snowmelt and contribute to stormwater during runoff events. The disturbed EWRDC Expansion surfaces would be more permeable with less surface runoff but with a greater contribution to groundwater. Following reclamation, the revegetated surfaces would result in some surface runoff with a smaller contribution to groundwater.	Similar to the Proposed Action Alternative.	Same as Agency Modified Alternative except the North Area Pit would be backfilled and more captured precipitation would be routed out of the backfilled pit.
Groundwater South Area Layback	The South Area Layback would not be constructed.	The groundwater flow paths for the Mineral Hill Pit would remain the same, and the groundwater pumping and capture systems on the site are designed to address impacts from Mineral Hill Pit operations. The South Area Layback would be an extension of the Mineral Hill Pit and would drain into the main pit where water would be captured by the underground pit sump and pumped from the pit to the WTP.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Groundwater North Area Pit	The North Area Pit would not be constructed.	The North Area Pit would be dewatered using two vertical dewatering wells around the perimeter of the pit. If vertical dewatering wells are not successful horizontal dewatering wells may be needed. If dewatering is incomplete, some groundwater would report to the pit and migration of the impacted groundwater out of the pit could occur. The water would report to the identified pit flowpaths and water would have to be captured by the Rattlesnake drainage capture wells.	Similar to the Proposed Action Alternative with modification to prepare design to convey pit water to the water treatment plant; regrade, cover with low permeable materials, cover with soil, and seed a portion of the pit; and line the sump area in the bottom of the pit. This would limit the amount of water that could seep into groundwater.	Same as Agency Modified Alternative except stormwater and snowmelt runoff would be routed out of the backfilled pit limiting the amount of water reporting to groundwater through acidic waste rock backfill.
Groundwater EWRDC Expansion	The EWRDC Expansion Area would not be constructed.	Discuss how long it is predicted for water to migrate through the dump to groundwater and the amount of water 2.1 gpm that would seep out at the base or report to groundwater. Discuss GSM proposed monitoring for seeps from the EWRDC Expansion area and plans if any to capture and treat the water to minimize impacts to groundwater.	Similar to the Proposed Action Alternative with modifications to monitor for toe seeps associated in the EWRDC Expansion area GSM would provide a detailed plan for after mining, on how seepage water would be collected and routed at the water treatment plant.	Same as the Agency Modified Alternative.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
	Wildlife and Fisheries			
South Area Layback/ North Area Pit	There would be no additional effects on wildlife or fish species within or adjacent to the Project area.	Construction and operational noise may cause a continued short-term, temporary disturbance to wildlife. The South Area Layback may reduce the approved wildlife highwall habitat approved in the 2007 SEIS. 22 acres would be covered with growth medium and reclaimed to grassland habitat. No detailed plan provided for bat and raptor habitat in the new pit. 30 acres would be covered with growth medium and reclaimed to grassland habitat.	Same as the Proposed Action Alternative except GSM would provide a plan to provide bat and raptor habitat in South Area Layback highwalls to provide some utility to the environment. GSM would provide a plan to provide bat and raptor habitat in North Area Pit highwalls to provide some utility to the environment.	Same as the Agency Modified Alternative except North Area Pit would be backfilled creating more vegetated grassland habitat and less bat and raptor habitat.

TABLE S-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES					
Resource, Land Use, or Activity	**General Impact**				
	No Action Alternative (Current Operating Permit)		**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Social and Economic Conditions					
Additional wages, salaries, and benefits paid in 2016		$0	$13,580,305	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Tax Revenues paid 2013-2016		Price of gold $1,300-$1,700/oz.	Price of gold $1,300-$1,700/oz.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
	2013	$4.615-$5.855 million	$4.677 - $5.915 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2014	$3.544-$4.420 million	$4.197 - $5.275 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2015	$1.005-$1.276 million	$2.871 - $3.556 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2016	$0.416 million	$2.538. -$3.242 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.

S.6 Preferred Alternative

The rules and regulations implementing MEPA (ARM 17.4.617) require agencies to indicate a preferred alternative in the Draft EIS, if one has been identified. At this time, a preferred alternative has not been selected by DEQ and the evaluation process will continue based on the public comments on the Draft EIS, new information that becomes available, or new analysis that might be needed in preparing the Final EIS.

Purpose of and Need for Action

1.1 Introduction

This draft environmental impact statement (EIS) has been prepared for the proposed expansion of the Golden Sunlight Mines (GSM) in Jefferson County, Montana (**Figure 1-1**). GSM submitted an Application for Amendment 015 to Operating Permit No. 00065 in September 2012 (GSM 2012a). The Department of Environmental Quality (DEQ) provided a first deficiency letter on November 2, 2012 and GSM responded to those comments on December 21, 2012 (GSM 2012b). DEQ sent a second deficiency letter on January 18, 2013 and GSM responded to the comments on February 1, 2013. DEQ issued a draft amendment to the operating permit on April 30, 2013. The mining and reclamation activity described in the Amendment 015 Application is the Proposed Action Alternative.

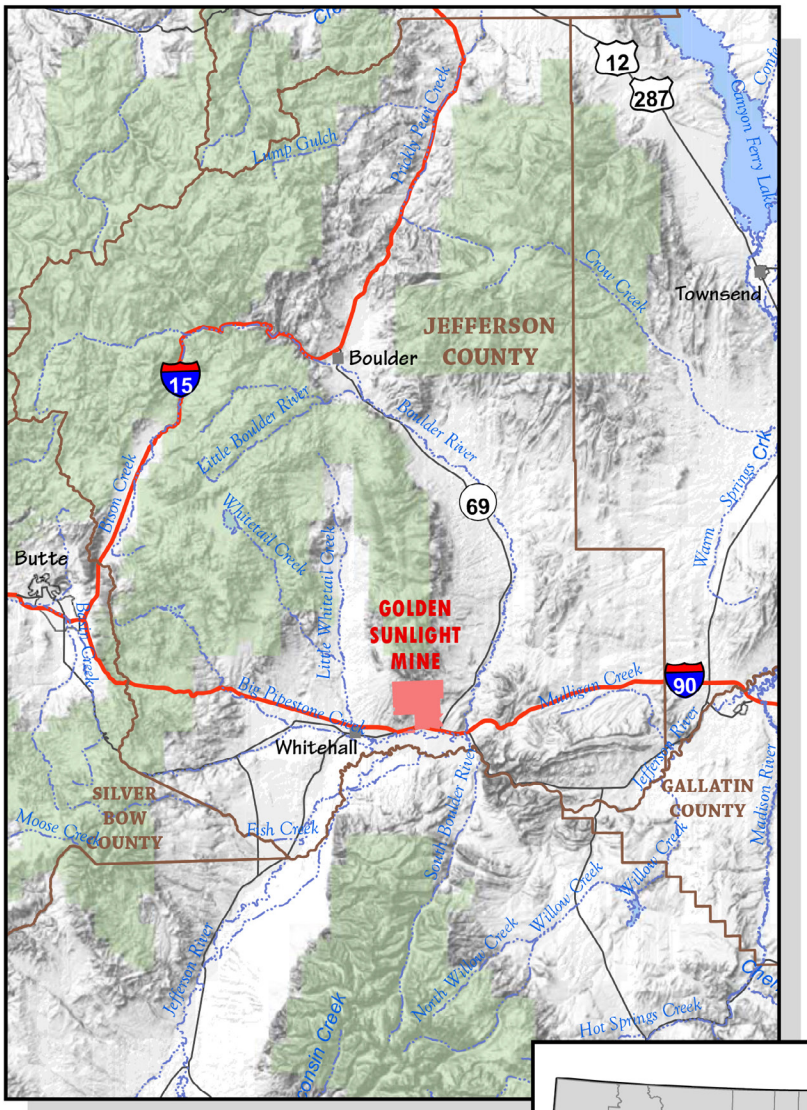
DEQ is the lead agency and prepared the EIS for the mine expansion. The EIS presents the analysis of possible environmental consequences of four alternatives: No Action Alternative, which is GSM current Operating Permit 00065; Proposed Action Alternative (Amendment 015); Agency Modified Alternative which includes mitigations proposed by DEQ, and the North Area Pit Backfill Alternative. The four alternatives are described in detail in Chapter 2. This EIS is tiered to the *Final Supplemental Environmental Impact Statement Golden Sunlight Mine Pit Reclamation* (SEIS) prepared by DEQ and the Bureau of Land Management (BLM) in 2007 (DEQ and BLM 2007).

1.2 Purpose and Need

GSM currently mines ore containing gold and other metals from the Mineral Hill Pit under Operating Permit 00065, issued by DEQ under the Montana Metal Mine Reclamation Act ([MMRA]; 82-4-301 *et seq.*, Montana Code Annotated [MCA]).

The application for amendment to mine additional ore reserves was developed to extend the life of the mine. The amendment would extend the current mining operation by up to two years beyond the current operating permit.

The Montana Environmental Policy Act (MEPA) requires an environmental review of actions taken by the State of Montana that may significantly affect the quality of the human environment. This EIS was written to fulfill the MEPA requirements. The Director of DEQ will decide which alternative should be approved in a Record of Decision (ROD) based on the analysis set forth in the Final EIS, including the comments received on the draft EIS and the agency's responses to those comments.



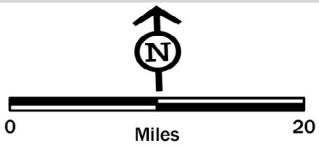


Figure 1-1
Location Map

1.3 Project Location and History

GSM currently operates an open pit gold mine in southern Jefferson County near Whitehall, MT (**Figure 1-1**). The mine has a 3,104-acre permitted disturbance boundary in a total mine permit area of 6,125 acres. GSM also has an approved Plan of Operations with the BLM.

1.4 Scope of the Document

Four alternatives are described and evaluated in detail in this EIS. Chapter 2 describes the No Action Alternative, the Proposed Action Alternative (proposed Amendment 015), the Agency Modified Alternative, and the North Area Pit Backfill Alternative. Chapter 3 describes the existing environment that may be affected by the alternatives. Resource areas discussed in detail include: geotechnical engineering; soil, vegetation, and reclamation; water resources including surface water, groundwater, and geochemistry; wildlife including threatened and endangered species; social and economic conditions, and aesthetics. Chapter 4 describes the environmental impacts that may occur under the alternatives.

The EIS does not include alternatives to, or reconsideration of, previously approved pit reclamation actions discussed and evaluated in the 2007 Final Supplemental EIS (SEIS).

Brief summaries of the four alternatives are presented below. Detailed descriptions of the alternatives are provided in Chapter 2.

1.4.1 No Action Alternative

The No Action Alternative reflects the current operations conducted under Operating Permit 00065 (through Amendment 014), including mining of the 5B Optimization Project in the Mineral Hill Pit. The main mine facilities consist of the Mineral Hill Pit, the East Pit, the milling and ore processing complex, two tailings storage facilities (TSF-1 and TSF-2), and five waste rock disposal areas. The mine would continue to operate 24-hours per day, 7 days per week, through the end of 2014 or early 2015. GSM is currently approved for mining and associated facilities disturbance on 3,104 acres in a permit boundary of 6,125 acres.

1.4.2 Proposed Action Alternative

Under the Proposed Action Alternative, GSM would expand their current mining operation with the addition of one new pit called the North Area Pit, and an expansion to the existing Mineral Hill Pit known as the South Area Layback. The expansion would allow GSM to mine an additional 4.2 million tons of gold ore that would be processed at

the existing mill facility. Mining would be consistent with current mining operations using conventional open pit mining methods.

Approximately 52.6 million tons of non-ore waste rock would be generated from the proposed new mining areas and would be primarily placed in the East Waste Rock Dump Complex (EWRDC) Expansion area (Section 2.3). Amendment 015 would increase the size of the permitted disturbance boundary by approximately 68.1 acres and would extend current mining operations by about two years.

1.4.3 Agency Modified Alternative

The Agency Modified Alternative is the same as the Proposed Action Alternative with modifications developed by DEQ to mitigate the environmental impacts from the Proposed Action Alternative. These modifications include the following:

1. The capture and routing of mining-related seeps in the EWRDC Expansion area that could contaminate groundwater and off-site surface water;

2. The capture and routing of North Area Pit surface water runoff and groundwater after mine closure;

3. The implementation of closure geodetic and ground-movement monitoring for the North Area Pit and EWRDC Expansion area to ensure safe access and to keep reclamation cover systems working;

4. The salvage of available fine-grained lakebed sediments in the North Area Pit and incorporation of organic amendments in the sediments when the sediments are used as growth media in reclamation cover systems.

5. The documentation of loss of bat and raptor habitat in the Mineral Hill Pit and plan for replacement of habitat.

6. The identification of replacement areas for the portion of the 37 acres of designated revegetation for the Mineral Hill Pit that would be eliminated by the South Area Layback.

7.

1.4.4 North Area Pit Backfill Alternative

Up to 9.2 million tons of waste rock from the South Area Layback would be used to backfill the North Area Pit rather than being hauled to the EWRDC Expansion area or the Buttress Dump Extension area.

1.5 Agency Roles and Responsibilities

Operating Permit No. 00065 was issued on June 27, 1975. GSM has subsequently obtained fourteen amendments to Operating Permit No. 00065. These amendments are listed in **Table 1-1**. Numerous other minor revisions have been approved.

TABLE 1-1
SUMMARY OF AMENDMENTS AND REVISIONS
GSM OPERATING PERMIT 00065

Permit Amendments	Change	Date Approved
Operating Permit 00065	Permit 00065 issued.	June 27, 1975
Amendment 001	10-year Operating Plan, New Mill Support Facilities, Tailings Storage Facility-1, and Pit Stages 1, 2, and 3. Increased allowed disturbance to 1,022 acres.	April 24, 1981
Amendment 002	Utility corridor added. Increased allowed disturbance to 1,028 acres.	October 7, 1981
Amendment 003	North Dump extension. Increased allowed disturbance to 1,098 acres.	April 15, 1983
Amendment 004	South Dump added. Increased allowed disturbance to 1,218 acres.	March 14, 1984
Amendment 004A	Pumpback wells added. Increased allowed disturbance to 1,241 acres.	July 31, 1984
Amendment 005	North Dump expansion. Increased allowed disturbance to 1,370 acres.	August 14, 1987
Amendment 006	Stage III mining and sump expansion. Increased allowed disturbance to 1,749 acres.	January 12, 1989
Amendment 007	Borrow pit added. Increased allowed disturbance to 1,764 acres.	August 4, 1989
Amendment 008	Add Stages 4 & 5, add Tailings Storage Facility- 2. Increasing allowed disturbance to 2,264 acres.	July 1, 1990
Amendment 009	Interim Dump Plan.	April 1, 1997
Amendment 010	Extend active mining through Stage 5B Optimization and modify reclamation plans. Increased allowed disturbance to 2,967 acres.	July 9, 1998
Amendment 011	SEIS Record of Decision – Underground Sump Pit Dewatering, add 21 Stipulations	August 17, 2007
Amendment 012	Reconfigure East Buttress Dump and extend mining with 5B Optimization Pit. Realigned permitted disturbance boundary and increased allowed disturbance to 3,101 acres.	February 17, 2010
Amendment 013	Authorize construction of Sulfide Flotation Plant (not yet implemented). Increased allowed disturbance to 3,102 acres.	June 4, 2010
Amendment 014	Mining in East Area Pit	November 22, 2010

Table 1-2 lists the permits DEQ has issued for GSM.

TABLE 1-2 PERMITS ISSUED TO GSM	
Permit or Review Required (Statutory Reference)	**Purpose of Permit or Review**
Montana Department of Environmental Quality	
Montana Metal Mine Reclamation Act, Operating and Reclamation Plans (82-4-301, MCA) Operating Permit 00065	To allow mine development. Mining must comply with state environmental laws and regulations. Approval may include stipulations for mine operation and reclamation. A sufficient reclamation bond must be posted with the state before an operating permit or amendment is issued.
MEPA Analysis of Impacts (75-1-102, MCA)	To disclose possible impacts.
Montana Water Quality Act, Montana Pollutant Discharge Elimination System (MPDES) for Active Mine Area (75-5-101, MCA) Permit No. MTR300199	To establish effluent limits, treatment standards, and other requirements for point source discharges to state waters including groundwater for active mine areas. Discharges to waters may not violate water quality standards.
Montana Water Quality Act, MPDES for Inactive Mine Area (75-5-101, MCA) Permit No. MTR300012	To establish effluent limits, treatment standards, and other requirements for point source discharges to state waters including groundwater for inactive mine areas. Discharges to waters may not violate water quality standards.
Clean Air Act of Montana, Air Quality Permit (75-2-Parts 1-4) Air Quality Permit No. 1689-06	To control particulate emissions of more than 25 tons per year.

1.6 Public Participation

DEQ published a legal notice in the Butte *Montana Standard* and *Whitehall Ledger* newspapers on March 31, 2013, and April 7, 2013, and issued a press release on April 1, 2013. The scoping meeting was held on April 10, 2013, at the Whitehall Community Center in Whitehall, Montana. 140 people signed in to the scoping meeting; attendees included a Jefferson County Commissioner (Leonard Wortman), the Mayor of Whitehall (Mary Janacaro Hensleigh), GSM employees, and the interested public. The legal notice and press release requested scoping comments be sent to DEQ by May 6, 2013. DEQ received 118 written comments submitted at the scoping meeting, by regular mail, or by electronic mail.

1.7 Issues of Concern

There were no adverse issues of concern raised by the public during scoping for the proposed GSM Amendment 015 expansion. The 118 comments were in support of the mine expansion and continued mining by GSM and included general comments about (1) socio-economic benefits, (2) company environmental stewardship, (3) safety, (4) only

minor changes for this amendment, and (5) to not delay the approval timeline. There were 10 comments that contained specific technical aspects about GSM or the Proposed Action Alternative and they are described in the Scoping Report (Tetra Tech 2013).

The issues of concern identified by DEQ while preparing the Draft EIS and agency modifications to the Proposed Action Alternative are listed below.

Geotechnical Engineering

Geodetic and Ground Movement Monitoring

The reclamation plan must provide sufficient measures for reclamation of open pits and rock faces to a condition of stability structurally competent to withstand geologic and climatic conditions without significant failure that would be a threat to public safety and the environment.

Geodetic and ground-movement monitoring of the EWRDC expansion area may be needed to identify ground movement in the EWRDC Expansion Area after reclamation. Additional monitoring would help ensure the reclamation covers on the EWRDC Expansion area are maintained to minimize infiltration into the acidic waste rock.

Water Resources

With regard to open pits and rock faces, the reclamation plan must provide sufficient measures for reclamation to a condition that mitigates or prevents undesirable offsite environmental impacts, including those to water resources. In addition, the reclamation plan must provide measures that prevent objectionable post-mining ground water discharges.

Capture and routing of North Area Pit surface water runoff and groundwater during mine operation and post-closure.

Concerns were expressed regarding the uncertainty of the groundwater flow paths from the North Area Pit toward the Mineral Hill Pit. GSM described the potential quality and quantity of groundwater to be intercepted and captured by the North Area Pit operational dewatering system and how that dewatering may affect groundwater that reports to the Mineral Hill Pit (GSM 2012b). GSM would divert surface water runoff around the North Area Pit. GSM would install dewatering wells to lower the water table to allow mining. Any water that collects in the pit during operations would be managed as needed to allow continued mining.

After mine closure, the dewatering wells would continue to dewater the North Area Pit. Precipitation, snowmelt, and groundwater seeps could collect in the bottom of the pit during closure. The water that collects in the pit could be contaminated by exposure to acid generating rock. This post-mining pit water would either evaporate or infiltrate into fractures and report to the groundwater flow paths.

The methods for collecting and transporting the North Area Pit surface water and groundwater would include dewatering wells, an internal sump, and a pipe delivery system.

Mining-related seeps in the EWRDC Expansion area could be contaminated with metals and be acidic and cause surface water and groundwater contamination. GSM is required to monitor for seeps associated in the EWRDC Expansion area. Additional seep collection ponds and interception wells may be needed downgradient of the EWRDC Expansion area to capture groundwater that has contacted mine waste rock.

Pit Backfill

Under the MMRA, the use of backfilling as a reclamation measure is neither required nor prohibited in all cases. Rather, a DEQ decision to require backfill must be based on whether and to what extent the backfilling is appropriate under the site-specific circumstances and conditions. In the permitting action that culminated in the issuance of a Record of Decision in August of 2007, DEQ considered in detail two alternatives that provided for backfill of the Mineral Hill Pit. DEQ determined that the backfill alternatives did not provide adequate protection of groundwater and surface water resources and, therefore, did not select either of the alternatives providing for backfill of the pit. The proposed South Area Layback to the Mineral Hill Pit does not change any of the environmental analysis regarding pit backfill that was relied on by DEQ in 2007. Therefore, backfill of the Mineral Hill Pit, including the proposed South Area Layback, is not an issue needing detailed analysis in this EIS.

While the North Area Pit is in close proximity to the Mineral Hill Pit, its size, pit configuration, hydrology, and other conditions may be materially different than the Mineral Hill Pit. Thus, an independent analysis is required to determine whether backfill should be required based on site-specific circumstances and conditions presented by the proposed North Area Pit.

Social and Economic Considerations

Beneficial impacts were expressed regarding good-paying jobs provided by GSM. GSM is an important part of the community and two more years of mine operations would benefit the GSM employees and the multiple contractors, suppliers, and vendors. GSM

provides tax revenue to Jefferson County and the State tax base that benefits the area, state, and schools.

Soils, Vegetation, and Reclamation

Prior to mining, soils on the site were inventoried for their suitability for reclamation. The estimated volume of soil was not sufficient to meet all reclamation needs. GSM identified sources of borrow material to supplement the soil for reclamation. While the borrow material has a high coarse-fragment content and is not as fertile as the naturally developed soils, it has been used to successfully reclaim at the mine.

GSM did not propose to salvage a geologic layer containing fine-grained lake bed sediments in the North Area Pit. These materials may be suitable to supplement available growth media sources for use on level areas such as the TSF-2 surface. Lake bed sediments typically require the use of organic amendments to limit crusting of the growth media surface and to enhance successful establishment of vegetation.

Successful long-term revegetation would be impacted by an increase of invasive non-native species. Weed species are aggressive and fast-growing and could out-compete the reseeded native grasses for nutrients and available moisture. GSM has a noxious weed control program but the disturbance of additional acres would increase the risk of more weeds. Reclamation using predominantly native species would reduce impacts to vegetation and reclamation but impacts would potentially increase and therefore this issue has been carried forward.

Wildlife

With regard to open pits and rock faces, the reclamation plan must provide sufficient measures for reclamation to a condition that affords some utility to humans or the environment.

Aesthetics

The reclamation plan must provide sufficient measures for reclamation of open pits and rock faces to a condition that mitigates or prevents post-reclamation visual contrasts between reclamation lands and adjacent lands.

1.8 Issues Considered but Not Studied in Detail

Through an IDT review, it was determined that a number of resource areas and associated issues would not be affected or would be minimally affected and therefore

would not be discussed further in the EIS. The resource areas and rationale for the determination are:

Air Quality

GSM currently operates under Air Quality Permit No. 1689-06. There would not be significant changes to air quality under Amendment 015 as there would be similar rates of mining and milling and no new emission sources. This issue has not been carried forward in the analysis.

Fisheries and Aquatics

No concerns were expressed about impacts to fisheries and aquatics. There is no fish habitat in the permitted disturbance boundary and any water discharged offsite would be treated to meet state water quality standards. This issue has not been carried forward in the analysis.

Noise

GSM is in a mountainous, rural environment. The mine has been operating since 1975 and is the main source of noise in the area. Noise sources associated with the open pit mining and milling activities include drilling, blasting, loading, hauling, and ore processing. Noise is primarily from heavy equipment (haul trucks, shovels, front end loaders, rotary drills, bulldozers, graders, dump trucks, and other vehicles) and by ore processing equipment (crushers, grinding and ball mills, circuit equipment, and other machinery) that is primarily inside the mill processing buildings.

The nearest community to GSM is Whitehall, Montana about 5 miles from the permitted disturbance boundary. Noise impacts are not expected to change as a result of the mine expansion and this issue has not been carried forward in the analysis.

Cultural and Paleontological Resources

Cultural resource studies have been completed for the mine area in 1994 (Peterson et al. 1994), 1996 (Peterson 1996), and 2012 (GANDA 2012). No cultural resources were documented in the North Area Pit and one historic mine road was inventoried for the South Area Layback area. A 1985 survey (Herbort 1985) identified three cultural resource sites in the EWRDC and EWRDC Expansion area but the sites are located away from the Proposed Action Alternative disturbance areas.

No paleontological resources have been found in more than 38 years of mining. The possibility of finding a paleontological resource in the increased disturbance area for the

North Area Pit and South Area Layback is low. Cultural and paleontological resource issues have not been carried forward in the analysis.

Transportation

Transportation impacts are not expected to change and have not been carried forward in the analysis. The Montana Department of Transportation (MDT) provided a comment during scoping stating they do not expect any changes to the present operation on MDT routes because extending the life of the mine does not increase the number of employees or change the present operation.

Wetlands and Waters of the U.S.

No concerns were expressed regarding impacts to wetlands and Waters of the U.S. GSM has purchased some land surrounding the mine to mitigate for riparian and wildlife habitat lost during mining. No wetlands would be disturbed by the proposed disturbances. The Candlestick Ranch has some areas that provide year-round water and cover for wildlife. These mitigation areas are routinely inspected by GSM personnel. Two sites on the ranch have perennial spring flows and evidence of wildlife use by deer, elk, and turkey. This issue has not been carried forward in the analysis.

Areas of Critical Environmental Concern

No BLM areas of critical environmental concern would be affected by any of the alternatives.

Prime or Unique Farmlands

No prime or unique farmlands would be affected by any of the alternatives.

Wild and Scenic Rivers

No wild and scenic rivers would be affected by any of the alternatives.

Wilderness

No wilderness, wilderness study, or inventoried roadless areas would be affected by any of the alternatives.

Water Rights

GSM uses water from the Jefferson River for a potable water supply. The EIS evaluates impacts on water quantity for all alternatives. Water rights holders would have to pursue action in water rights courts over any unavoidable impacts to water rights. There would be no increased use of potable or other water sources and therefore no new impact on water rights holders so this issue has not been carried forward in the analysis.

Safety

GSM is regulated by the Mine Safety and Health Administration (MSHA). This issue has not been carried forward in the analysis as it is outside the scope of the EIS.

Description of Alternatives

2.1 Introduction

The No Action Alternative reflects the status quo and serves as a benchmark against which the Proposed Action Alternative and other alternatives can be evaluated. For this analysis, the No Action Alternative is GSM's Operating Permit 00065 and the previously approved amendments (through Amendment 014), including mining of the Stage 5B Optimization Project and approved waste rock dump designs. The Proposed Action Alternative is the proposed expansion of GSM's mining operations set forth in its Application for Amendment 015 to Operating Permit No. 00065. MEPA requires the evaluation of reasonable alternatives to the Proposed Action. Reasonable MEPA alternatives are those that are achievable under current technology and that are economically feasible. The Agency-Modified Alternative includes mitigation measures addressing specific technical issues that the IDT considered relevant to mitigating environmental impacts from the Proposed Action Alternative. The Agency also considered a North Area Pit Backfill Alternative.

Alternatives considered but eliminated from further study are discussed in Section 2.6.

2.2 No Action Alternative

GSM's Operating Permit No. 00065 was issued by the Department of State Lands, now DEQ, on June 27, 1975. Operating Permit No. 00165 has been modified a number of times since then, including major amendments allowing expansion. The most recent modification, Amendment 14, was approved in November of 2010. The No Action Alternative consists of the current approved operating plan, including all previously approved major and minor amendments and revisions through Amendment 014.

The main mine facilities (**Figure 2-1**) include the Mineral Hill Pit, milling and ore processing complex, two tailings storage facilities (one active and one decommissioned), and five rock disposal areas located east, west, and south of the Mineral Hill Pit. Mine support facilities include maintenance shops, an assay lab, fuel bays, a blasting contractor facility, administration buildings, and other infrastructure such as roads, water tanks, and power lines.

GSM uses conventional open pit mining methods consisting of drilling, blasting, loading, and hauling the waste rock and ore. The mine operates 22 hours per day, 7 days per week, with a 10-hour day shift and a 12-hour night shift. The mill operates 24-hours per day, 7 days per week on 12-hour shifts.

2.2.1 Permitted Disturbance Boundary and Disturbances

GSM is currently approved for mining and associated facilities disturbance on 3,104 acres in a permit boundary of 6,125 acres. As of December 31, 2012 (GSM 2013), the actual disturbed area was 2,399 acres. **Table 2-1** summarizes the disturbed acres by the main mining areas and facilities and **Figure 2-1** shows the permit and disturbance area boundaries.

Current mining activities are primarily associated with the Mineral Hill Pit Stage 5B Optimization Project.

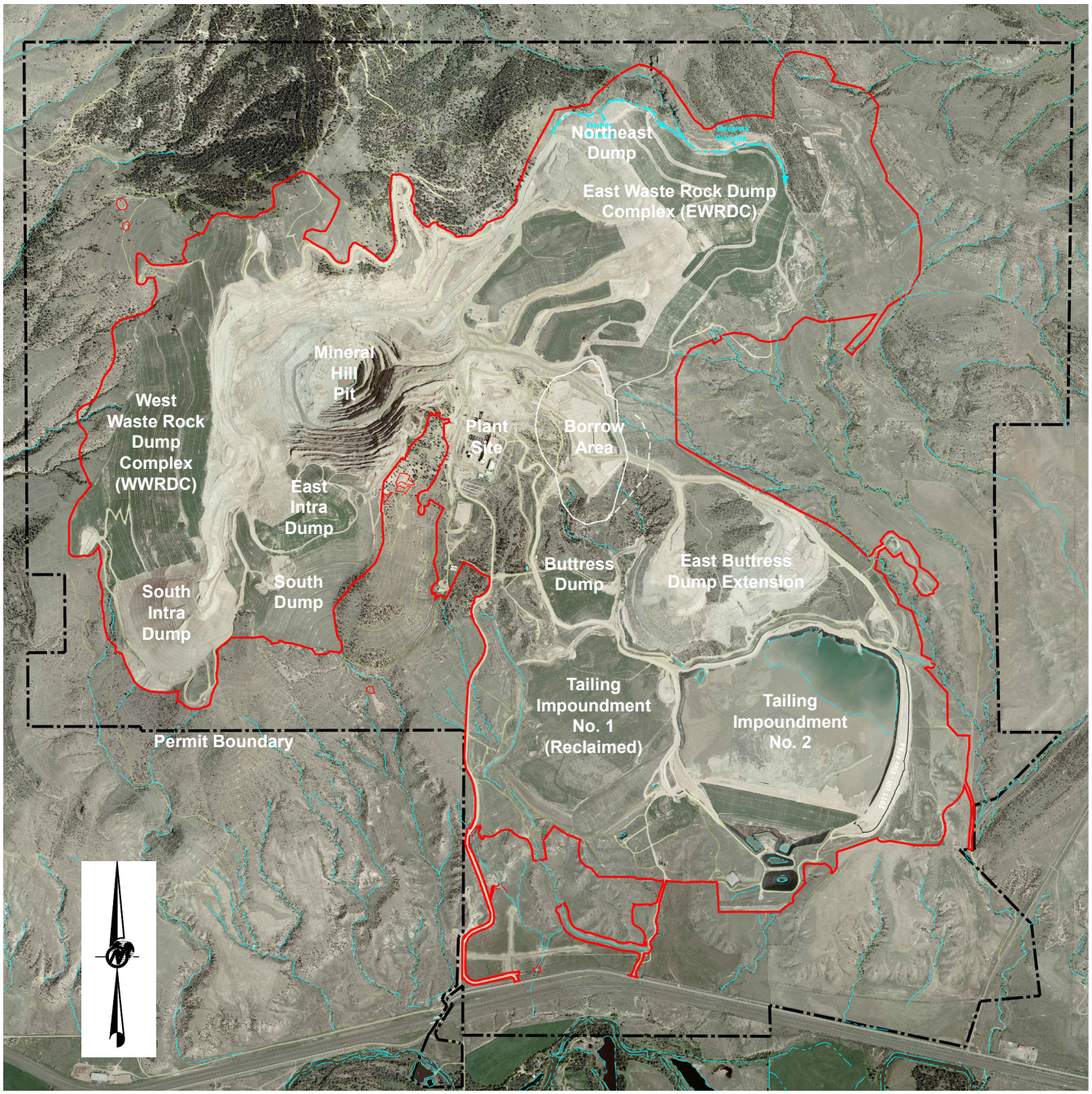
TABLE 2-1
GSM APPROVED DISTURBANCE AREAS (AS OF DECEMBER 31, 2012)

Facility	Approved Disturbance Acres
Mineral Hill Open Pit	336
East Area Pit	30
East Waste Rock Dump Complex	683
West Waste Rock Dump Complex	627
Buttress Dump Complex	327
Tailings Impoundments	865
Facilities	35
Stockpiles, Borrow Areas, Roads, and Misc.	201
TOTAL	**3,104**

2.2.2 Mining Method and Pit Description

Mining in the Mineral Hill Pit began in 1982 and will continue through 2015 under the currently approved operating permit. Mining has been completed through pit Stages 1 to 5B while current mining is occurring under the Stage 5B Optimization Project. GSM developed two phases of underground mining in 2002 with portals in the open pit. GSM will mine over 400 million tons of ore and waste rock from the 336-acre Mineral Hill Pit. The ultimate pit floor elevation will be 4,400 feet (all elevations are in reference to GSM datum, which is 91.4 feet higher than North American Vertical Datum of 1988 (NAVD88).

The current Stage 5B Optimization Project was approved in 2008. Slope instability issues were addressed by reducing slope angles, modifying bench heights and widths, controlling blasting techniques, installing horizontal drain holes, and continuing automated monitoring. Approximately 10 million tons of ore will be extracted from the Stage 5B Optimization Project pit over the 5-year mine life.



SCALE: 1" = 4,000 Feet

LEGEND

- Permit Boundary (July 2012)
- Permitted Disturbance Boundary (November 2012)
- Drainages

Source: Golden Sunlight Mine 2012a

Figure 2-1
No Action Alternative - Mine Facilities, Permitted Disturbance Boundary, and Permit Boundary

2.2.3 Ore Processing

Gold is extracted from the ore using physical and chemical processes as shown on the generalized ore processing diagram (**Figure 2-2**). Ore is crushed using a primary, secondary, and tertiary crushing circuit. Modifications to the standard crushing circuit have been used at times to improve gold recovery. The crushing circuit reduces the ore particles to less than 3/4-inch. Wet grinding in rod and ball mills further reduces the particles to approximately 150 microns or about 0.0058 inch. The finely ground ore is thickened; pumped through carbon columns; mixed with sodium cyanide, lime, and compressed air; leached, and processed through carbon for the absorption of the gold. The gold is removed from the carbon, returned to solution for electrowinning onto steel wool cathodes, smelted, and poured into bars that assay about 75 percent gold, 8 percent silver, and 13 percent other metal impurities. Typically, approximately 7,000 tons of ore can be processed per day.

After the gold is recovered from the ore, the cyanide concentration in the tailings slurry is greater than 200 milligrams per liter (mg/L). GSM built a sulfur dioxide (SO_2)/air cyanide destruction plant in 1998 that normally reduces the cyanide concentration in the tailings to less than 5 mg/L (equivalent to 5 parts per million [ppm]). The final treated tailings slurry is transported to the tailings storage facility (TSF-2).

Water for ore processing is pumped from the Jefferson Slough but the mill also uses reclaimed water pumped from the tailings impoundment. Surface water is used because groundwater of suitable quantity is not available.

2.2.4 Water Resources

Water management primarily involves pit dewatering, storm water and sediment control, tailings impoundment water, and managing water after mine closure. These key areas of water resources management are discussed below.

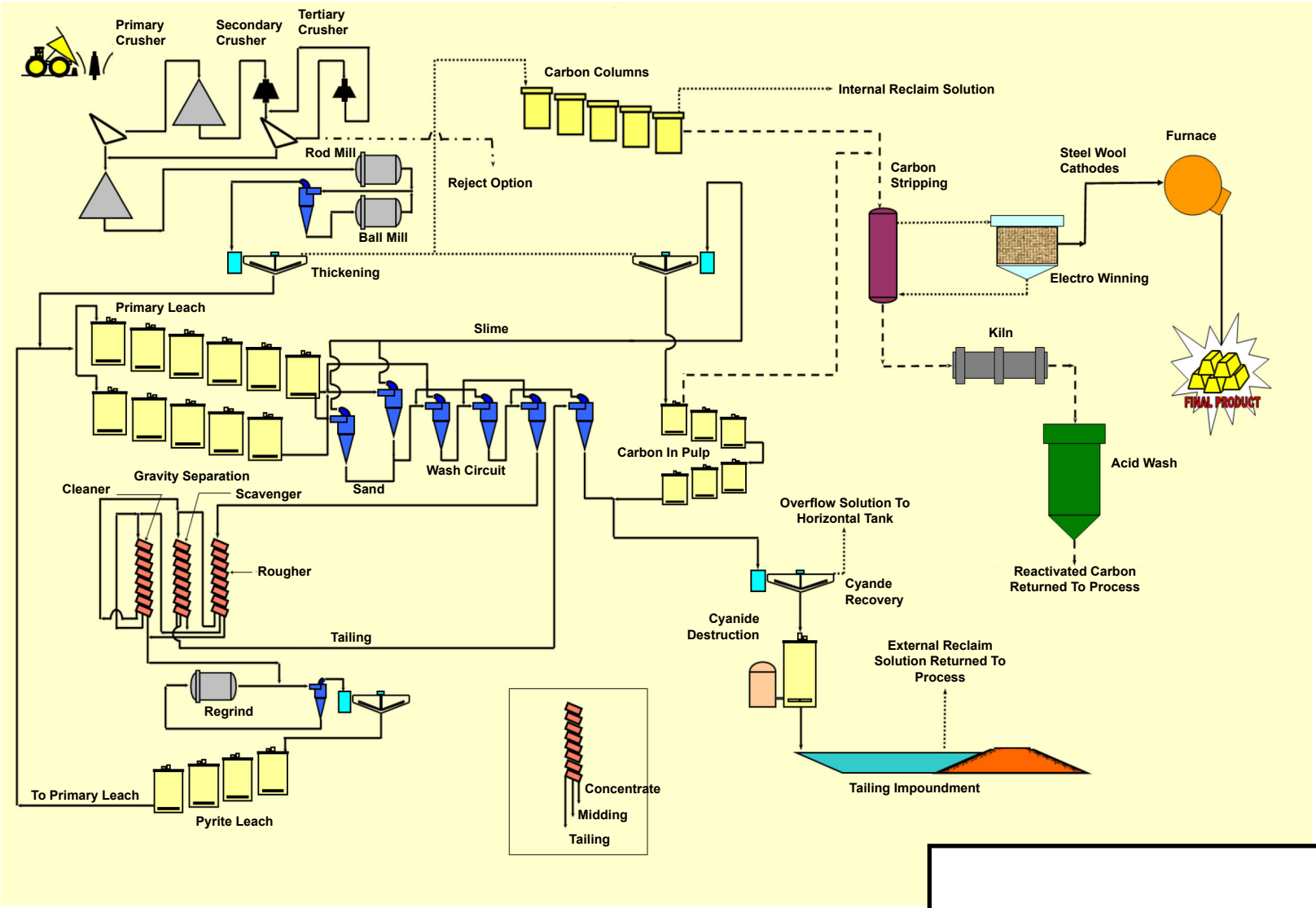


Figure 2-2
Generalized Ore Processing Diagram

Source: Golden Sunlight Mine

2.2.4.1 Pit Dewatering

One main aspect of water management is controlling the accumulation of precipitation and groundwater in the Mineral Hill Pit. Water is removed from the pit (pit dewatering) to avoid accumulation of water in active mining areas and to reduce pore pressures in the open pit highwalls. Since July 2002, a combination of wells in the pit bottom and wells in the underground workings were used. The pit inflows are collected and temporarily stored in the underground mine workings. Storm water within the pit drains to the underground workings through holes drilled in the bottom of the pit. Water is pumped from the underground workings to consecutive booster stations at 4,700 feet, 4,850 feet, and 5,000 feet through high-density polyethylene (HDPE) lines. Finally, the water is pumped out of the pit at the 5,000-foot bench booster station to a lined holding pond below the mill. The underground workings can store more than four million gallons of water before there is accumulation in the pit bottom. Up to 15.8 million gallons of water have been pumped out of the pit annually. Water from the lined holding pond is routed to the water treatment plant in the mill building.

2.2.4.2 Storm Water Management and Sediment Control

Storm water discharges are covered under General Permit MTR300199. Site storm water routing utilizes sumps and conveyances to collect and divert storm water into natural drainages for discharge. Additional best management practices are used in the drainages to control velocity and sedimentation transport. Storm water sampling locations are established in these drainages near the mine's permit boundaries. All regulated process waters or mine drainage not discharged to natural drainages are contained on site and managed using diversion ditches, capture systems, treatment systems, infiltration, land application, and reuse. Mine drainage waters are infiltrated to groundwater in internal drainage areas or diverted to the tailings impoundment and do not discharge from the permit boundary.

2.2.4.3 Tailings Impoundment Waters

GSM has evaluated the quantity of water from mine sources requiring treatment once mining has ceased. The mine sources include water drainage collected from the TSF-1 pumpback system and the dewatering of TSF-2. The estimated quantity of water to capture and treat from TSF-1 was estimated at 200 gpm but recent observed flows have been lower than 200 gpm and continued to decline. A volume of 25 gpm was estimated to be collected and treated for TSF-2 which includes 15 gpm of ambient groundwater flux from the Bozeman Formation. An estimated 225 gpm of groundwater from the tailings impoundments would be captured and treated at the water treatment plant after mining.

2.2.4.4 Water Management after Closure

After closure, mine waters will be treated using a standard lime treatment plant below TSF-2. The 1998 ROD approved the mine water treatment plant with a design capacity of 392 gallons per minute (gpm) which includes an estimated 65 gpm from the dewatering of the Mineral Hill Pit. The water treatment plant will dispose of the treated water in a percolation pond below TSF-2.

2.2.5 Tailings Storage Facilities

The mine has two tailings storage facilities, TSF-1 and TSF-2. Construction of these facilities disturbed approximately 865 acres. Approximately 271 acres associated with TSF-1 have been reclaimed. GSM deposited tailings in TSF-1 from 1983 to 1995 and in TSF-2 since 1993. TSF-1 contains approximately 27 million tons of tailings. The design capacity for TSF-2 with a tailings dam elevation of 4,770 feet is approximately 42 million tons.

GSM's tailings embankment design uses centerline construction techniques where initial construction includes a toe dike and a starter embankment using compacted, homogeneous, granular fill. The fill was taken from borrow areas in the permit boundary or from the floor of the impoundment.

Since operations ceased at the unlined TSF-1 in 1995, the facility has been undergoing tailings dewatering, consolidation, and final reclamation. Dewatering from TSF-1 has reached an equilibrium drainage rate of 8 to 23 gpm (Telesto 2007) which continues today (GSM 2013). Surface reclamation was completed and the reclamation bond for the regrading, soil covering, and reseeding was released. Downgradient leakage from TSF-1 was first noted in 1983 beyond the bentonite cut-off wall. GSM completed several corrective actions including installing a series of downgradient pump-back wells, installing a series of upgradient capture wells, and implementing a monitoring system.

Due to issues with TSF-1, GSM developed several new design features to improve the environmental performance of TSF-2 and the tailings delivery system. Improvements to the tailings pipeline included use of double-lined HDPE pipe with leak detection. New design features for TSF-2 were the use of a 60-mil HDPE geomembrane liner over the compacted soil material under the TSF-2 basin and a system of designed drains in the impoundment to convey water from the overlying tailings to the reclaim water basins. Changes to the TSF-2 drainage system were intended to minimize uncontrolled leakage from TSF-2 and to improve the drainage of the tailings water after closure. The ultimate crest elevation of the TSF-2 embankment under the Stage 5B Pit Optimization Project (current plan) is 4,750 feet.

2.2.6 Waste Rock Storage Areas

Waste rock is extracted from the Mineral Hill Pit and hauled to one of three waste rock dump complexes for disposal. The waste rock dump complexes are the East Waste Rock Dump Complex (EWRDC), the West Waste Rock Dump Complex (WWRDC), and the Buttress Dump Complex/East Buttress Extension (**Figure 2-2**). The disturbed areas and volumes of waste rock for these disposal areas are shown in Table 2-2. The permitted disturbance area for each waste rock dump complex includes a buffer zone that extends 100 to 300 feet from the dump toe. Buffer zones are typically used for access roads, sediment ponds, temporary laydown areas, boneyards, staging and equipment storage areas, soil stockpiles, retention berms, monitoring wells, and borrow areas. Waste rock dump slopes will be regraded to slopes ranging from two feet horizontal to one foot vertical (2H:1V) to three feet horizontal to one foot vertical (3H:1V) prior to covering with growth media and final reclamation. Where practical, reclamation regrading incorporates a "natural regrade" hybrid design.

TABLE 2-2
DISTURBED AREAS AND PERMITTED VOLUMES FOR WASTE ROCK DUMPS

Waste Rock Dump	Acres	Million Tons
East Waste Rock Dump Complex	683	174
West Waste Rock Dump Complex	627	265
Buttress Dump Complex and East Buttress Extension	327	45
Total	**1,637**	**484**

The EWRDC facility is permitted to hold up to 174 million tons of waste rock and has a permitted disturbance area, including buffer zones, of 683 acres. Maximum elevation will be approximately 5,850 feet.

The WWRDC is permitted to hold up to 265 million tons of waste rock with a permitted disturbance, including buffer zones, of 627 acres. The WWRDC was reclaimed (including resloping, soil cover installation, and seeding), but some of the reclaimed area was redisturbed for disposal of approximately 42 million tons of additional waste rock from the 5B Optimization Project.

The Buttress Dump Complex and East Buttress Extension dumps are permitted to hold up to 45 million tons of waste rock in a permitted disturbance area, including buffer zones, of 327 acres. The original Buttress Dump, constructed in 1994 and 1995, is a 66-acre dump containing approximately 3 million tons of waste rock. The original dump was placed at the toe of the Rattlesnake ground movement block to aid in stabilizing the ground movement. This dump is completely reclaimed. The East Buttress Extension Dump is 144 acres.

Most of the waste rock could generate acid when exposed to air and water. GSM monitors reclaimed areas and evaluates vegetation establishment and erosion after reseeding. Unsuccessful revegetated areas that exceed 0.5 contiguous acres are investigated to determine if underlying acid-generating material may be affecting plant growth in the reclamation soil material. GSM is required to notify DEQ when a suspect area is identified.

2.2.7 Haul Roads and Access Roads

Main haul roads connect the Mineral Hill Pit to the EWRDC, WWRDC, and Buttress Dump Complex, and to the crusher and maintenance shops. Haul roads are approximately 100 feet wide and have berms along the sides for safety. Haul roads in the lower part of the Mineral Hill Pit are about 40 feet wide. As of December 31, 2012, about 28 acres of road disturbances are included in the permitted disturbance boundary.

In addition to haul roads, the entire mine site contains an extensive system of access roads to mine facilities. Access roads are typically 20 feet wide with a berm on each side. Access roads to remote areas of the mine site are typically unimproved and are two wheel tracks.

The main access road would remain at closure and currently meets county road specifications.

2.2.8 Topography after Mining

GSM will use a natural regrade design for regrading slopes, where possible, to create an aesthetically pleasing, natural, and stable landform. Natural regrade design techniques will be used for many slopes in the EWRDC and WWRDC areas. Previously reclaimed areas will remain in their completed configuration. Previously regraded slopes incorporated diversion benches and dozer divots and were regraded to between 2H:1V and 3H:1V slopes.

Final slope configurations for the upper lift of the EWRDC are intended to blend with the adjacent undisturbed hill slope north of the dump. The EWRDC upper lift will block a portion of the view of the Mineral Hill Pit from the northeast. The final EWRDC topography will divert surface water runoff around the mine disturbance area and increase stability of the Sunlight Block and Midas Slump by moving material farther from these features.

Existing slopes on the WWRDC were reduced to 2H:1V with erosion and access benches constructed every 200 vertical feet along the dump slopes. New WWRDC

slopes would be regraded using some aspects of the natural regrade design to produce an overall slope of approximately 2.3H:1V.

The existing Buttress Dump Complex slopes have been substantially reclaimed with slopes of 3H:1V. Newer areas of the East Buttress Extension will be reclaimed using natural regrade design techniques with overall slopes of about 2.5H:1V. Regrading will not be required for support areas and buffer areas. These areas will be ripped prior to soil capping and reseeding to provide suitable planting conditions. Pit reclamation for the Mineral Hill Pit was approved in August of 2007. No backfill is to be placed in the Mineral Hill Pit. A groundwater dewatering system will be designed and constructed at closure to maintain the groundwater level below the final 4,525 –foot pit bottom elevation. The dewatering system will use the underground mine workings as a sump. Water collected in the sump will be pumped to the water treatment plant. Approximately 37 acres in the pit will be treated to the following measures if the work can be done safely to comply with MMRA 82-4-336 (9) (b) (iii):

1. End dumping and/or cast blasting will occur along the upper portion of the northwest and west highwalls, and these areas will be soiled, seeded, and planted with trees;

2. Dozer work will be completed on the area of the west highwall that sloughed in 2005 or a replacement area approved by DEQ, and this area will be soiled, seeded, and planted with trees;

3. Soil sampling on the old slide area on the northwest highwall will be completed, and this area will be seeded and planted with trees;

4. Soil will be placed on the highwall bench above the 5,700-foot safety bench, and the area will be seeded and planted with trees, if it is safe to do so;

5. Trees will be planted where possible on the 5,700- and 5,400-foot safety benches.

Permit stipulations in place prior to the 2007 approval require GSM to construct nesting cavities for raptors and bats in the highwalls reclaimed as rock faces in the Mineral Hill Pit.

2.2.9 Revegetation

Operating Permit No. 00065 requires reclamation of lands disturbed by GSM, except the rock faces of the Mineral Hill Pit, to comparable stability and utility as that of adjacent undisturbed areas. The approved post-mining land uses include grazing and wildlife

habitat. As of December 31, 2012, GSM has revegetated (regraded, covered with soil and/or growth media, and reseeded) approximately 1,178 mined acres. Reclamation seed mixtures have been developed for various slope configurations. Most of the reclaimed areas have successfully reestablished a grassland vegetation cover. Some plantings of shrubs in the revegetated grasslands have partially survived. The only successful shrubs established from seed have been fourwing saltbush and rubber rabbitbrush. Fourwing saltbush has subsequently died out in most areas and has not reproduced from seed.

The rocky and well-drained soils used for reclamation minimize soil erosion and sedimentation from the reclaimed areas during the initial establishment periods. Specific erosion control procedures are listed in the reclamation plan. Noxious weed infestations are monitored through field reconnaissance and controlled using standard practices that are summarized in each annual report to the agencies.

2.2.10 Operational and Post-Closure Monitoring and Control Programs

GSM currently has approved operational monitoring plans described in the 2010 Operating and Reclamation Plan (SPSI 2010) for (1) Water Quality and Quantity, (2) Ground Movement/Geodetic, (3) Waste Rock Steam Vents, and (4) Revegetation (including Reclamation Test Plots). GSM currently monitors the mine for soil erosion, waste rock geochemistry, noxious weeds, and wildlife.

Post-closure, GSM will continue monitoring the soil, vegetation, water, air, and wildlife resources. GSM will develop and implement a remote monitoring system for pit dewatering components including pumps, pipelines, powerlines, and other components to ensure water is captured efficiently. Final design specifics of the remote monitoring program will be submitted to the agencies for approval.

Long-term mine water monitoring would include impacts on springs from long-term pit dewatering. Post-closure storm water monitoring will be designed to have minimal maintenance and repair but will require long-term, routine sediment removal. Post reclamation monitoring will consist of inspections and maintenance of runoff and sediment control structures across the mine site.

Water quality management will continue after mining until all water management facilities are reclaimed and regulatory requirements are met. Pumping rates from the pumpback wells will be recorded monthly and reviewed annually to determine long-term trends in dewatering and seepage capture. With agency concurrence, the locations and frequency of long-term monitoring may be reduced as the facilities are reclaimed. Specific post-closure water resources monitoring requirements will be determined by GSM and the agencies at the end of mining.

Monitoring, data analysis, and annual reporting will continue after mine closure and after reclamation. Post-mine reclamation success will be determined by measuring revegetation canopy cover, erosion rates, stability of reclamation covers, and soil chemistry. Revegetation cover success will be evaluated through comparisons with undisturbed reference areas. Erosion rates and ground stability will be evaluated by visual observation and in comparison with reference areas. Soil geochemistry will be evaluated by sampling and analysis. Reclaimed areas that do not achieve a level comparable to the native reference areas will be fertilized, reseeded, or have additional soil applied, depending on site-specific conditions. All reclaimed surfaces will be inspected annually and checked for vegetative cover, acid seepage development, and noxious weeds.

GSM will monitor reclamation success for the pit walls through visual observations for raveling, sloughing, erosion, and noxious weeds. Where safe to access with appropriate equipment, rock that has raveled or sloughed on revegetated areas will be removed or covered with new soil and reseeded. Additional soil placement and reseeding will be done in areas that have settled or had soil eroded and are safe to access. Where safe to access, noxious weeds would be controlled. GSM will conduct annual post-reclamation monitoring until GSM and the agencies agree the reclamation cover will be stable over the long term. GSM anticipates the frequency of reclamation monitoring will be reduced in three to five years after final revegetation. GSM will then develop a revised monitoring plan.

2.3 Proposed Action Alternative

In its application for Amendment 015, GSM proposes to expand its mining operations by extracting ore at a new North Area Pit and at an expansion of the Mineral Hill Pit known as the South Area Layback (**Figure 2-3**). The mine expansions would allow GSM to mine approximately 4.2 million tons of additional ore, to be processed at the existing mill. Mining at the North Area Pit and the South Area Layback would generate up to 52.6 million tons of waste rock. All proposed facilities are on land owned by GSM.

The North Area Pit would extend below the natural water table so dewatering would be necessary. A dewatering program is proposed for the North Area Pit through installation of dewatering wells peripheral to the pit, or by drilling horizontal holes into the pit highwalls to drain trapped water (Schlumberger Water Services [SWS] 2011). Any surface water runoff and precipitation along with water collected from pit highwall dewatering wells would be removed from the pit by pumping the water through a series of staging tanks to a common pit sump and then transferred to the tailings storage facility where it is used as process water.

Like the current dewatering of the Mineral Hill Pit, the water would be used in the milling process to offset fresh water use during operations.

As an expansion of the Mineral Hill Pit, the South Area Layback area would naturally drain into the Mineral Hill Pit so operational and closure dewatering in the Mineral Hill Pit would handle this water. After mining and milling is completed, the captured water from the North Area Pit dewatering wells and the Mineral Hill Pit underground sump would be pumped to a water treatment plant.

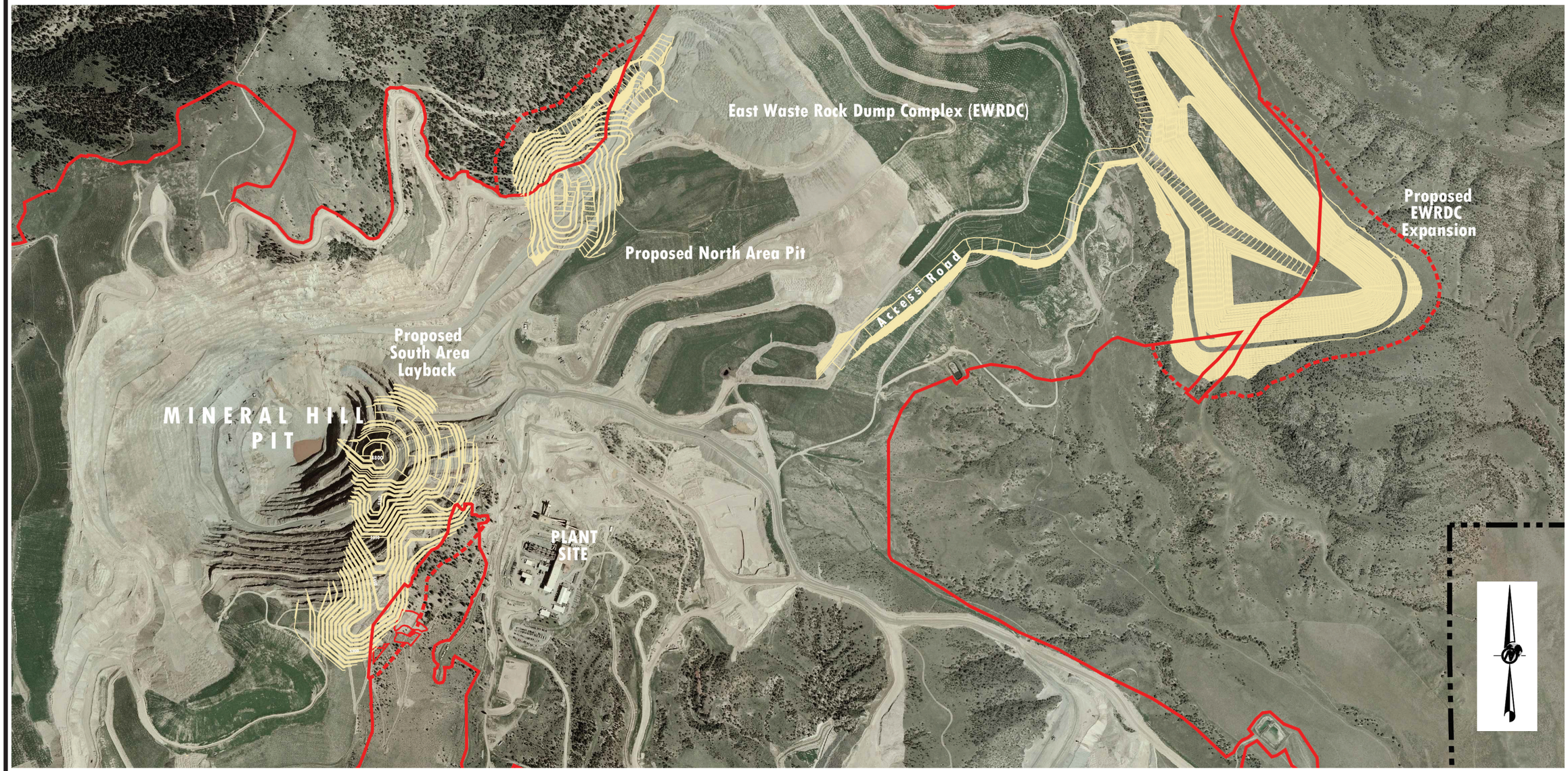
Up to 48.6 million tons of acid-producing waste rock from the North Area Pit and South Area Layback areas would be placed in the EWRDC Expansion Area (**Figure 2-3**). Up to 6 million tons of waste rock could also be placed in the Buttress Dump Extension. Approximately 4 million tons of non-acid generating waste rock from the Bozeman Group/Landslide Debris material excavated from the east wall of the North Area Pit would be stockpiled and used for reclamation growth media materials. GSM would not salvage some fine-grained lakebed sediments in the east wall of the North Area Pit.

Mining activity at the North Area Pit and South Area Layback would be completed in late 2016 or early 2017. The proposed amendment would extend the mine life by approximately two years beyond the current operating permit. GSM also processes off-site ore in their mill, mostly from legacy mining materials in southwest Montana. The proposed amendment would facilitate an additional two years of processing these legacy materials, depending on gold prices and grade of the materials.

2.3.1 Permitted Disturbance Boundary and Disturbances

Table 2-3 lists the proposed disturbances for the Proposed Action Alternative mine components. The operating permit boundary would not change. The total proposed disturbance for all Amendment 015 components would be 302.9[1] acres (215.5 acres in the current permitted disturbance boundary and 87.4 acres in the expanded permitted disturbance boundary). The current approved size of the permitted disturbance boundary is 3,104 acres. This would increase to 3,191.9 acres for the Proposed Action Alternative.

[1] *The permitted disturbance boundary should be 19.3 acres larger to include the Buffer Area around the southeast portion of the EWRDC Expansion area. The new disturbance acres outside the permitted disturbance boundary for the EWRDC Expansion area would total 57.0 acres (compared to 37.7 acres) and the revised total permitted disturbance boundary area would be 3,191.9 acres (compared to 3,172.6 acres).*



LEGEND

- Permit Disturbance Boundary February 2010
- Proposed Permitted Disturbance Boundary
- Permit Boundary July 2012

SCALE: 1" = 1,000 Feet

Source: Golden Sunlight Mine 2012a

Figure 2-3
Proposed Action Alternative Features

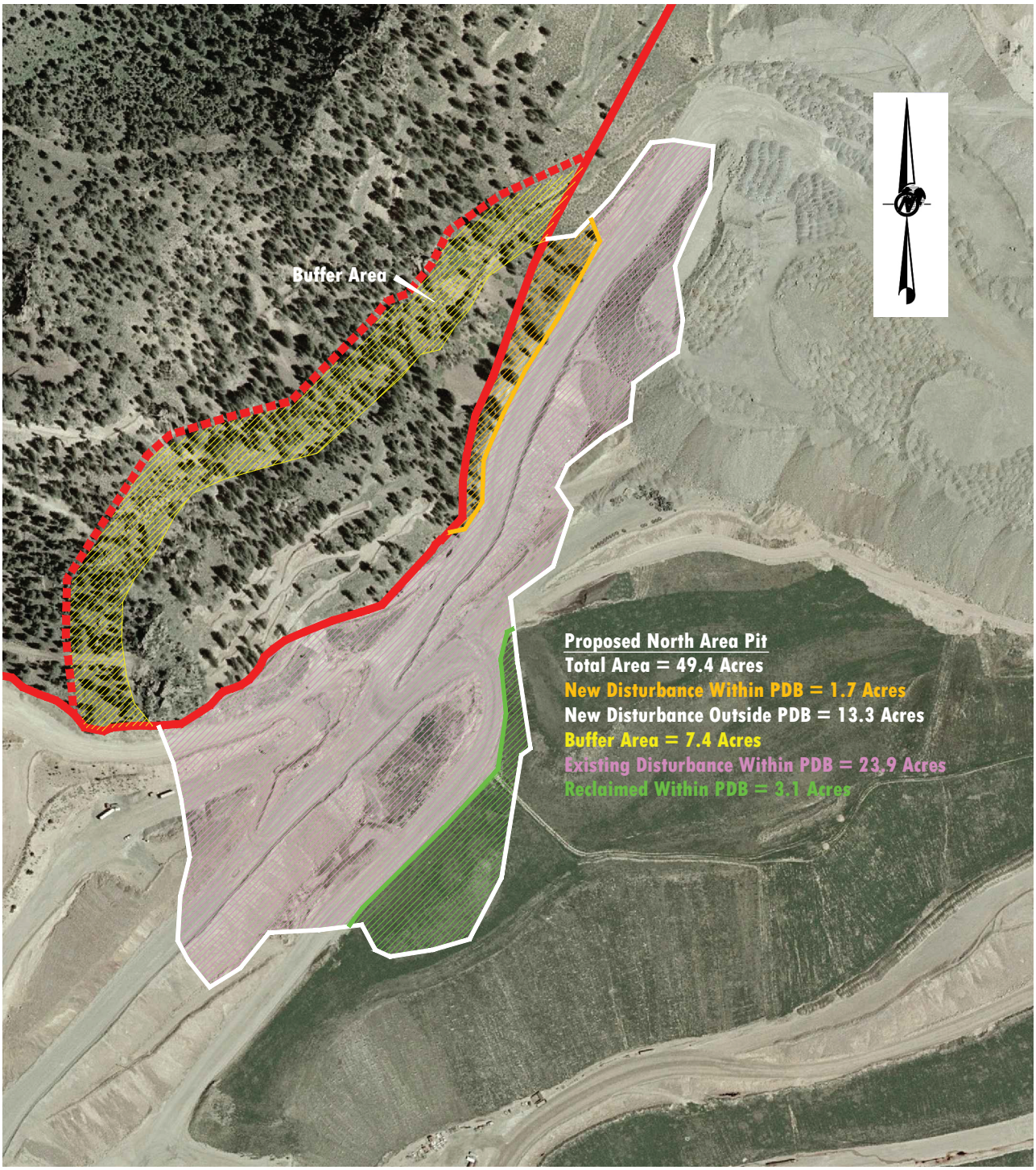
TABLE 2-3 PROPOSED ACTION ALTERNATIVE DISTURBANCE ACRES						
Mine Component	**New Disturbance in Permitted Disturbance Boundary**	**New Disturbance Outside Permitted Disturbance Boundary**	**Buffer Area**	**Existing Disturbance in Permitted Disturbance Boundary**	**Disturbed Reclaimed Areas**	**Total Acres**
North Area Pit	1.7	13.3	7.4	23.9	3.1	49.4
South Area Layback	6.8	4.1	5.6	46.4	6.5	69.4
EWRDC Expansion	51.7	37.7	19.3	5.1	65.8	179.6
TSF-2	4.5	0	0	0	0	4.5
Total	**64.7**	**55.1**	**32.3**	**75.4**	**75.4**	**302.9**

2.3.2 Mining Method and Pit Description

Mining in the North Area Pit and South Area Layback areas would be consistent with existing GSM mining operations using conventional open pit methods. The area to be mined is drilled and blasted and the broken material loaded with hydraulic and electric shovels and front-end loaders into haul trucks. Other mining equipment includes drill rigs, shovels, loaders, haul trucks, bulldozers, motor graders, excavators, water and sand trucks, and light-duty vehicles. The viability of the Proposed Action Alternative depends on the blending of ores from the North Area Pit and the South Area Layback areas.

The North Area Pit would be approximately 49.4 acres, about 1,750 feet by 1,140 feet (**Figure 2-4**). The pit would require dewatering to lower the water table about 200 feet. GSM would initially dewater at 50 gpm for six months to drawdown the water table. After the drawdown elevation target is met, the dewatering would decrease to a maintenance rate of less than 10 gpm. During mining, the groundwater would be used in the milling process water circuit. After mining, the captured water would be pumped to the water treatment plant and managed consistent with existing permit requirements approved for a conventional lime water treatment system to treat up to 392 gpm of mine water. The North Area Pit would produce an additional 1.2 million tons of ore and 8 million tons of waste rock. The North Area Pit would disturb an additional 15 acres (not including the 7.4 acres of buffer area) not previously disturbed by mining.

The South Area Layback in the Mineral Hill Pit would be approximately 69.4 acres and would expand the Mineral Hill Pit to the east and south (**Figure 2-5**). Dewatering of the South Area Layback would not be necessary as it is above the water table and stormwater would drain to the lower portion of the Mineral Hill Pit. The South Area Layback would disturb an additional 10.9 acres with 4.1 acres outside the current permitted disturbance boundary.



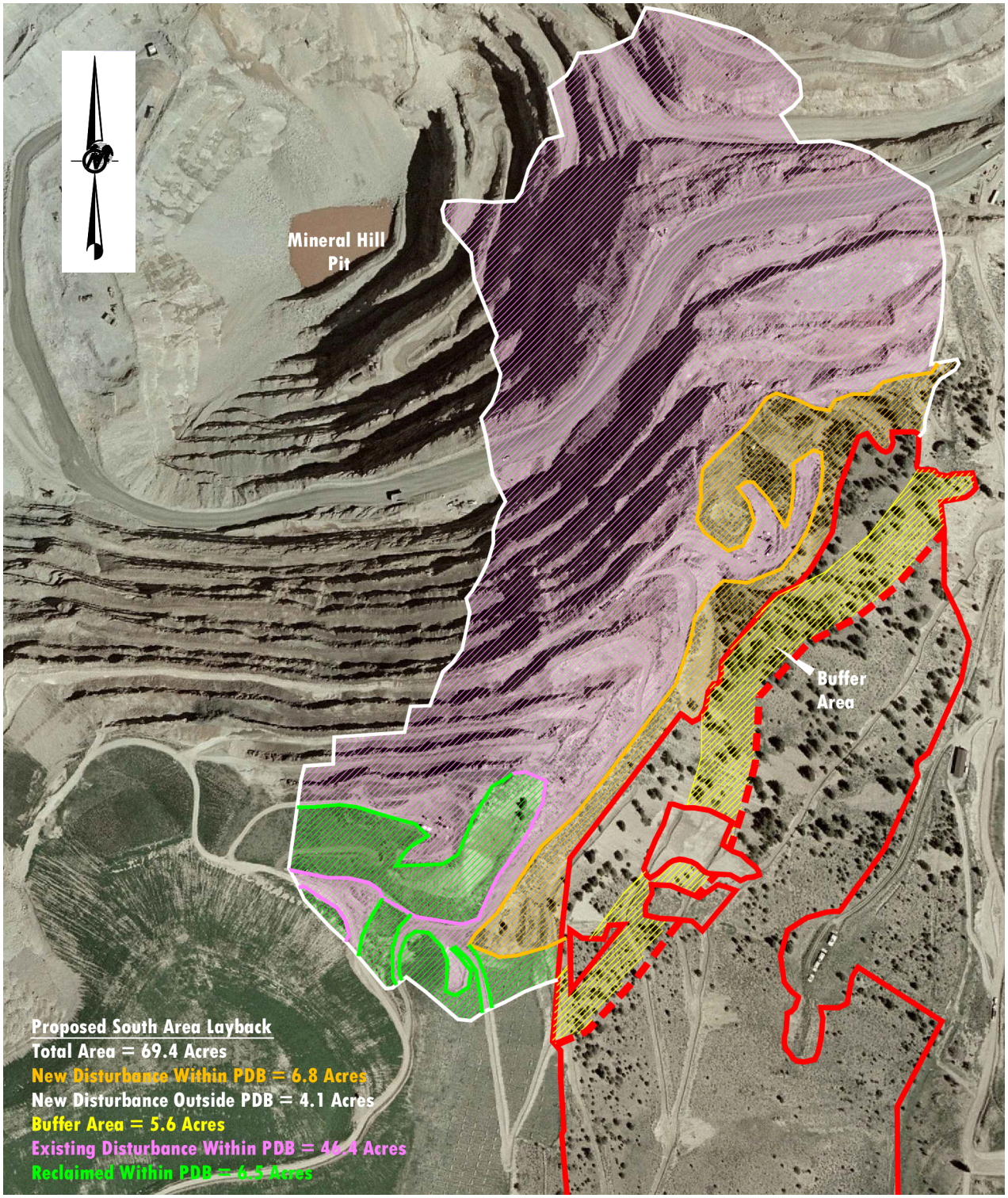
SCALE: 1" = 1,000 Feet

LEGEND

- Permit Disturbance Boundary February 2010
- Proposed Permitted Disturbance Boundary

Source: Golden Sunlight Mine 2012a

Figure 2-4
Proposed Action Alternative - North Area Pit



SCALE: 1" = 1,000 Feet

LEGEND

Permit Disturbance Boundary February 2010

Proposed Permitted Disturbance Boundary

Source: Golden Sunlight Mine 2012a

Figure 2-5
Proposed Action Alternative - South Area Layback

The South Area Layback would produce an additional 3 million tons of ore and 44.6 million tons of waste rock. Up to 6 million tons of waste rock could be placed in the Buttress Dump Extension and the remaining 38.6 million tons of waste rock would be placed in the EWRDC Expansion area.

2.3.3 Ore Processing

Ore processing would continue as described for the No Action Alternative. The additional ore would extend operations for approximately two years. During this period, legacy waste rock and tailings would continue to be processed.

2.3.4 Water Resources

Two vertical dewatering wells would be installed adjacent to the North Area Pit area. One would intercept and capture the southern area bedrock groundwater and one would dewater the northern area. These wells would maintain the groundwater level in the North Area Pit below the pit floor elevation of 5,375 feet (GSM datum). If the pit dewatering wells do not dewater the pit adequately, GSM would drill horizontal holes into the pit highwalls to drain trapped water. Any surface water runoff and precipitation along with water collected from pit highwall dewatering wells would be removed from the pit by pumping the water through a series of staging tanks to a common pit sump and then transferred to the tailings storage facility where it is used as process water.

The South Area Layback would not require any additional water management. During mining, water captured in the Mineral Hill Pit sump and from the North Area Pit wells would be used in the mill, offsetting some of the makeup water currently obtained from the Jefferson Slough. After mining, the water from the Mineral Hill Pit sump (same as the No Action Alternative) and from the North Area Pit dewatering wells and water from the pit sump would be pumped to the water treatment plant and managed as required in the existing permit. No revised plan for capture and routing of North Area Pit water at closure has been submitted.

The stormwater pollution prevention plan (SWPPP) would be revised to include stormwater from all new or expanded facilities.

2.3.5 Tailings Storage Facilities

The Proposed Action Alternative would increase the capacity of TSF-2 impoundment by approximately 5.0 million tons. The additional tailings would be generated from the processing of ore from the South Area Layback and North Area Pit (4.2 million tons), and from processing of mine waste rock and tailings from legacy mine sites. Raising TSF-2

would create a footprint disturbance increase of 4.5 acres; all in the permitted disturbance boundary.

The only new disturbance would be to raise the east wing wall to 4,774 feet (GSM datum) which would disturb approximately 4.5 acres.

2.3.6 Waste Rock Storage Areas

The acid-generating waste rock from the North Area Pit (4 million tons) and South Area Layback (44.6 million tons) would be placed in existing rock disposal areas or in a stand-alone extension of the EWRDC rock disposal area called the EWRDC Expansion area located on the east side of Sheep Rock Creek (**Figure 2-6**). A majority of the 179.6 acre EWRDC Expansion area is in the current permitted disturbance boundary, but about 57 acres (37.3 disturbed acres + 19.3 buffer area acres) would be outside the current permitted disturbance boundary. Amendment 015 would expand the permitted disturbance boundary to include the entire EWRDC Expansion area. The approximately 4 million tons of non-acid generating Bozeman Group/Landslide Debris material waste rock from the North Area Pit would be stockpiled and used for subsoil cover material for reclamation of the existing EWRDC or TSF-2. GSM would not salvage some fine-grained lakebed sediments removed from the North Area Pit.

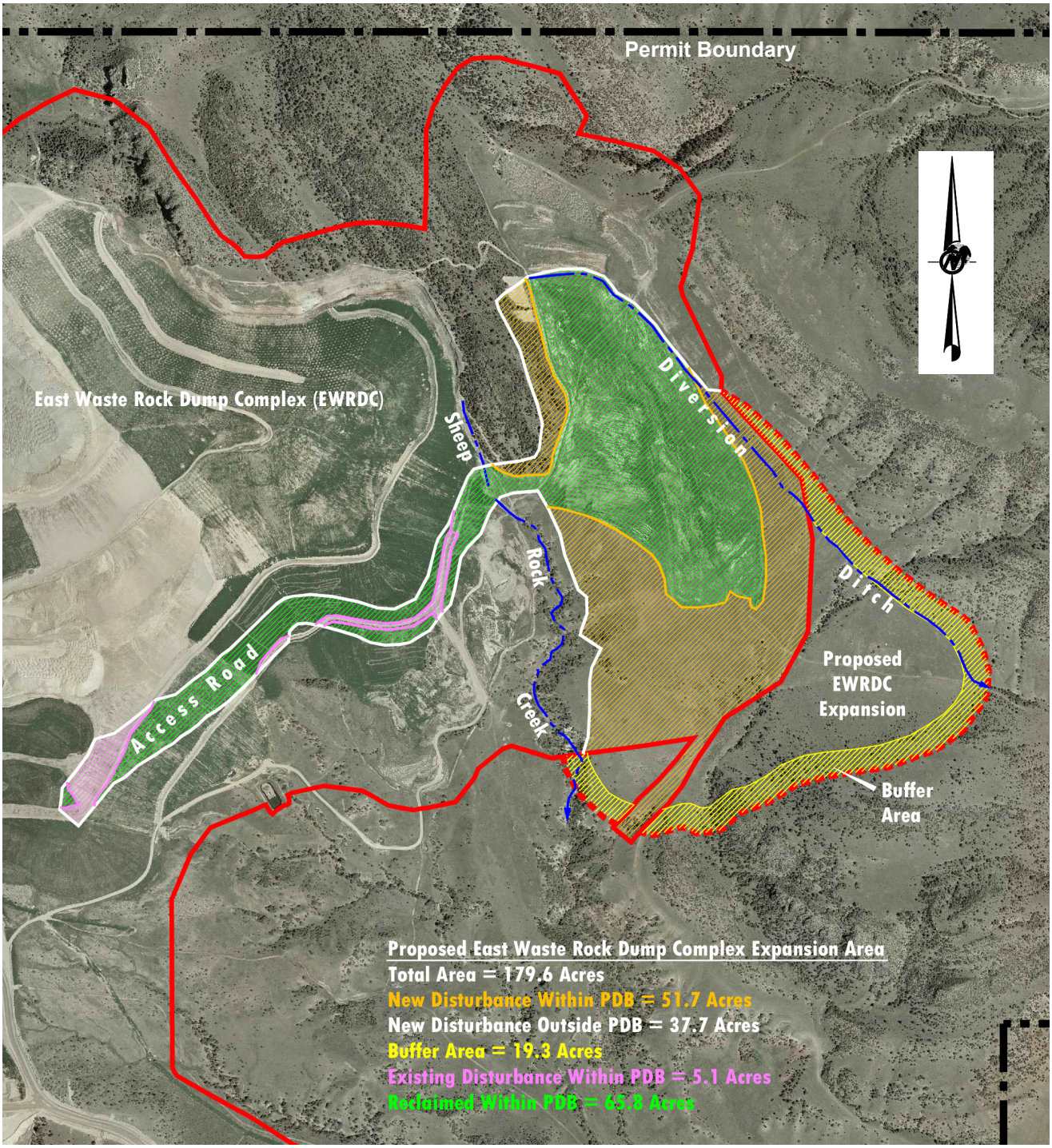
The proposed EWRDC Expansion area would have a maximum height of 290 feet above the natural topography and an average thickness of 140 feet. The proposed outer slopes would have an overall angle of 2.0H:1.0V. GSM would construct the EWRDC Expansion area in 3 to 4 lifts with a total design capacity to hold up to 48.6 million tons of waste rock.

2.3.7 Haul Roads and Access Roads

The Proposed Action Alternative would include the construction of new haul roads in the proposed North Area Pit and South Area Layback footprints. Access to the North Area Pit would be from the east side. The haul road for the South Area Layback would be from the northeast side of the Mineral Hill Pit. Haul roads in upper portions of the pits would be approximately 100 feet wide with the sides bermed for safety. The lower pit and layback haul road would be about 40 feet wide.

A new haul road would be constructed for the EWRDC Expansion area and would include a temporary crossing of Sheep Rock Creek (**Figure 2-6**). An 8-foot diameter culvert (or equivalent), sized to convey a 100-year 1-hour storm, would be installed at the crossing. After final reclamation of the EWRDC Expansion area, the culvert would be removed and Sheep Rock Creek would be reestablished in its natural channel.

Haul roads and access roads would be reclaimed in accordance with the approved plan.



SCALE: 1" = 1,000 Feet

LEGEND

- Permit Disturbance Boundary February 2010
- Proposed Permitted Disturbance Boundary
- Permit Boundary July 2012

Source: Golden Sunlight Mine 2012a

Figure 2-6
Proposed Action Alternative - East Waste Rock Dump Complex (EWRDC) Expansion

2.3.8 Topography after Mining

Regrading would be implemented concurrently where feasible. The eastern portion comprising more than half of the North Area Pit would be developed as a 2H:1V slope during operations. Minor regrading would be required at closure. The remaining North Area Pit highwall would not be regraded at closure. It would measure approximately 575 feet in height as measured from the bottom of the pit.

No portions of the South Area Layback would be regraded at closure.

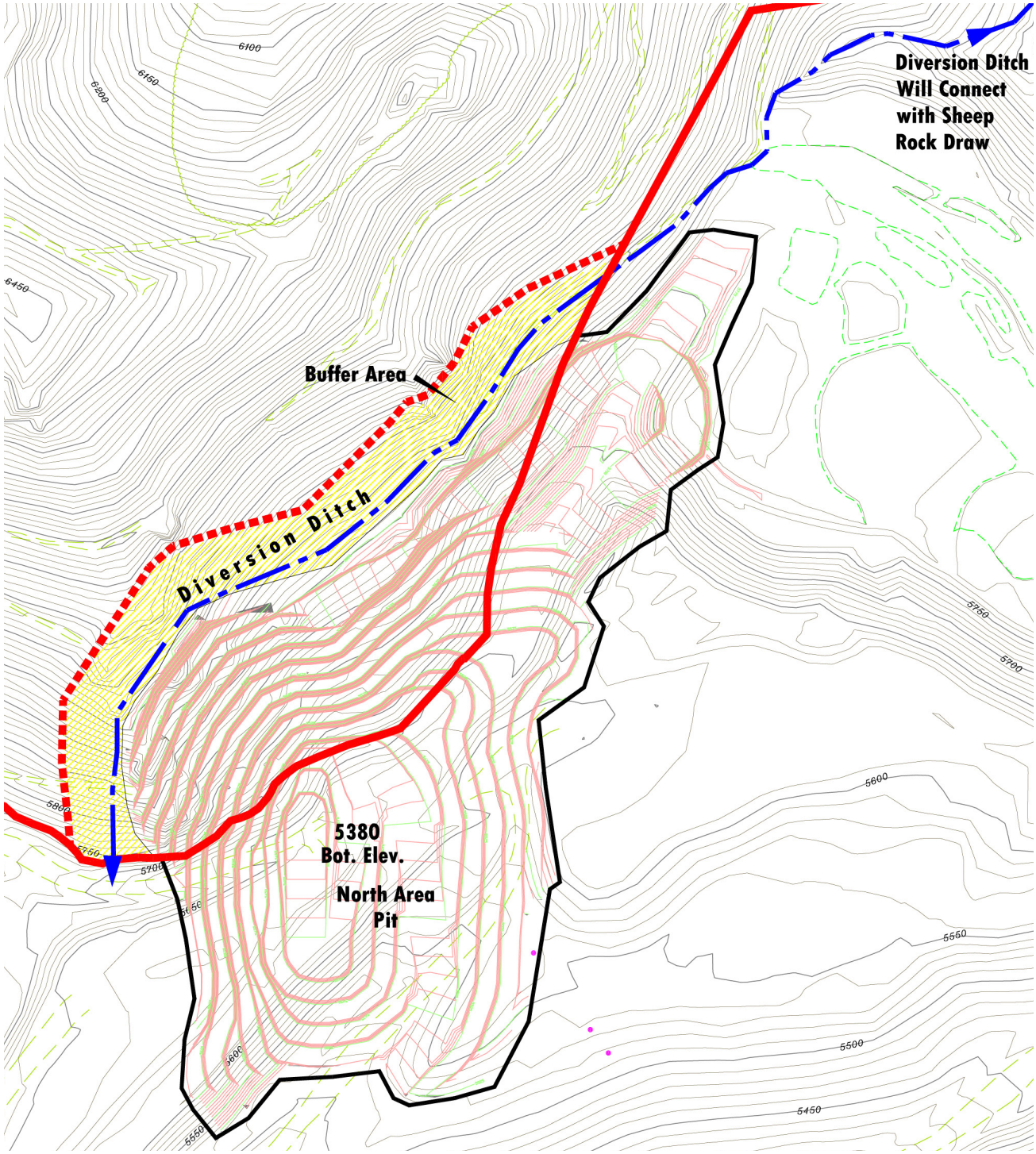
The EWRDC Expansion area and the East Buttress Dump Extension would be regraded to 2H:1V slopes or less steep once waste rock production from the North Area Pit and the South Area Layback ceases. Natural regrade practices would be implemented where feasible on the waste rock dumps.

2.3.9 Revegetation

GSM's reclamation methods for the additional areas disturbed by the Proposed Action Alternative would be similar to GSM's existing approved reclamation plan. All disturbed areas would be reclaimed. The reclamation goal would be the same as the No Action Alternative goal which is to return the mine site, other than open pits and rock faces, to stability and utility comparable to the adjacent unmined areas. The approved post-closure land uses are primarily grazing and wildlife habitat. GSM in conjunction with local governmental and business entities has developed a business park along the southern edge of the mine site for commercial use. After mining, the mine office buildings and some of the mill buildings could be available for public or private industrial use.

GSM would continue using its current practice for rock disposal area reclamation at the EWRDC Expansion Area. Placement of the rock within the proposed footprint of the expansion area would result in a slope configuration of 2.H:1.V (overall slope factoring in the benches formed with each lift would be 2.5H:1V). The EWRDC Expansion Area would be capped with placement of 31 inches of calcareous growth media with a coarse fragment content of at least 25 percent. Following placement of the growth media, the EWRDC would be seeded with an approved seed-mix.

The eastern portion that comprises more than half of the North Area Pit and has a 2H:1V slope would be covered with plant growth media and seeded with an approved seed mix (**Figure 2-7**).



SCALE: 1" = 1,000 Feet

LEGEND

Permit Disturbance Boundary
February 2010

Proposed Permitted Disturbance
Boundary

Source: Golden Sunlight Mine 2012a

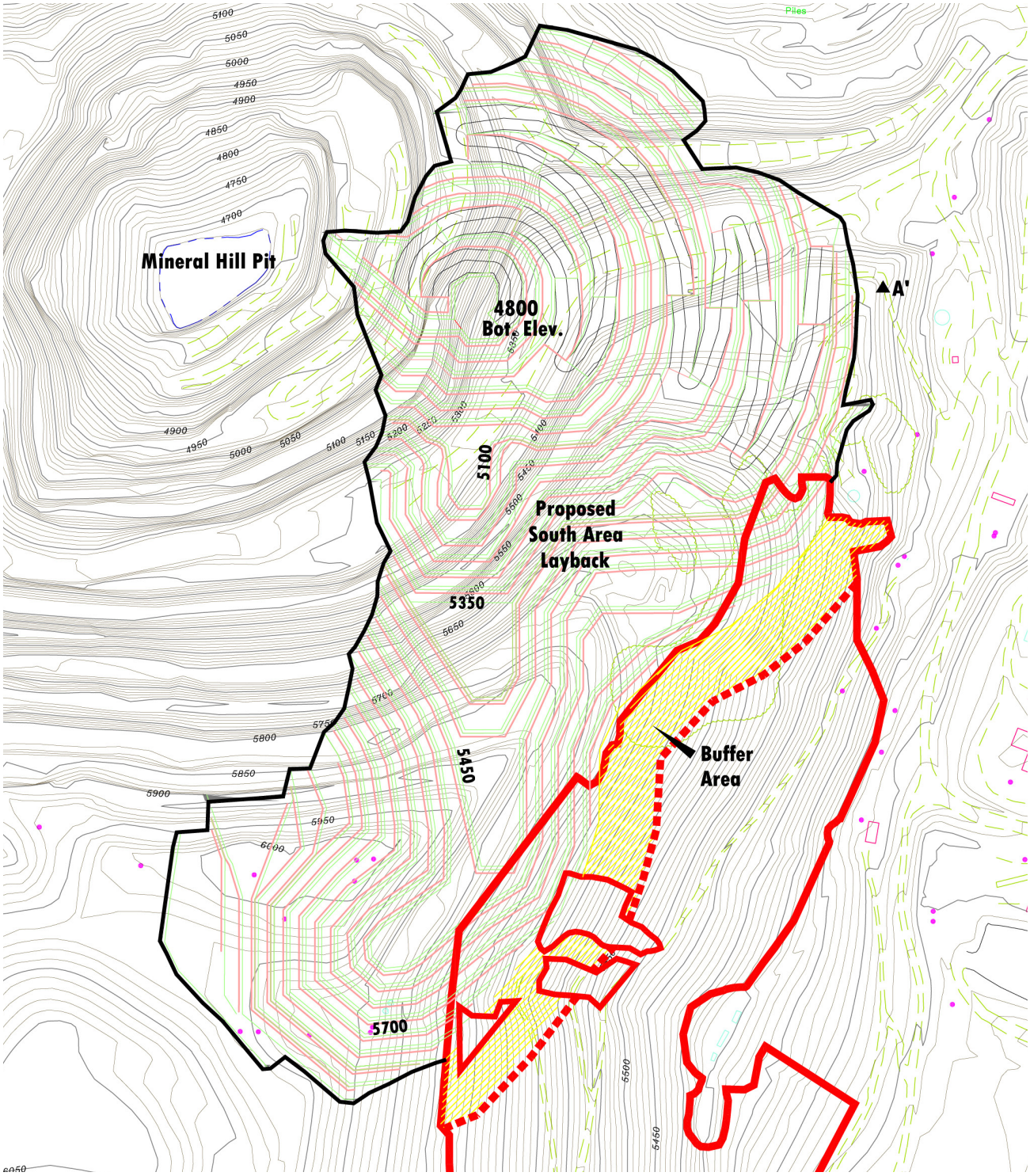
Figure 2-7
Proposed Action Alternative -
North Area Pit Design Topography

To the extent that pit benches in the South Area Layback can be safely accessed, GSM would place growth media on the pit benches to support establishment of vegetation or tree seedlings would be planted on berms and benches. In addition, GSM would place growth media on large benches within the South Area Layback prior to loss of access to these areas. The growth media would be seeded with an approved seed mix. The revegetated portions of the South Area Layback would total approximately 22 acres and would promote water infiltration, reduce runoff, and provide wildlife habitat. The rest of the highwalls in the South Area Layback would be reclaimed as rock faces and not revegetated.

About 30 acres on the south and east non-reactive walls of North Area Pit would be amended or capped if needed and revegetated. The rest of the North Area Pit highwalls would be reclaimed as rock faces. Raveling of the north and west wall rock faces would eventually cover some of the revegetated portion of the pit floor. GSM is required to keep the external dewatering wells in place at closure to prevent a pit lake from forming in the pit. No plans are provided to capture and route precipitation and groundwater reporting to the pit that is not captured by the perimeter dewatering wells.

2.3.10 Operational and Post-Closure Monitoring and Control Programs

GSM's approved operational monitoring plans are described in the 2010 Operating and Reclamation Plan (GSM 2010) for (1) Water Quality and Quantity, (2) Ground Movement/Geodetic, (3) Waste Rock Steam Vents, and (4) Revegetation (including Reclamation Test Plots). GSM currently monitors the mine for soil erosion, waste rock chemistry, noxious weeds, and wildlife. The existing post-closure monitoring and control plans would be amended to include monitoring of the additional areas.



SCALE: 1" = 1,000 Feet

LEGEND

Permit Disturbance Boundary
February 2010

Proposed Permitted Disturbance
Boundary

Source: Golden Sunlight Mine 2012a

Figure 2-8
Proposed Action Alternative -
South Area Layback Design Topography

2.4 Agency Modified Alternative

The Agency Modified Alternative would be similar to the Proposed Action Alternative with additional project modifications. A cross-section view of the North Area Pit with the Agency modifications is provided in **Figure 2-9**. The issues and the modifications are described below along with the project specific modifications to be incorporated into the Agency Modified Alternative.

Issue 1: Capture and Routing of Seeps in the EWRDC Expansion Area

Mining-related seeps in the EWRDC Expansion area could be contaminated with metals and be acidic and cause surface water and groundwater contamination. GSM proposes to monitor and capture water from mining-related seeps. The volume of seepage water has been estimated at 2.1 gpm. GSM is required to monitor for seeps associated in the EWRDC Expansion area and to continue monitoring for seeps across the mine site.

Agency Modification:

1. GSM would provide a conceptual plan for how to collect and route EWRDC Expansion area seepage water to water treatment plant.

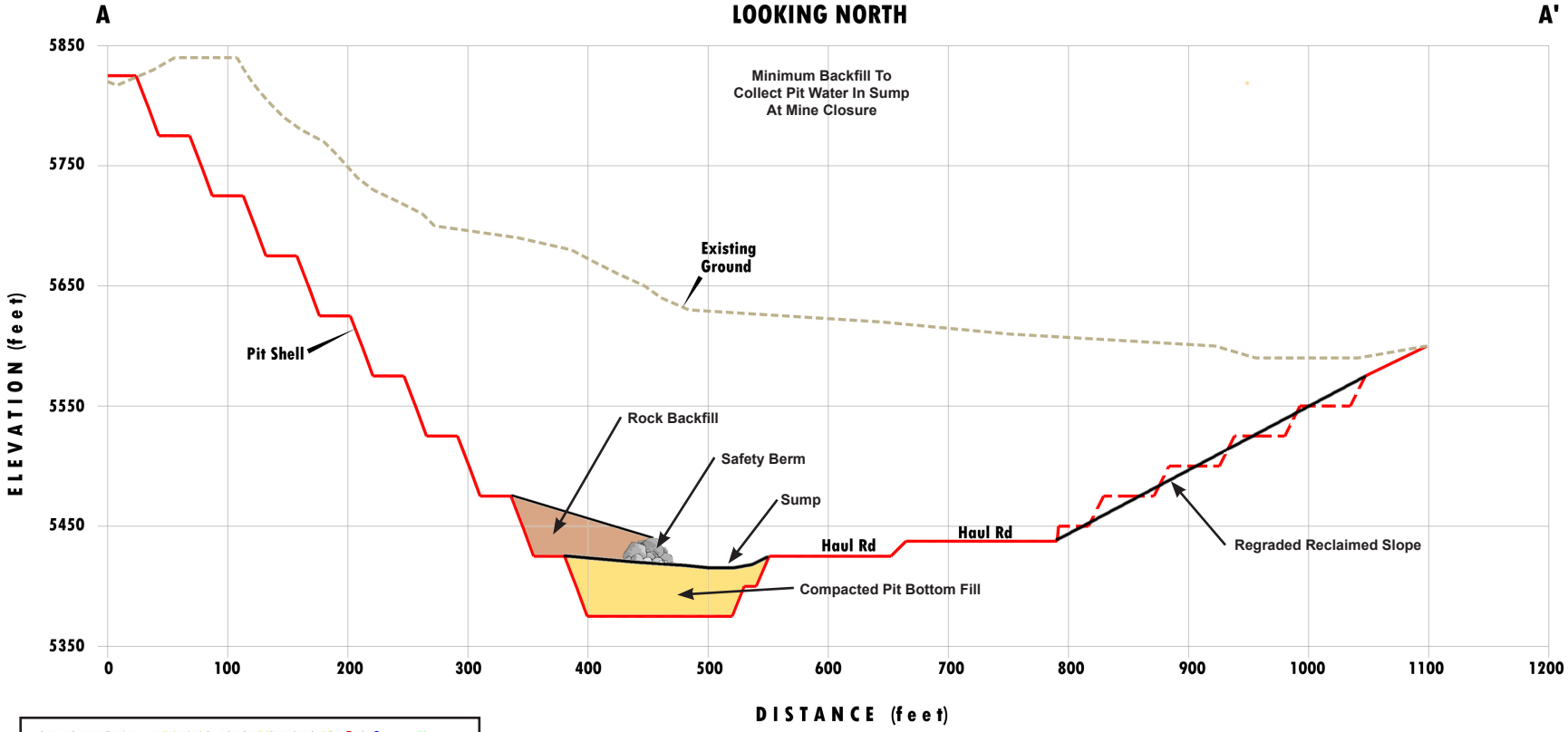
Issue 2: Capture and Routing of North Area Pit Surface Water Runoff and Groundwater after Mine Closure

GSM's application states there would be no pit pond or pool allowed in the North Area Pit because of potential impacts to wildlife. During operations groundwater and surface water from the North Area Pit would be captured and conveyed to the water treatment plant. The operational methods for collecting and transporting the North Area Pit precipitation and groundwater would include dewatering wells, a pit sump (if needed), and a pipeline. Operational water collection and routing systems may not capture all water at closure. Additional details on the plan to capture and route precipitation and groundwater collecting in the North Area Pit to the water treatment plant after mining are needed.

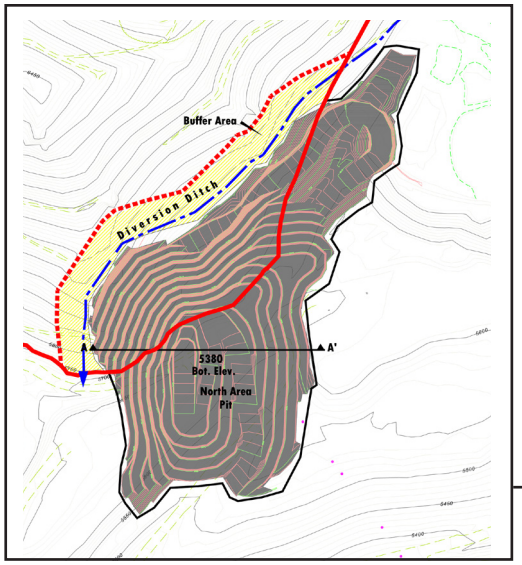
Agency Modification:

1. GSM would provide a conceptual design to capture and convey pit water to the water treatment plant after mining, including:

    - final pit regrading plan;
    - partial pit backfill with compacted Bozeman Group materials, as needed, to direct groundwater, precipitation, and snowmelt to a closure pit sump and to create a safe pit floor working surface;



NOTE: Haul road to be converted to access road for sump maintenance. Alignment to be determined.



Cross-Section Location

Figure 2-9
Agency Modified Alternative
North Area Pit Modifications

- cover soil/growth media appropriate for the 2H:1V slope angles, and seed; design collect water and convey to the closure water treatment plant;
- plan for location and maintenance of access road into the pit to service the sump, pump, and water lines; and install a berm in the bottom of the pit to capture north and west wall pit raveling rock which would protect workers in the pit bottom.

Issue 3: Implement Closure Geodetic and Ground Movement Monitoring for the North Area Pit and EWRDC Expansion area to ensure safe access and to keep reclamation cover systems working

GSM has monitored ground movement operationally at the mine since 1994 using geodetic survey data, inclinometers, piezometers, and other methods. The Proposed Action Alternative would modify their existing operational ground movement monitoring program to include the proposed North Area Pit and South Area Layback area. GSM's Amendment 015 application (Appendix A-2) also included additional ground movement monitoring plans for the EWRDC Expansion area.

Aspects of GSM's operational geodetic and ground-movement monitoring for the Agency-Modified Alternative would be similar to the Proposed Action Alternative with the following additional information and clarification for use during closure:

Geodetic and ground-movement monitoring would be needed after mining to monitor the potential for long-term ground movement for the North Area Pit and EWRDC Expansion area. The monitoring is needed to allow safe access into the North Area Pit for maintaining the water removal systems from the pit sump. Monitoring should also be used to monitor waste rock dumps expanded as part of Amendment 015 to keep reclamation cover systems working.

Agency Modification:

1. GSM would develop a conceptual post-mining geodetic and groundwater monitoring plan.

Issue 4: Salvage Available Fine-grained Lakebed Sediments in the North Area Pit and Incorporate Organic Amendments in the Sediments when the Sediments are used as Growth Media in Reclamation Cover Systems.

While GSM would salvage the available soils and nonacid generating Bozeman Group and landslide debris materials from the North Area Pit, South Area Layback, and EWRDC Expansion area, GSM would not salvage any fine-grained silt-textured lakebed sediments. These fine-grained sediments would be suitable for reclamation on flat and gentle slopes

and would support vegetation. An organic amendment incorporated into the upper layer would minimize soil crusting and enhance seedling establishment in these materials.

Agency Modification:

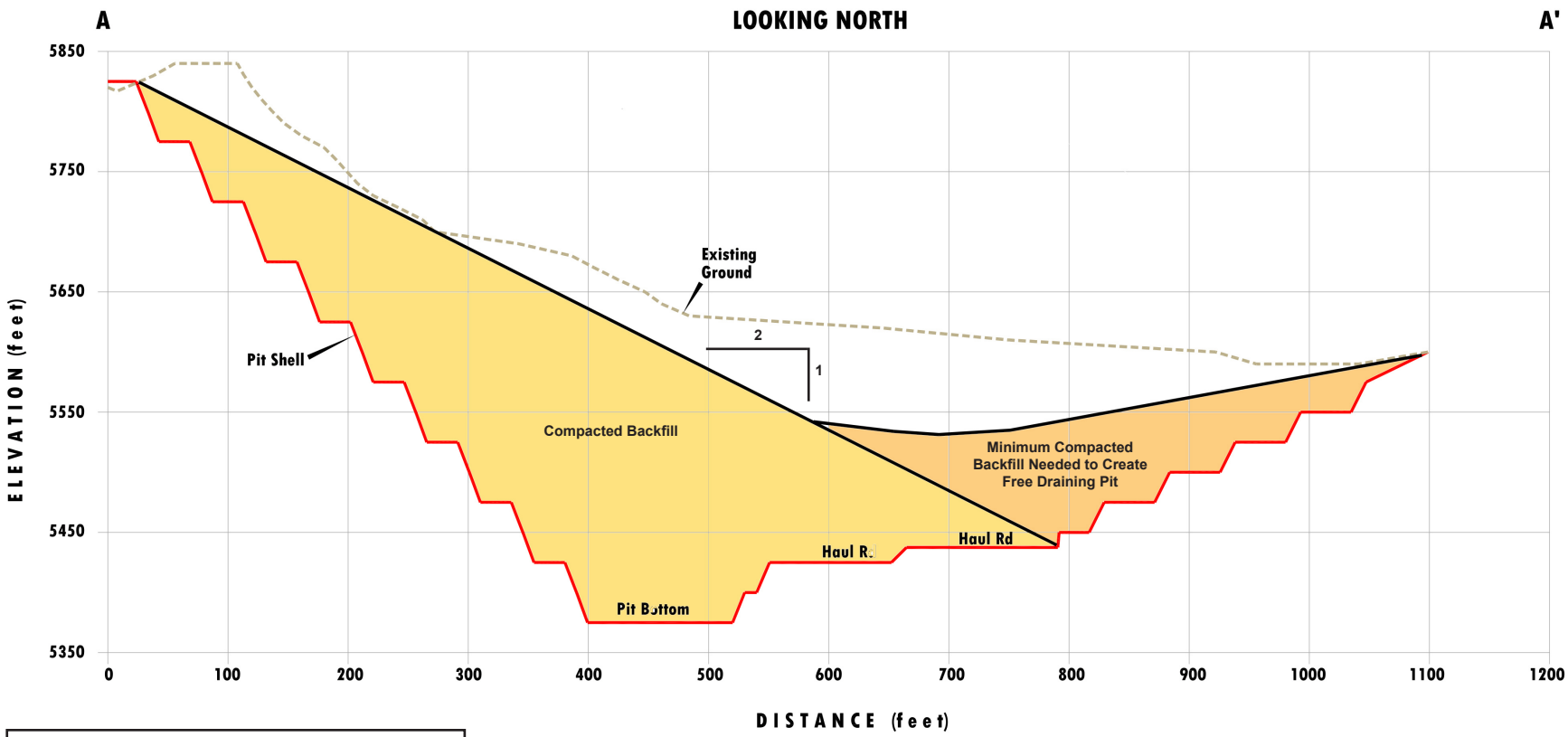
1. GSM would salvage and stockpile silt-textured lake bed sediments. GSM would incorporate compost or other organic matter to achieve 1 percent by volume organic matter when the sediments are used for reclamation growth media.

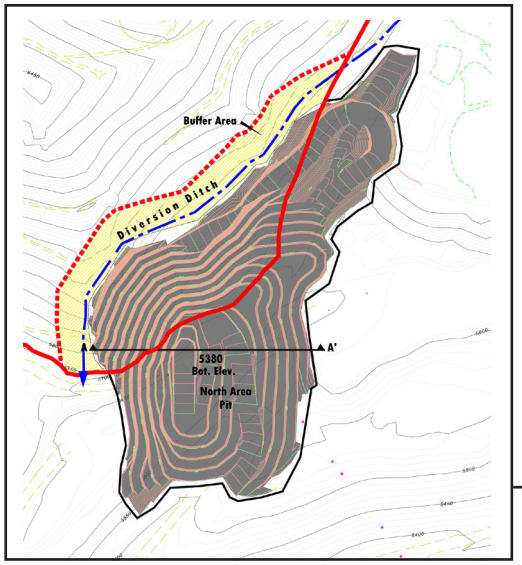
GSM would identify the fine-grained silt-textured sediment materials in the North Area Pit as it is mined. These fine-grained sediments would be salvaged and stored in a separate soil stockpile for later use during reclamation. After mining or when a gentle sloping area is ready for reclamation, the fine-grained sediments would be spread onto the regraded areas. If the fine-grained sediments are used for the upper lift, an organic amendment (e.g., compost) would be incorporated into the upper 6 inches prior to reseeding. If the fine-grained sediment materials are used for reclamation subsoil material, then no organic amendment would be incorporated.

2.5 North Area Pit Backfill Alternative

Under the North Area Pit Backfill Alternative, the North Area Pit would likely be mined before the South Area Layback. Ore extracted from the North Area Pit would be stockpiled in the mill area. During preparation for and mining of the South Area Layback, up to 9.2 million tons of the 44.6 million tons of acid producing waste rock from the South Area Layback would be used to backfill the North Area Pit rather than hauling the waste rock to the EWRDC Expansion area or the Buttress Dump Extension area. A cross-section view of the backfilled North Area Pit is in **Figure 2-10**.

The North Area Pit would be backfilled to achieve a 2H:1V waste rock dump slope from the top of the pit west highwalls (**Figure 2-10**). The 2H:1V waste rock dump slope would toe into the east wall of the North Area Pit. Final adjustments would be needed to ensure the backfilled pit would be free-draining to prevent precipitation and snowmelt from collecting in the pit area where it may infiltrate into underlying acid-producing waste rock. If the surface flow of precipitation and snow melt could not be routed safely to drainages below acid-producing waste rock, then the water would be routed to a lined pond and gravity fed to a drainage below acid-producing materials or routed to the treatment plant.





Cross-Section Location

Figure 2-10
North Area Pit Backfill Alternative

Reclamation of the backfilled pit would be consistent with the reclamation of other 2H:1V slopes in the waste rock dump complexes. The 2H:1V slopes would be covered with plant growth media containing the necessary rock content to control erosion. The slopes on the east side of the pit would also be covered with plant growth media and seeded. All acidic waste rock in the pit would be covered with backfill and revegetated. Pit dewatering wells located outside the pit would continue to keep the water table depressed below the level of the pit backfill. The downgradient dewatering well would collect some of the water that infiltrates through the backfill.

2.6 Related Future Actions

Related future actions are those related to the Proposed Action Alternative by location or type. For this EIS, other opencut and metal mine projects in Jefferson and nearby counties were considered for evaluation. The development of the Sunlight Business Park, new residential subdivisions, permitted Butte Highlands gold mine, and potential reactivation or closure of the Montana Tunnels Mine near Jefferson City, Montana have been established as related future actions for this EIS. Descriptions of these future actions are provided in Chapter 4.

2.7 Alternatives Considered But Dismissed

Additional alternatives were considered and evaluated. Two of them were dismissed from detailed consideration in the EIS due to the reasons explained below.

2.7.1 Mining only the North Area Pit or only the South Area Layback

The primary reason for dismissing this alternative is that GSM would not be able to mine half the resource because they rely on ore blending (high silver in one ore and high copper in the other ore) to control costs and keep production viable, the amount of gold would likely not support the capital investment, and one small pit area would not have enough dig faces to supply continuous ore to the mill. The production sequence and scheduling of ore delivery from both pits is important to continuous mill operations.

2.7.2 Partial Pit Backfill Alternative for South Area Layback of the Mineral Hill Pit

In 2007, DEQ approved Amendment 011 to GSM's operating permit, selecting the Underground Sump Alternative. DEQ determined that the alternatives under which GSM would partially backfill the Mineral Hill Pit did not provide sufficient control of pit discharges to assure protection of the Jefferson River alluvial aquifer and the Jefferson River Slough. In addition to the problems associated with drilling and maintaining wells up to 875 feet deep in unconsolidated waste rock required for the Partial Pit Backfill with

In-Pit Collection Alternative, the settling of fines may cause reduced permeability in the crusher reject used to create the pumping zone. The reduced permeability may cause the crusher reject to lose its ability to function as a sink to collect pit seepage. Additionally, perched groundwater paths may form in the backfill material, permitting seepage to leave the pit without being captured by the wells. Finally, the low permeability of the backfill material would likely make the control of pit seepage with vertical wells drilled in the backfill unreliable.

Under the Partial Pit Backfill with Downgradient Collection Alternative, DEQ believed that a maximum of 80 percent of groundwater would likely be captured by each of two capture systems, providing a combined capture efficiency of 92 percent. This capture efficiency would result in violations of water quality standards. DEQ-7 human health quality standards for nickel and copper would be exceeded within the Jefferson River alluvial aquifer. Nondegradation criteria for groundwater quality in the Jefferson River alluvial aquifer would fail for arsenic, cadmium, copper, iron, and nickel. The chronic aquatic life standard for aluminum would be exceeded in the Jefferson River Slough. Nondegradation criteria for surface water quality in the Jefferson River Slough would fail for aluminum, copper, and iron.

Mining of the proposed South Area Layback and North Area Pit would not change the analysis resulting in DEQ's 2007 decision not to require partial pit backfill of the Mineral Hill Pit. Drilling and maintaining wells in deep unconsolidated waste rock, reduced permeability due to the settling of fines, perched groundwater paths, and low permeability of the backfill material would still be problematic in a backfilled Mineral Hill Pit. Additionally, the results of the dynamic system model used to predict water impacts in 2007 are still valid even considering a reduction in groundwater flow through the primary pit flow path as a result of pumping of the North Area Pit. Furthermore, recent pit water pumping rates from the Mineral Hill Pit are greater than what was estimated in the 2007 SEIS. Thus, seepage volumes under the backfill alternatives would be greater than what was estimated in the 2007 SEIS. Any increase in the pit seepage rate would cause nickel and likely other metals to exceed groundwater quality standards even more so than that predicted in the 2007 SEIS. Because the analysis resulting in DEQ's 2007 decision remains valid, DEQ is not considering a partial pit backfill alternative for the South Area Layback in detail.

Affected Environment and Environmental Consequences

Information in this chapter describes the relevant resource components of the existing environment. Only resources that could be affected by the alternatives are described and include: geotechnical engineering; soils, vegetation, and reclamation; water resources; wildlife; aesthetics, and social and economic considerations. After the environment of each resource has been described, the impacts of the No Action Alternative, Proposed Action Alternative, Agency Modified Alternative, and North Area Pit Backfill Alternative are discussed.

3.1 Location Description and Study Area

The project location and associated study area for the mine include all lands and resources in the mine permit boundary, plus those additional areas identified by technical disciplines as "resource analysis areas" that are beyond the mine permit boundary. Resource analysis areas are identified for each technical discipline. Additional information on analysis areas is in Chapter 4. By definition, the resource analysis areas that extend beyond the mine permit boundary are included in the "study area" for this EIS

3.2 Geotechnical Engineering

A discussion of slope stability concerns for the highwalls in the North Area Pit and the South Area Layback of the Mineral Hill Pit and the stability of waste rock storage area slopes are in this section. The effects on ground movement blocks are also discussed.

3.2.1 Analysis Methods

3.2.1.1 Analysis Area

The analysis area for geotechnical engineering includes the North Area Pit and the South Area Layback Area, the expanded waste rock storage areas and the active TSF-2.

3.2.1.2 Information Sources

Information for the analysis of geotechnical engineering issues was found in Application for Amendment 015 to Operating Permit 00065 for the Golden Sunlight Mine (GSM 2012a) and Appendix A (Geotechnical Reports) of the referenced document.

3.2.1.3 Methods of Analysis

Geotechnical engineering slope stability was analyzed by Golder Associates using limited equilibrium techniques or kinematic design based on stereographic analysis of the rock discontinuities (naturally occurring breaks in rock by bedding planes, joints, fractures, faults, and shear zones) to assess the stability of the North Area Pit, the South Area Layback of the Mineral Hill Pit, and the expanded waste rock storage areas under both static (long-term gravitational loading) and seismic (earthquake ground motion) loading conditions. Kinematic design by stereographic analysis involves studying the spatial relationships between the orientation of the rock discontinuities and any given slope face accounting for structural orientation, persistence, roughness, and infilling in relation to the trend of the excavation slope.

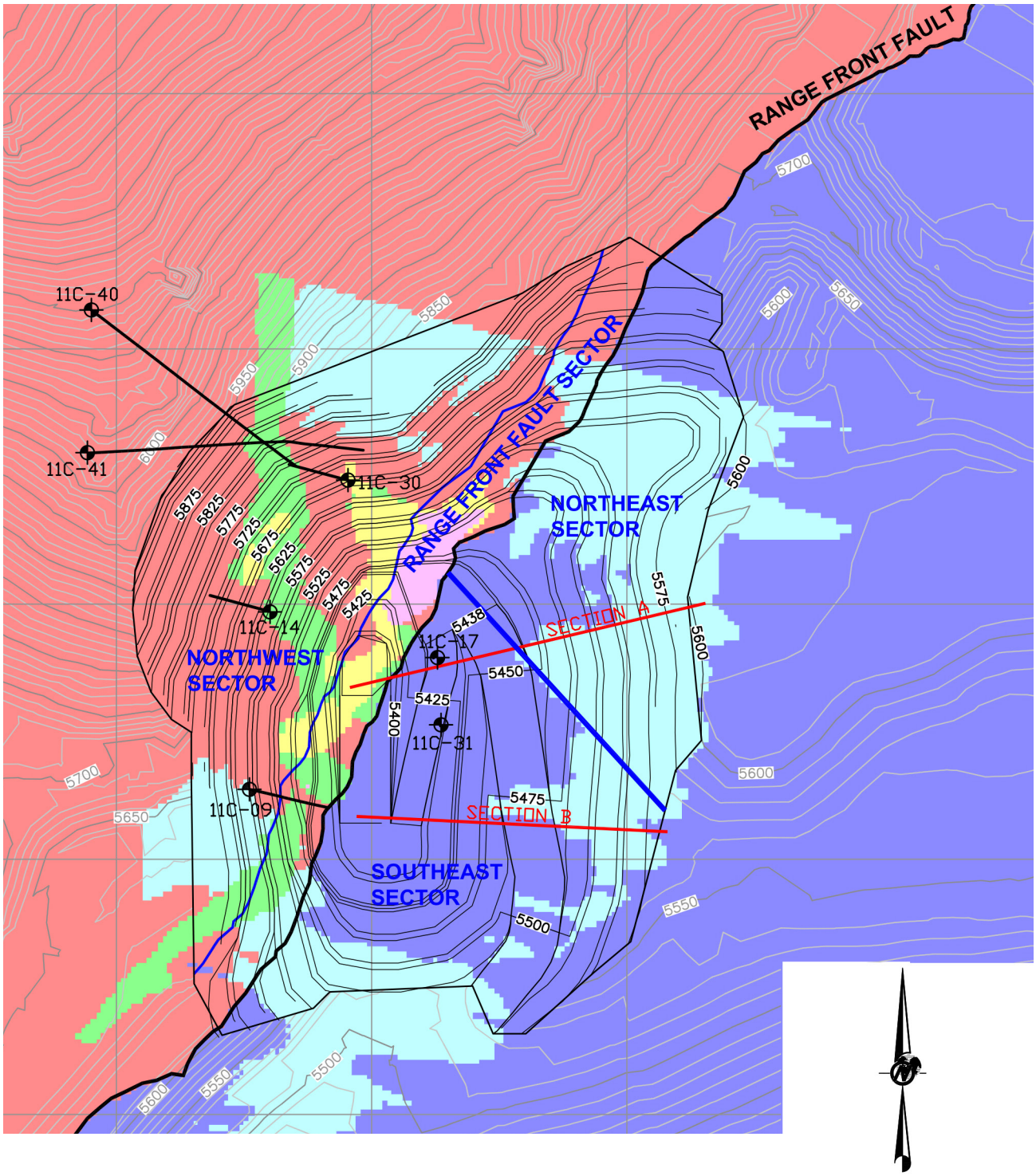
Computer software including the SLIDE V 5.044 program developed by RocScience (2010) was used in the analysis to evaluate the slope conditions with development of the North Area Pit in the Tertiary sediments and landslide deposits (**Figure 3-1**). Other sectors of the pit slopes developed in the bedrock units west of the Range Front Fault were evaluated using computer software programs SLIDE or DIPs developed by RocScience (RocScience, 2009). Pit slopes for the South Area Layback were evaluated using the RocScience software programs. The expansion of the EWRDC area was also analyzed using the SLIDE software program.

This SLIDE software program provided an estimate for a factor of safety (FOS) against a large-scale failure of a pit highwall and of the inter-ramp slopes during operational conditions. In traditional limit equilibrium analysis which accounts for a summation of forces across a failure plane, an FOS is the ratio of resisting forces to acting forces. The generally accepted FOS when working with slopes is 1.3 for short-term stability, 1.5 for long-term stability, and greater than 1.1 for slopes subjected to earthquake forces. A minimum FOS of 1.2 for pit operational conditions is consistent with stability objectives accepted for non-critical slopes at other large-scale mining operations (Read & Stacey, 2009).

3.2.2 Affected Environment

3.2.2.1 North Area Pit

The North Area Pit would be mined to a bottom elevation of 5,375 feet (GSM datum), resulting in pit dimensions of 1,750 feet by 1,140 feet. The highest slope in the pit would be along the northwest wall projected to be 575 feet (elevation 5,950 feet GSM datum).



SCALE: 1" = 300 Feet

LEGEND

- Geotechnical Coreholes (11C-03)
- Fault
- Sector Boundary
- Layback Outline
- Latite
- Siltite
- Quartzite
- Sunlight Vein
- Lamprophyre

Source: Golden Sunlight Mine 2012a

Figure 3-1
North Area Pit
Geology

The North Area Pit intersects geologic deposits of Cretaceous age latite and Proterozoic siltite, argillite, and quartzite as well as Quaternary landslide and debris flow materials overlying bedrock (**Figure 3-1**). The pit is bisected by the Range Front Fault zone, a steep east-dipping structural contact that trends northeast through the bottom of the pit and adjacent highwalls. Bedrock along the fault zone up to about 100 feet wide is characterized by a high degree of shattering and a corresponding low rock quality designation (RQD) and rock mass rating (RMR). Slopes northwest of the fault zone would be developed in the Cretaceous and Proterozoic aged bedrock formations and to the southeast in the Tertiary aged sedimentary rocks of the Bozeman Formation, landslide deposits, and debris flow materials.

The North Area Pit mining practices, including drilling, blasting, loading, and hauling, generally take place on either single or double benches separated by 25-foot highwalls. According to the proposed mine plan and draft amendment to the mine operating permit application, rock-fall catch benches varying in width from 22 to 44 feet have been planned on the pit highwalls depending on the materials excavated and the actual inter-ramp angle constructed. Either 22 to 24 feet wide benches would be constructed in the latite, siltite, argillite, or quartzite bedrock slopes and 39 to 44 foot wide benches in the Tertiary sediments (Bozeman Formation and landslide deposits). A single 90-foot wide haul road at a maximum grade of 12 percent would be used to access the pit, entering on the south side of the mine at an elevation of 5,550 feet. The haul road switchbacks on north to south headings on the east side of the mine pit to reach ore and waste rock at depth. Slope design recommendations for bedrock slopes were 50 degrees for a base case with controlled blasting, 55 degrees for an upside potential given favorable rock and structural control, and in the Range Front Fault zone of 45.6 degrees using controlled blasting techniques.

Excavation of the pit below the groundwater table would require lowering of the water table and mitigating inflow of groundwater into the pit. Subsequent slope design recommendations are predicated on effective depressurization of the pit walls. Initial drilling information indicates that groundwater levels in the North Area Pit generally decrease to the south from an elevation of about 5,540 feet in bedrock in the north to about 5,440 feet in bedrock to the south. Water levels in the Tertiary sediments range from about 5,518 to 5,401 feet (GSM Datum). A dewatering program is proposed for the North Area Pit through installation of dewatering wells peripheral to the pit, or by drilling horizontal holes into the pit highwalls to drain trapped water (Schlumberger Water Services [SWS] 2011). Any surface water runoff and precipitation along with water collected from horizontal dewatering wells installed in the pit highwall would be removed from the pit by pumping the water through a series of staging tanks to a common pit sump and then transferred to TSF-2 where it is used as process water.

At closure the water from a new common pit sump would be pumped to the treatment plant. Treated water would be pumped to an infiltration basin below TSF-2.

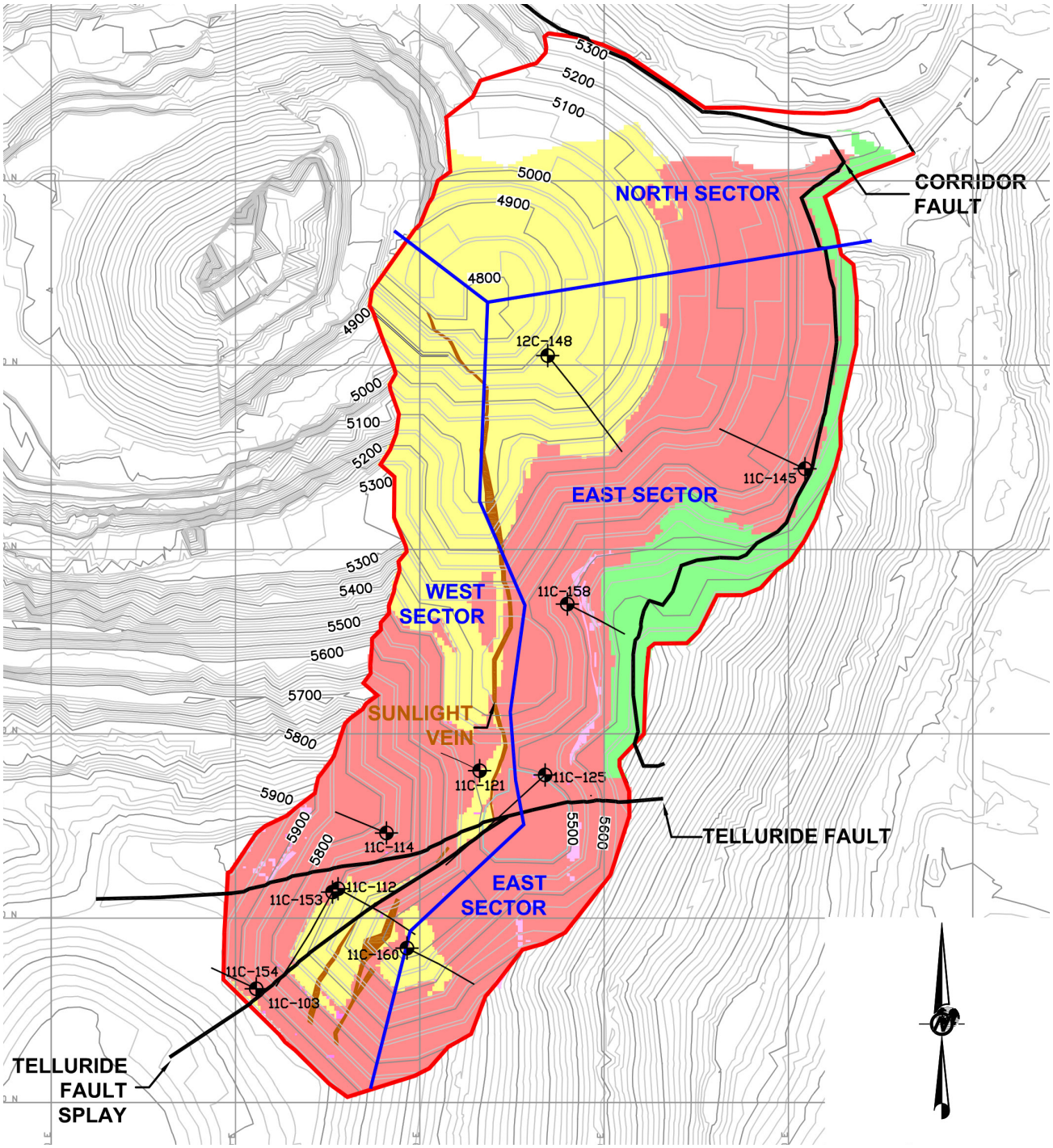
3.2.2.2 South Area Layback

The South Area Layback in the Mineral Hill Pit would be mined to a bottom elevation of 4,800 feet (GSM datum), resulting in a pit having maximum dimensions of approximately 2,800 feet by 1,300 feet at its greatest distances. The highest slopes in the pit would be along the north portion projected to be 550 to 650 feet (elevation 5,350 feet GSM datum) (Golder Associates 2012a). The haul ramp is in the northeast and east wall slopes and switches back repeatedly, resulting in overall slope angles of 42 degrees in the north wall and 36 degrees in the north part of the east wall. Through completion of the South Area Layback mining operation, an estimated 44.6 million tons of waste rock and 3.0 million tons of ore would be recovered.

The South Area Layback would be excavated entirely in bedrock composed of geologic deposits of Cretaceous age latite and Proterozoic siltite, argillite, and quartzite of fair to good rock quality (**Figure 3-2**). Ore-bearing mineralization occurs along the Sunlight Vein which dips westerly at about 80 degrees and trends north-south through the pit but turns southwest at the southern margins. The pit bottom increases in elevation from north to south along the Sunlight Vein having its deepest excavation in the east wall of the Mineral Hill Pit.

Latite and siltite bedrock along the east pit wall is bisected by the Corridor Fault. This fault dips gently to the east to southeast at about 25 degrees and is truncated in the south by the Telluride Fault. The main part of the Telluride Fault strikes east-northeast through the south part of the layback area and dips steeply to the north at 75 degrees. A fault splay bifurcates from the main fault to the southwest and dips northwest at 85 degrees. A zone of bedrock in the vicinity of both faults some 60 to 150 feet wide is characterized by a high degree of intense shearing, fracture, and decreased corresponding low RQD and RMR.

Pit mining practices would be similar to those described for the North Area Pit. A single 90-foot wide haul road at a maximum grade of 12 percent would be used to access the layback, entering on the northeast of the mine at an elevation of 5,310 feet. The haul road switchbacks on north to south headings on the northeast side of the mine pit to reach ore and waste rock at depth. Interramp angle slope design recommendations for bedrock slopes were 50 degrees for a base case with controlled blasting, 55 degrees for an upside potential given favorable rock and structural control, and in the Corridor Fault Zone of 45.6 degrees using controlled blasting techniques.



SCALE: 1" = 500 Feet

LEGEND

- 11C–03 Geotechnical Coreholes
- Fault
- Sector Boundary
- Layback Outline
- Latite
- Siltite
- Quartzite
- Sunlight Vein
- Lamprophyre

Source: Golden Sunlight Mine 2012a

Figure 3-2
South Area Layback
Geology

Groundwater in the South Area Layback is already controlled by Mineral Hill Pit dewatering and any additional inflow due to the pit development would be managed by the current operational dewatering system for the Mineral Hill Pit. Only the pit bottom in the northern portion of the layback is anticipated to extend below current groundwater levels, at about 5,150 feet. Slope recommendations for the South Area Layback also assume effective depressurization of the slopes.

3.2.2.3 East Waste Rock Dump Complex Expansion Area

A majority of the waste rock would be disposed of in the planned expansion of the EWRDC located in the northeastern portion of the mine permit boundary. The proposed EWRDC Expansion area would cover 179.6 total acres, 37.7 acres of which would be located outside of the current permitted disturbance boundary. The EWRDC Expansion area would contain up to 48.6 million tons of waste rock composed of 4 million tons sourced from the North Area Pit and up to 44.6 million tons from the South Area Layback. Up to 6 million tons could be placed in the Buttress Dump Extension Dump. The average thickness of the EWRDC Expansion would be 140 feet reaching as much as 290 feet above natural topography at the greatest extent. The reclaimed design condition would have an outslope along the dump face ratio of 2H: 1V (Golder Associates 2012a). The EWRDC Expansion area would be constructed over Quaternary and Tertiary sediments underlain by extensive thicknesses of Paleozoic sedimentary limestone from the Mission Canyon and Lodgepole formations.

The existing EWRDC area was originally designed to be constructed using 50-foot lifts. There have been no waste rock storage area slope stability problems. The investigation for the Expansion area confirmed the location of the eastern limit of the Sunlight Block and that the EWRDC lies outside of the limits of all of the known earth blocks.

3.2.3 Environmental Consequences

3.2.3.1 No Action Alternative

Work at the mine would continue until the Mineral Hill Pit reaches a bottom elevation of 4,250 feet through the approved 5B Optimization Project to ensure continuous mill processing through 2015. During this period, tailings would continue to be deposited in TSF-2 and waste rock would continue to be placed on the existing waste rock storage areas.

Mineral Hill Pit

Mining operations would cease after the pit reaches the permitted limits described above. During operations, pit highwall stability pit would continue to be monitored

using the existing system of survey prisms and extensometers. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and to minimize potential damage to mining equipment.

Some erosion of the Mineral Hill Pit highwalls and raveling of material onto benches would likely continue during the life of mine. There would be the potential for smaller scale slope failures on pit highwalls and release of rock into the mine pit similar to the failures that have previously occurred during operations.

Monitoring and maintenance of safety precautions would continue until all approved reclamation in the pit has been completed. GSM would have to maintain the 5,700 foot safety bench and road access to the underground workings for maintenance of the underground sump so pit water can be routed to the water treatment plant. No long term stability monitoring is proposed or bonded in the pit.

Tailings Storage Facility and Embankment

After mining operations cease, the surface of TSF-2 would be dewatered and capped. The final surface of TSF-2 would have a 0.5 percent to 5 percent slope toward the east end of the embankment to facilitate surface water drainage to the spillway. The tailings would be capped with a minimum of 36 inches of nonacid-generating cap rock and 24 inches of soil on top of the tailings. The capped TSF-2 surface would be seeded. The outside slope of the TSF-2 embankment would be reclaimed by reducing the slope to 2.5H: 1V. The regraded embankment surface would be covered with 16 inches of soil and seeded. Under the No Action Alternative, there are no adverse impacts to TSF-2 and embankment stability provided final slope contours are achieved and good reclamation practices coupled with adequate site drainage occur across the final top surface.

Waste Rock Storage Areas

After mining operations cease, the waste rock storage areas would be reclaimed as required by the operating permit. The tops of waste rock storage areas would be essentially flat (less than 2 percent slope). The waste rock storage area tops would be regraded to eliminate depressions and to provide surface water flow away from the steeper side slopes. Shallow drainageways would be created on the waste rock storage area tops to direct flows to undisturbed ground.

Final waste rock storage area reclamation would include slope reduction from angle-of-repose to slopes ranging from 2H:1V to 3H:1V. Natural regrade would be practiced where possible to diversify slope angles and to make the dumps appear more natural. The dumps would have drainage diversions constructed to divert runoff. Waste rock dumps would be covered with covers ranging from 16-36 inches of growth media

depending on slope angle. The growth media would consist of nonacid-generating cap rock where necessary, and placement of 16 inches of soil. The waste rock dumps would be revegetated with approved seed mixes.

Where reclamation has been completed on waste rock storage areas, these reclamation practices have been successful, resulting in a stable, well-vegetated tops and slopes. Under the No Action Alternative, there are no adverse impacts to the waste rock storage areas and embankment stability provided final slope contours are achieved and good reclamation practices coupled with adequate site drainage occur across the areas.

3.2.3.2 Proposed Action Alternative

Under the Proposed Action Alternative, mining would begin concurrently on both the North Area Pit and South Area Layback once the Mineral Hill Pit reaches the planned bottom elevation and layback configuration in the 5B Optimization Project. During mining, tailings would continue to be deposited in TSF-2, and waste rock would continue to be placed on the waste rock storage areas with the 48.6 million tons of non-ore rock placed in the EWRDC Expansion area. Up to 6 million tons of waste rock could also be placed in the Buttress Dump Extension.

North Area Pit

Operations. The North Area Pit design in terms of highwall stability is divided into three sectors defined by differing geomaterials (**Figure 2.7**). The Northwest Sector is predominantly competent bedrock consisting of siltite and latite with minor intrusions of lamprophyre sills on the northwest side of the Range Front Fault. The Range Front Fault is a 100-foot shear zone of broken, poor quality bedrock. The Southeast Sector is composed of Tertiary sediments consisting of landslide deposits and Bozeman Group fluvial facies overbank clay deposits and occasional unconsolidated channel sand interlayers.

Northwest Sector: Drilling information and the RQD data indicate the siltite and latite are good quality bedrock and should support relatively steep slopes with good presplit and best practices perimeter blasting. Slope recommendations are 50 degrees for a base case with controlled blasting and 55 degrees for an upside potential assuming the bedrock and structure quality is as favorable as geomechanics information indicates. Current steep natural slopes developed in the bedrock support this general supposition. Bedding orientations and dip are mostly favorable and relatively flat such that bedding is not expected to be a pervasive control on stability. Lamprophyre sills parallel to bedding could cause local planar failures in the benches if they are highly clay-altered and of weaker rock strength than anticipated. Should the dip on bedding planes in localized areas having dip direction of 90 degrees increase to 30 to 35 degrees, a potential exists for plane type failures to occur primarily at bench crests.

Joint sets of primary and secondary structure were measured in the bedrock fabric (Golder Associates 2012, Appendix A). The primary sets are oriented favorably for slope stability. The secondary set dips south-southwest at about 45 degrees and could represent a stability risk for slope orientations between about 160 and 245 degrees. According to the measurements of structural data and stereographic contour results, the set is not prominent in the structural data and is anticipated to be limited in distribution or continuity. Where the secondary set is encountered in slopes oriented within plus or minus 30 degrees (dip direction 160 to 245 degrees), it is anticipated to only control stability of bench crests and upper benches versus full bench heights.

Range Front Fault: The character and extent of fracture and sheared zone associated with the Range Front Fault is currently poorly defined. Current recommendations are for a highwall design of 45.6 degrees in this location. Pit highwall stability may require reassessment upon further refinement of the bedrock characteristics either prior to or during mining. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and minimize potential damage to mining equipment.

Southeast Sector: Limit equilibrium stability analysis of the Tertiary sediments was completed for two sections (Section A and Section B) drawn through the east wall of the North Area Pit design using the RocScience program SLIDE V5.044 (RocScience, 2010). Stability analysis results determined that a slope angle of 24 degrees was required for a FOS of 1.2 in the northern locations of this sector and a slope angle of 26 degrees was required for the southern portion of the sector. The analysis also assumes fully depressurized pit slopes.

Initial stability calculations determined FOS 1.16, slightly below the recommended minimum of 1.2 for the slope above the uppermost ramp area in the north portion of the sector (Section A). Failure surfaces generated for the early slope designs above the uppermost ramp passed through a larger percentage of low strength Tertiary sediments than through overlying landslide and mine waste rock of known higher strength characteristics. To improve calculated stability design, iterations required raising the ramp 10 feet to achieve a FOS of 1.23; above the requisite of 1.2. Raising the ramp elevation increased the percentage of the critical failure surface passing through the stronger landslide and mine waste materials. The FOS for circular failure of the overall slope is calculated to be 1.42.

In the southern portion of the east highwall (Section B), the slope below the ramp is composed entirely of Tertiary sediments and the slope above the ramp is in landslide deposits and mine waste. A FOS of 1.73 was calculated by modeling of the overall slope and FOS 1.42 against failure for the lower slope in the Tertiary sediments.

The 70 foot thick seam of high-plasticity clay encountered in corehole 11C-17 is highly unfavorable for development of slopes on both a bench scale and an inter-ramp and overall slope scale. The extent of this clay zone are not yet fully understood both vertically and laterally in the east pit highwall areas and poorly defined by the limited subsurface data available. For example, similar high-plasticity clay was encountered in borehole 11C-31 at differing depths having thicknesses of 1 and 3 feet respectively, thus the clay occurrence does not seem to be laterally extensive. Further definition by subsurface exploration or during pit development may require re-evaluation of the pit highwall design in this zone. Continued efforts should focus on further definition of the zone of poor quality rock at the fault location and defining the character and extent of the high plasticity clay seam intersected in borehole 11C-17.

Some erosion of the North Area Pit highwalls and raveling of material onto benches would likely continue during the life of mine. The North Area Pit would expose zones of weaker rock of poor rock quality in some of the highwalls resulting in higher potential for small highwall instability problems, especially in and around the Range Front Fault.

Ground Movement Blocks. Mining of the North Area Pit would not affect the ground movement block at GSM. If anything, pit development should relieve loading pressures in the head area and should not instigate further movement in the block. Dewatering the area may help limit water movement into the Midas Slump area which would help stabilize that area.

Closure. The operational dewatering program for the North Area Pit using dewatering wells peripheral to the pit, and/or by horizontal holes drilled into the pit highwalls to drain trapped water would need to be modified at closure. During operations, any surface water runoff, precipitation, snowmelt, along with any water collected from pit highwall dewatering wells or natural seeps in highwalls not captured by dewatering wells would be removed from the pit by pumping the water through a series of staging tanks to a common pit sump and then transferred to TSF-2 where it is used as process water. Raveling and minor failures of portions of the highwalls could threaten the pit water collection and routing system. The operational capture and routing system would need to be modified at closure.

At closure, the Northwest Sector would be left as completed during operations. Minor raveling and small wall failures could occur over time but would not present a risk to human health or the environment. The same conditions would apply for the Range Front Fault sector except this area would be expected to ravel more often. The Southeast Sector Tertiary sediments, landslide debris, mine waste, and the high-plasticity clay seam would be final graded to a 2H:1V slope covered with salvaged growth media if needed and revegetated. The potential for slope failure on these portions of the pit would be minimal. Erosion of the fine-grained Bozeman Formation materials on the

2H:1V southeast portion of the east highwall would be the largest potential for movement of materials.

A pit pond would be prevented from forming in the North Area Pit at closure. Raveling and minor failures of portions of the highwalls could threaten the pit water collection and routing system. A conceptual plan is needed to address safe access into the pit to maintain the closure collection sump and pipeline.

South Area Layback

Operations. The South Area Layback would be developed along the southern wall of the Mineral Hill Pit resulting in an approximate 69.4-acre expansion to the existing Mineral Hill Pit to the east and south. Through completion of the South Area Layback mining operation, an estimated 44.6 million tons of waste rock and 3.0 million tons of ore would be recovered.

The South Area Layback pit would be mined to a bottom elevation of 4,800 feet (GSM datum), resulting in a pit having maximum dimensions of approximately 2,800 feet by 1,300 feet at its greatest distances. The highest slopes in the pit would be along the north portion projected to be 550 to 650 feet (elevation 5,350 GSM datum). The haul ramp is in the northeast and east wall slopes and switches back repeatedly, resulting in overall slope angles of 42 degrees in the north wall and 36 degrees in the north part of the east wall.

The South Area Layback design in terms of highwall stability is divided into three sectors defined by differing rock structure, two fault zones and the Sunlight ore vein (**Figure 3-2**). Rock mass quality is generally good with some exceptions in and near the Corridor and Telluride Fault zones and the Telluride Splay Fault. In general, weathered bedrock from the surface to a depth on the order of 100 feet exhibits increased fracturing and oxidation. The North Sector is predominantly competent bedrock consisting of quartzite and siltite. The East Sector is composed of siltite, latite, and lamprophyre dikes of lesser rock quality. The West Sector is composed of siltite, quartzite, and the Sunlight ore vein.

North Sector: Geologic data indicates east-dipping bedding and steep structural joint sets orthogonal to bedding or parallel to the Sunlight vein and Telluride Fault. Structure appears to be favorable in this sector. The uppermost bench would be developed in the hanging wall of the Corridor Fault of known poor-quality rock. Slope ratios have been reduced to 45.6 degrees in this location and local modification to the pit wall design may be required to reflect the areas of poor rock quality. Careful controlled blasting and active post-blast rock scaling would be essential to ensure worker safety and minimize potential damage to mining equipment.

East Sector: Structure is favorable for pit highwall stability in this sector. Bedding dips east into the wall at an inclination of 25 degrees and joint sets are steeply dipping either parallel to the Sunlight vein or orthogonal to bedding. These steep joint sets are expected to control the development of bench face angles which should enhance their stability. The uppermost two benches in the north portion of this sector would be developed in the hanging wall of the Corridor Fault associated with poor rock quality. A similar geologic setting of lesser rock quality would occur near the Telluride Fault and the Splay Fault to the south. Careful controlled blasting and scaling should mitigate rockfall concerns and stability risks associated with lower rock mass quality.

West Sector: Structure is favorable for slope stability and data indicates that bedding dips out of the slope at an angle of 15 to 25 degrees or less. Based on performance of the Mineral Hill Pit, this angle is too flat to develop structural control of slope stability as occurred in the west wall of the Mineral Hill Pit and would create planar instabilities. Dip angles of failures increased to 35 degrees at that location. A stereographic plot of structure sets shows steep northeast striking structures orthogonal to bedding and a second set that dips southeast having variable dip and dip direction. These features may control bench face angles when oriented within 30 degrees of the dip direction of the bench face.

General: During operations, effective groundwater depressurization would be required and controlled blasting techniques would be used in the mine pit development to maintain the integrity of the benches and minimize raveling to ensure the benches remain capable of containing future rock falls. GSM would mine slopes at 50 degrees for a base case with controlled blasting, and 55 degrees for an upside potential assuming the bedrock and structure quality is as favorable as geomechanics information indicates. GSM would mine slopes at a reduced slope inclination of 45.6 degrees for the upper 100 feet of weathered bedrock and within the influence zone of the Corridor Fault.

The South Area Layback would remove approximately one-half of the Swimming Pool Earth Block. Movement of this block has been attributed to loading of the lower portion of the block and not to actions affecting the head of the block. As such, the proposed South Area Layback development should relieve loading pressures in the head area and should not instigate further movement in the block (Golder Associates, 2012b).

Closure. Raveling and minor failures of the South Area Layback highwalls would occur over time but would not present a risk to human health or the environment.

TSF-2 and Embankment

Operations. Approximately 4.2 million tons of tailings generated from processing ore would be placed in TSF-2. TSF-2 is currently permitted to a minimum embankment elevation of 4,770 feet (GSM datum) and the current elevation of the embankment is at

4,762 feet (GSM datum). The Proposed Action Alternative would result in milling into year 2017 and would result in an embankment raise of 4.5 feet to elevation 4,774.5 feet (GSM datum) (AMEC 2012). Based on previous analysis, no adverse operational geotechnical impacts from the TSF-2 expansion are anticipated.

Closure. After mining operations cease, the ponded water in TSF-2 would be drained or pumped to the south pond and the tailings surface would be capped with a minimum of 48 inches of soil on top of the tailings. The final surface of TSF-2 would have a 0.5 percent to 5 percent slope toward a drainage ditch along the west side. The capped surface would be seeded. The outside slope of the TSF-2 embankment would be reclaimed by reducing the slope from angle of repose to 2.5H: 1V. The regraded embankment surface would be covered with 16 inches of soil and seeded. Based on previous analysis, no adverse closure geotechnical impacts from the TSF-2 expansion are anticipated.

Waste Rock Storage Areas

Operations. A majority of the waste rock would be disposed of in the EWRDC Expansion area with up to 44.6 million tons from the South Area Layback, and 4 million tons from the North Area Pit. A stability evaluation of the proposed EWRDC Expansion was performed (Golder Associates 2012a). This evaluation included review of existing subsurface information and geotechnical monitoring data, new subsurface information obtained from four coreholes drilled within the proposed footprint of the EWRDC, geotechnical laboratory test data, and a sensitivity study of the limit equilibrium analysis.

The stability analysis reported acceptable FOS greater than 1.4 for three of four sections analyzed in the EWRDC and a FOS of 1.2 for the west slope of Section D under a potential block failure mode. No large scale or catastrophic failures were indicated by the stability evaluations performed for the proposed expansion.

Subsequent modeling of Section D for seismic displacements using the design earthquake ground motions and conservative strength data for sediments in the Tertiary Bozeman Group suggested potential slope displacements on the order of two to three feet could potentially develop. However, the estimated magnitude of movement is considered to be acceptable for non-critical mine facilities (waste rock disposal facilities) and would not impact other mine facilities.

Geotechnical recommendations incorporated into the EWRDC Expansion design placed limits on the expansion footprint to avoid cultural areas, the headwaters to Sheep Rock Creek Tributary and a tributary of Conrow Creek, shallow groundwater locations near PW-79, and locations underlain by Madison Group limestone with a potential for development of karst features. In addition, GSM is required to perform operational

geotechnical monitoring of inclinometers, GPS points, and groundwater monitoring of wells and piezometers during periods of active dumping. Slope stability modeling concluded that as currently designed the planned EWRDC Expansion area dump would have no effect on the stability of the Sunlight Block (Golder Associates 2012a).

Up to 6 million tons of waste rock could go to the Buttress Dump Extension. This waste rock would not exceed earlier volumes of waste rock approved for the facility so no additional geotechnical evaluations were completed.

Closure. No closure geotechnical monitoring of inclinometers and GPS points was proposed for the waste rock dump areas. If ground movement occurs after closure, reclamation cover systems could be compromised allowing more infiltration into the acidic waste rock dumps.

3.2.3.3 Agency Modified Alternative

The Agency Modified Alternative would be similar to the Proposed Action Alternative with additional project modifications. No agency modifications are proposed for the South Area Layback and TSF-2.

Raveling and minor failures of portions of the highwalls could threaten the pit water collection and routing system. A conceptual plan is needed to address safe access into the pit to maintain the closure collection sump and pipeline from highwall rock failures over time. This closure plan issue is discussed in detail in the Water Resources Section 3.4.3.

No closure geodetic and geotechnical monitoring of inclinometers and GPS points is proposed for the waste rock dump areas or the North Area Pit. Additional remote monitoring for highwall rock failures and ground movement under the Agency-Modified Alternative may provide advanced warning of potential problems or would identify that ground movements have occurred. When highwall rock failures occur, solutions to restore pit water collection systems can be engineered. If ground movement occurs, reclamation cover systems may be compromised. Early identification of these movements and implementation of remedial measures would minimize potential increased infiltration into acidic waste rock.

GSM would provide a conceptual closure monitoring program that would identify pit highwall failures in areas where the North Area Pit collection sump would be compromised or where access into the North Area Pit would be blocked. GSM would also provide a closure ground movement monitoring program that would identify if the EWRDC Expansion area settled or moved laterally such that the reclamation cover

system was compromised. GSM would provide conceptual plans on how the instability problems would be remedied.

North Area Pit Backfill Alternative

Closure. The raveling and minor failures of portions of the highwalls that may occur under the Proposed Action Alternative at closure would not occur under the North Area Pit Backfill Alternative. Minor settlement of the backfilled waste rock would occur over time as acid-generating waste rock weathers. Backfilling the eastern portion of the North Area Pit would add mass near the upper end of the Sunlight Block, which could decrease the stability of this landslide block. However, less material would be placed back into this area of the pit during backfilling than would be removed during mining of the North Area Pit (**Figure 2-10**), so overall effects on geotechnical stability after backfilling would be comparable to the No Action Alternative.

3.3 Soil, Vegetation, and Reclamation

The 1997 Draft EIS (DEQ and BLM 1997) described the soil and vegetation resources in the GSM permit area. The SEIS (DEQ and BLM 2007) refers to the 1997 Draft EIS and provides some additional information about the borrow source north of TSP-1 to be used to supplement soils used for reclamation.

This section discusses the soil, vegetation, and reclamation resources in the GSM study area.

3.3.1 Analysis Methods

3.3.1.1 Analysis Areas

The analysis area for soils, vegetation, and reclamation includes the GSM operating permit area of 6,051 acres. All areas to be disturbed by mining, including the North Area Pit, South Area Layback, and expanded EWRDC, are in the analysis area. The analysis area for sensitive plants and plant communities includes the area within a 10-mile radius of the mine site.

3.3.1.2 Information Sources - Soils

A mine-site soil survey was completed as part of GSM's 1995 Permit Amendment Application and included soil profile descriptions and laboratory analyses. Jefferson County soils have been mapped as part of the U.S. Department of Agriculture (USDA), County Soil Survey (USDA 2003). The major part of the USDA soil survey and mapping was completed in 1996 but the survey was not issued until 2003. The Jefferson County

Soil Survey is not available as a published soil survey but is available electronically from the Montana Natural Resource Information System (NRIS) website (nris.mt.gov/). GSM also uses borrow and other nonacid producing geologic materials for growth media. GSM Annual Reports (most recent is for 2012) contain detailed information on soil, borrow, and other growth media volumes available for reclamation.

3.3.1.3 Information Sources – Vegetation

The vegetation communities were identified in 1995 by Westech Inc. for the 1995 Permit Amendment Application (Westech 1995). An updated vegetation study was completed by Bighorn Environmental Sciences in 2011 and is Appendix H of the proposed Amendment 015 Application (GSM 2012).

3.3.1.4 Information Sources – Reclamation

The Operating and Reclamation Plan was prepared in 2010 (SPSI 2010) with revisions in February 2011 and May 2011. GSM Annual Reports (most recent is for 2012) contain detailed information that pertains to the mining, reclamation, environmental monitoring, and reclamation bonding. Reclamation is proposed for all disturbed areas including waste-rock disposal areas, tailings storage facilities, mine pits, haul and access roads, and the facilities areas. Some of the mine facilities would be left for post-mine industrial uses.

3.3.1.5 Methods of Analysis

Soil salvage and borrow replacement volumes needed for reclamation were verified. Soil and growth media quality for post mine land use have been documented in the reclamation of over 1,000 acres to date and has not been readdressed. For vegetation, the acres of vegetation disturbed during the mine operations were evaluated and compared for each alternative. The potential to impact to any recorded sensitive plant species or plant community was also analyzed. Reclamation was analyzed for the probable success of current reclamation methods. The ability of reclamation to stabilize disturbed areas and re-establish vegetation was evaluated and compared for each alternative.

3.3.2 Affected Environment

3.3.2.1 Soil Resources

Soils around the mine site are generally characterized as rocky, shallow, and poorly developed on hillsides with 25 to 60 percent slopes. As of December 31, 2011, 2,361 acres have been disturbed with soils salvaged from most of these areas. Some of the

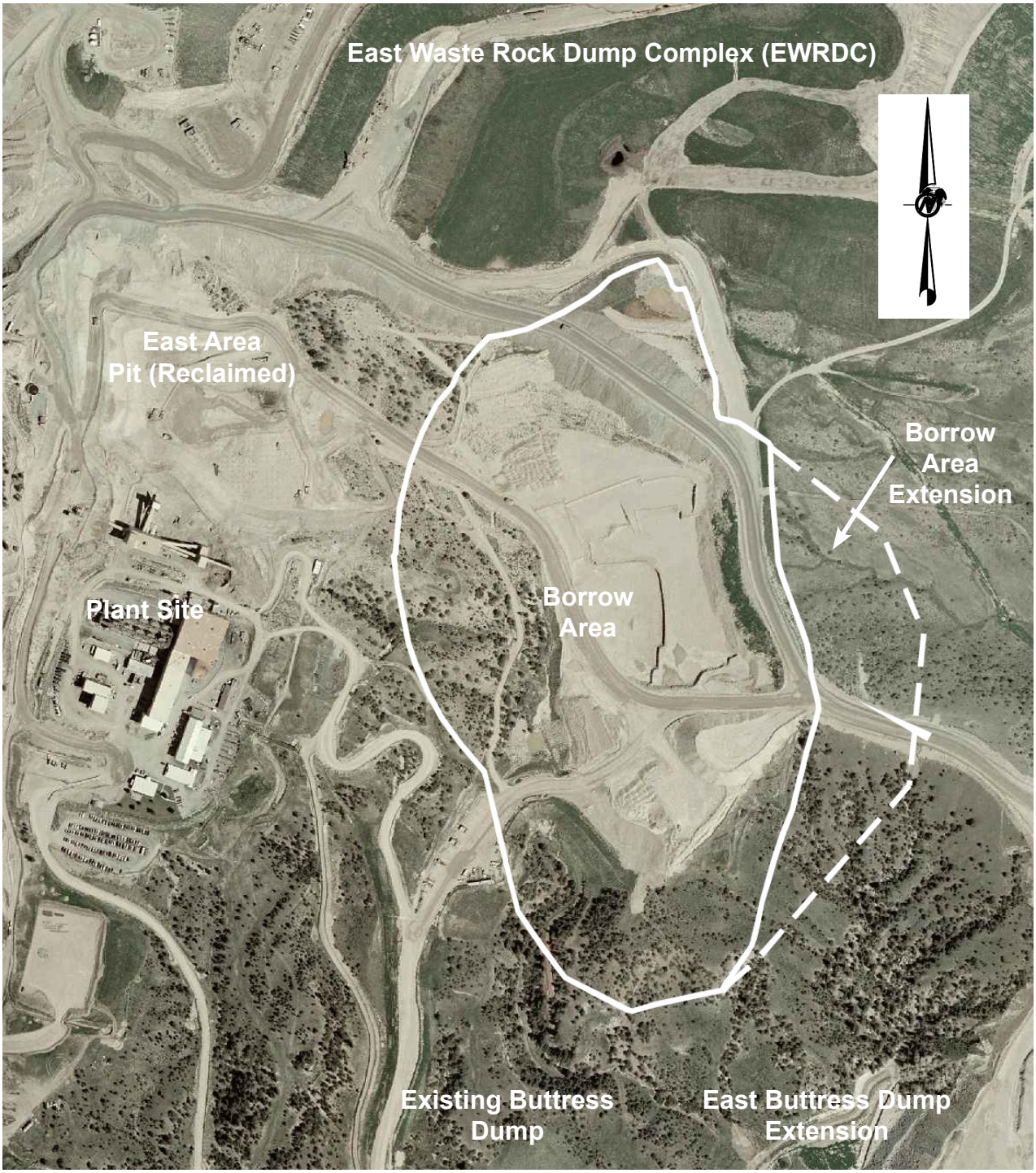
mine areas have soils mapped as a "Soil Complex" with part of the complex being boulder or rock outcrop. Information from the Jefferson County Soil Survey was used to identify and evaluate the dominant soil types on the mine site (USDA 2003).

DEQ policy considers soils on slopes over 50 percent as generally unsalvageable due to equipment limitations and worker safety. Depth of soil, percent of rock fragments in the soil, pH, and soil texture are the main properties used to determine the soil's use in reclamation. Soil salvage depths vary greatly from area to area but GSM is committed to salvaging all available soil. Soils used on steep slopes must contain at least 20 percent rock fragments over one inch in size to limit erosion. Removal depths are determined in the field and the equipment operators make site-specific adjustments. Salvaged soils are stockpiled for reclamation.

Available soils from the North Area Pit, South Area Layback, and EWRDC Expansion area would be salvaged except for soils on slopes greater than 50 percent and from any silt-textured lakebed sediments. Soil salvage estimates for the North Area Pit and South Area Layback are not easily determined due to steep slopes. Nonacid generating rip rap material may be salvaged from the scree slopes in the North Area Pit areas and stockpiled for reclamation. GSM estimates approximately 121,000 cubic yards (CY) of soil would be salvaged as part of the EWRDC Expansion area.

There is an overall shortfall of stockpiled soil for reclamation. GSM has used Bozeman Group materials for borrow for many years. GSM has identified a source of borrow material (**Figure 3-3**), that when combined with the stockpiled soil, has been used successfully as a plant growth medium. The combined volume of stockpiled soil and borrow materials would provide the volume of soils needed for final reclamation of all disturbed areas.

There is an estimated 2 feet of additional soil that would be salvaged from the EWRDC Expansion area. GSM would excavate holes in the areas where soils have already been salvaged to determine if additional soil materials are available. The volume of additional soil to be salvaged in the EWRDC Expansion area has not been quantified.



SCALE: 1" = 250 Feet

Figure 3-3
Borrow Pit Area Closeup

Source: Golden Sunlight Mine 2012a

3.3.2.2 Vegetation Resources

A vegetation study was completed as part of the Amendment 015 application to map vegetation communities in the undisturbed areas of the proposed North Area Pit, South Area Layback, and EWRDC Expansion area (Bighorn Environmental Sciences 2011). The reasons for the recent vegetation study were to determine changes in the vegetation communities since the previous vegetation inventory (Westech 1995), inventory areas not previously surveyed, and determine presence of special status species. Primary changes in the vegetation communities since 1995 have been an increase in size and quantity of the woody plants and increased invasive or noxious weeds. No plant species of concern or special status species were identified during the 2011 vegetation inventory.

The North Area Pit vegetation was mapped as Douglas-fir/scree (big sagebrush/bluebunch wheatgrass). Other vegetation mapping units included mountain mahogany/rock outcrop and Douglas-fir/bluebunch wheatgrass types. The forest type along the eastern edge of the proposed North Area Pit is Douglas-fir/bluebunch wheatgrass.

The vegetation in the southern part of the South Area Layback is sagebrush/bluebunch wheatgrass and Douglas-fir/bluebunch wheatgrass. The northern part of the South Area Layback contains big sagebrush growing on talus, big sagebrush and wheatgrass on talus, and Douglas-fir, without distinct boundaries between the plant communities. Other shrubs in the northern part of the South Area Layback are wax currant, mock orange, and chokecherry (Bighorn Environmental Sciences 2011).

Vegetation communities in the EWRDC Expansion area consist of sagebrush, mixed shrubs, and grassland types with no distinct boundaries between them. The sagebrush community contains both low and big sagebrush. The mixed shrub type has a mixture of shrubs with an understory of grasses. The short to medium height grassland type is found in the southern portion of the EWRDC Expansion area.

Noxious and other weeds have increased on the mine site since 1995 and were identified in areas to be disturbed by the Amendment 015 expansion. Although the GSM operations include a weed-control program, weed distribution has increased through continued mining and land disturbance, traffic, and from off-site sources. Noxious weeds observed in the proposed North Area Pit, South Area Layback, and EWRDC Expansion area include: leafy spurge, Canadian thistle, musk thistle, spotted knapweed, mullein, whitetop, and Dalmatian toadflax. Cheatgrass and black henbane (non-noxious weeds) were also present in the North Area Pit, South Area Layback, and EWRDC Expansion areas.

The Montana Natural Heritage Program (MTNHP) database was queried and reported one potential plant species of concern within Townships T2N, R3W and T2N, R4W, Jefferson County, Montana. Limestone larkspur (*Delphinium bicolor*) has been verified as occurring in Jefferson County but was not identified by Bighorn Environmental Sciences during the 2011 vegetation study.

3.3.2.3 Reclamation

Reclamation, including soil salvage, soil redistribution, and revegetation, was discussed in the 2007 Final SEIS (DEQ and BLM July 2007) and in the approved Operating and Reclamation Plan (GSM 2010). GSM's mine reclamation plan is designed to return disturbed land other than open pits and rock faces to stability and utility comparable to that of adjacent areas. GSM's reclamation plan requires the regrading and revegetation of most disturbed areas to achieve post-closure land uses of grazing and wildlife habitat; some areas will be reclaimed for post-mine industrial uses.

3.3.3 Environmental Consequences

3.3.3.1 No Action Alternative

Mining causes adverse impacts to soils and vegetation. With successful implementation of the approved reclamation plan, including erosion control procedures, impacts to soils and vegetation would be minimized. According to GSM's 2012 Annual Progress Report, GSM mining operations have disturbed 2,399 acres at the mine and GSM has partially reclaimed 1,178 acres.

Impacts on soil may result from the removal and storage of soils and redisturbance during replacement after mining. Soil has been salvaged from a majority of the 2,399 disturbed acres except on most slopes steeper than 2H:1V where there are equipment limitations and worker safety issues. GSM has salvaged soil on slopes steeper than 2H:1V and with rock content that exceeds 50 percent on the west side of the mine because of the limited soil resources on less steep slopes in that area.

Specific impacts to soils under the No Action Alternative would include loss of soil development and horizons, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of these specific impacts would influence the potential success of reclaiming the disturbed areas to grazing and wildlife habitat.

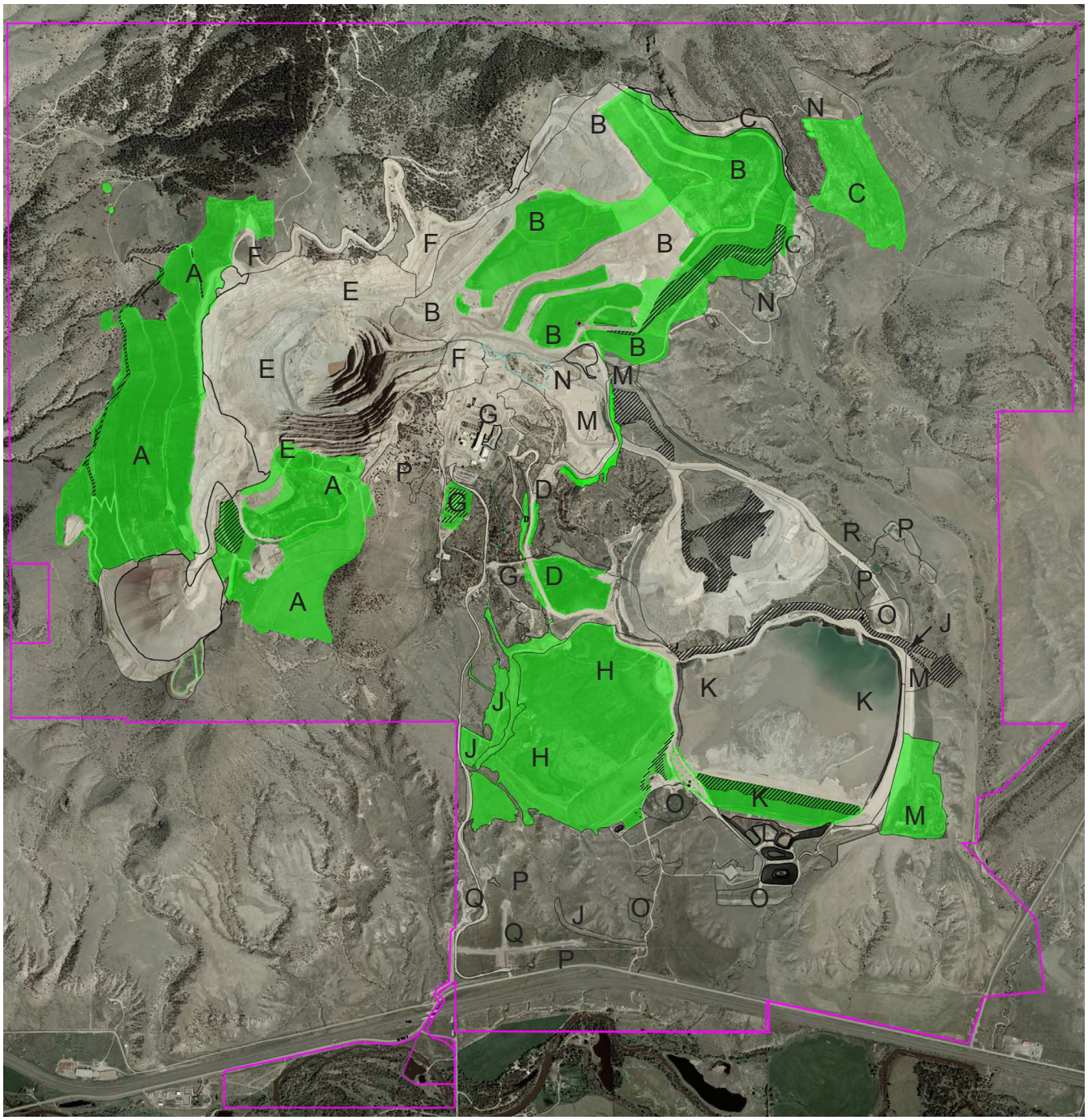
As of December 31, 2012, GSM reported a balance of 3,670,476 CY of soil needed for reclamation and a combined total of 6,392,244 CY of stockpiled soil and in situ borrow materials available for reclamation (GSM 2012 Annual Report, June 2013). GSM is required to replacing approximately 31 to 36 inches of soil on 59 acres in the Mineral Hill Pit; 31 to 36 inches on most areas of the West Waste Rock Dump Complex, EWRDC, and Buttress Dumps; 48 inches on the tailings impoundments; 6 to 36 inches over the plant site; and 6 inches on the buffer areas. The soil stockpile volume is dynamic and changes yearly.

GSM identified suitable reclamation growth media in the 03 Borrow source (**Figure 3-3**). The 03 Borrow area has a higher percentage of coarse-fragment content ranging from 35 to 60 percent. The high rock fragment amounts may limit the water holding capacity and fertility but those soils have been used successfully for reclamation on steeper slopes. Some beneficial effects of the high rock fragment content soil are high infiltration, lower soil erosion, and less compaction during soil redistribution operations. Reclamation and revegetation completed at GSM do not appear to be limited by high rock fragment content in the native soils and borrow materials. Native soils on the steep slopes in the area have the same high coarse fragment contents.

GSM has reclaimed approximately 1,178 acres across the entire mine site (**Figure 3-4**). Some of the reclaimed areas have successfully re-established a grassland vegetation cover. Reclamation seed mixtures have been developed for various slope configurations and facilities. The rocky and well-drained soils used for reclamation appear to help minimize soil erosion and sedimentation from the reclaimed areas during the initial establishment periods. Specific erosion control procedures are listed in the reclamation plan. Noxious weed infestations are monitored through field reconnaissance and controlled using standard practices that are summarized in each annual report to the agencies.

GSM has not successfully reclaimed any areas to Douglas-fir or mixed shrub plant communities. Some plantings of shrubs on the revegetated grasslands have partially survived. The only successful shrubs established from seed are rubber rabbitbrush and fourwing saltbush. Fourwing saltbush has not successfully reseeded itself.

Vegetation impacts to date have included the loss of native plant communities, temporary loss of vegetation productivity and canopy cover, reduction in species diversity, and increased invasive species including noxious weeds. Salvage and replacement of soil and seeding with native species on over 1,000 acres have reduced some of these impacts but the diverse native vegetation communities have not returned. These are the unavoidable impacts of allowing soil disturbance.



Legend

- Disturbance Boundary
- Reclaimed Areas
- Permit Boundary
- Disturbed
- Un-Disturbed

Area

A West and South Waste Rock Dumps
B East Waste Rock Dumps
C East Waste Rock Dumps Misc.
D Buttress Waste Rock Dump and Road
E Mineral Hill Open Pit
F Mineral Hill Open Pit Misc.
G Facilities
H Tailing Pond #1
J Tailing Ponds Misc.
K Tailing Pond #2
L Tailing Pond #2 Process Ponds
M Borrow Areas
N Stockpiles, Mine Area
O Stockpiles , Tailing Area
P Miscellaneous
Q Jefferson Local Development Corp.
R 5BOP Buttress Dump

SCALE: 1" = 4,000 Feet

Figure 3-4
Golden Sunlight Mine Disturbed and Reclaimed Areas (December 2012)

Source: Golden Sunlight Mine 2012a

3.3.3.2 Proposed Action Alternative

Impacts to soils, vegetation, and reclamation would be similar to those described under the No Action Alternative but would apply to a larger area of disturbance. An additional 302.9 acres would be disturbed or redisturbed as part of the Proposed Action Alternative. Approximately 152.1 acres of new disturbance would be outside the permitted disturbance boundary and not previously disturbed, and 150.8 acres would be in the permitted disturbance boundary and previously disturbed. Approximately 75.4 acres of the previously disturbed land has been reclaimed.

Soil would be stripped from a majority of the 302.9 acres but not from slopes over 50 percent or from soils that developed from silt-textured lake bed sediments. Salvaging the available soil from the 75.4 acres of reclaimed land would follow the method described in Permit Revision MR 08-003 where GSM would salvage soil to within 6 inches of the original acid generating waste rock surfaces rather than from a stipulated salvaged depth (e.g., 24 inches).

Soils from areas around the EWRDC Expansion area are typically fine-grained and calcareous and would be salvaged. These soils would not be used for steep slope reclamation (e.g. 2H:1V slopes) but would be used for reclaiming gentle sloping and flat areas. The higher coarse fragment content borrow materials would be used for steep slope reclamation in the EWRDC Expansion area and for covering the additional acres of TSF-2. Reclamation efforts completed to date at the mine have been successful and do not appear to be limited by soil rock fragment content.

The volume of soil to be salvaged from the 302.9 acres of disturbance was not totally estimated but would be a minimum of 121,000 CY (estimated volume of soil from the EWRDC Expansion area). Two feet of soil salvaged from the 75.4 acres of reclaimed land would equal about 243,000 CY. Soil salvage estimates for the North Area Pit and South Area Layback were not easily determined due to steep slopes. Nonacid generating rip rap would be salvaged from the scree slopes in the North Area Pit and stockpiled for reclamation. Salvaged soil would be placed in stockpiles and seeded with the approved seed mix for soil stockpiles.

The Proposed Action Alternative would increase the area requiring revegetation compared to the No Action Alternative by an additional 152.1 acres. The additional area would be reclaimed using methods and procedures outlined in the approved GSM Operating and Reclamation Plan. Approximately 32.3 acres of the additional 152.1 acres are Buffer areas and would be used for access roads, reclamation material stockpiles, monitoring wells, power lines, pipelines, and potential borrow sources. It is not anticipated that any acid-generating material would be deposited in the Buffer areas. Reclamation of the Buffer areas would require some grading and ripping, prior to covering with 6 inches of soil and reseeding.

The seedbed preparation and revegetation plans for the additional areas under the Proposed Action Alternative would be nearly identical to the current plans to be used for the No Action Alternative. The mine currently has five site-specific revegetation seed mixtures designed for various slope angles and slope aspect, and for the TSF areas, Buffer areas, and support areas. The seed mixtures contain predominantly native vegetation and any changes or modifications are approved at the time of seeding.

Impacts to vegetation would be similar as the No Action Alternative, except approximately 77 acres of the Mineral Hill Pit and North Area Pit highwalls would be reclaimed as rockfaces and would not be covered with soil or revegetated.

3.3.3.3 Agency Modified Alternative

The soils, vegetation, and reclamation resources impacted by mining under the Agency-Modified Alternative would be similar to impacts described under the Proposed Action Alternative. No additional modifications are needed for soils, vegetation, and reclamation resources except DEQ would require salvage of fine-grained silt lakebed sediments. These soils would be suitable for use on slopes less than eight percent. Organic amendment additions increasing the organic matter content to one percent in the surface six inches would reduce crusting, so water would infiltrate and seeds can germinate, commonly associated with the lakebed sediments.

Impacts to vegetation would be the same as listed for the No Action Alternative and Proposed Action Alternative.

3.3.3.4 North Area Pit Backfill Alternative

Backfilling of the North Area Pit would result in additional acres of 2H:1V slope revegetated landscape, compared with the Proposed Action Alternative and the Agency Modified Alternative. Elimination of the pit highwall would prevent potential damage to revegetated areas near the base of the highwall that could otherwise be affected by highwall raveling and/or acidic storm water runoff.

3.4 Water Resources

The water resources at the Golden Sunlight Mine include surface water, seeps, springs, and groundwater. The expansion of the site to include the proposed North Area Pit, South Area Layback, and EWRDC Expansion area could impact surface water due to increased sediment load depending on how stormwater is diverted to reduce water entering the pits, the amount of recharge to groundwater, impacts to groundwater quality, and the water treatment system capacity. This section will evaluate the impact of the proposed activities on the overall water resources of the site.

3.4.1 Analysis Method

The proposed amendment, annual reports, and other documents related to the site, and comments and reviews by DEQ were reviewed to evaluate the impact of the Proposed Action Alternative on the water resources.

3.4.2 Affected Environment

3.4.2.1 Surface Water

Riverine surface water features near the project area consist of the Jefferson River, Boulder River, and Whitetail Creek. Jefferson Slough, an abandoned oxbow of the Jefferson River, contains surface water, but is generally fed by groundwater in the floodplain of the Jefferson River except during high flows. All of these features are located off the Project Area. In the Project Area, surface water generally only exists as ephemeral flow in several channels and it generally only exists for a short period following rainfall or snowmelt. The major ephemeral channels include Sheep Rock Creek, Saint Paul Gulch, and Conrow Creek. Several unnamed tributaries exist to these major channels.

Ephemeral surface water flow from Sheep Rock Creek and Saint Paul Gulch would report to the Jefferson Slough. Ephemeral surface water flow in Conrow Creek and its unnamed tributaries reports to the Boulder River not far above its confluence with the Jefferson River.

Ephemeral drainages rarely flow, so records of flow in these drainages are rare. GSM (1995) reported flow in Sheep Rock Creek of three to four cubic feet per second (cfs) following a precipitation event during July of 1995. GSM (ibid) also noted flow in various unnamed tributaries of Conrow Creek on two occasions during May of 1995. Flow in these unnamed tributaries was estimated to be as much as four to five cfs.

Flow in the Jefferson River has been measured by the U. S. Geological Survey at several locations and for many years. The nearest long-term measuring station on the Jefferson River is approximately 32 miles downstream of the Project area, near Three Forks, Montana where the mean flow is 2,750 cfs.

There are springs and seeps in the mine area, generally associated with geologic contacts, topographical depressions, bedrock fractures, and collapsed adits (Schlumberger 2012). **Figure 3-5** shows these water features. In general, these springs and seeps flow at less than 1 gpm. The exception is Beaver Spring north of the mine, which can flow at rates of 25 gpm for a month in the spring.

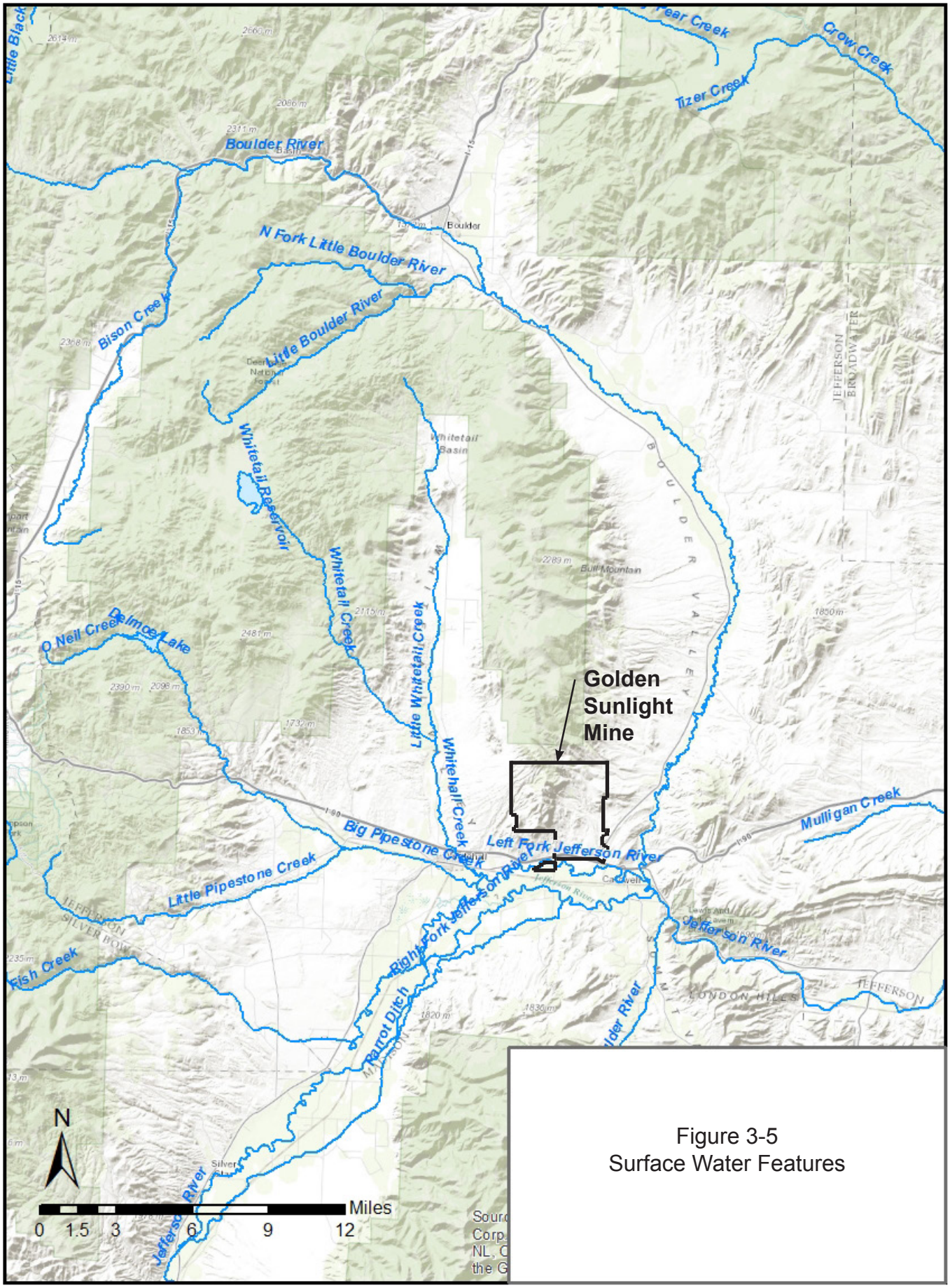
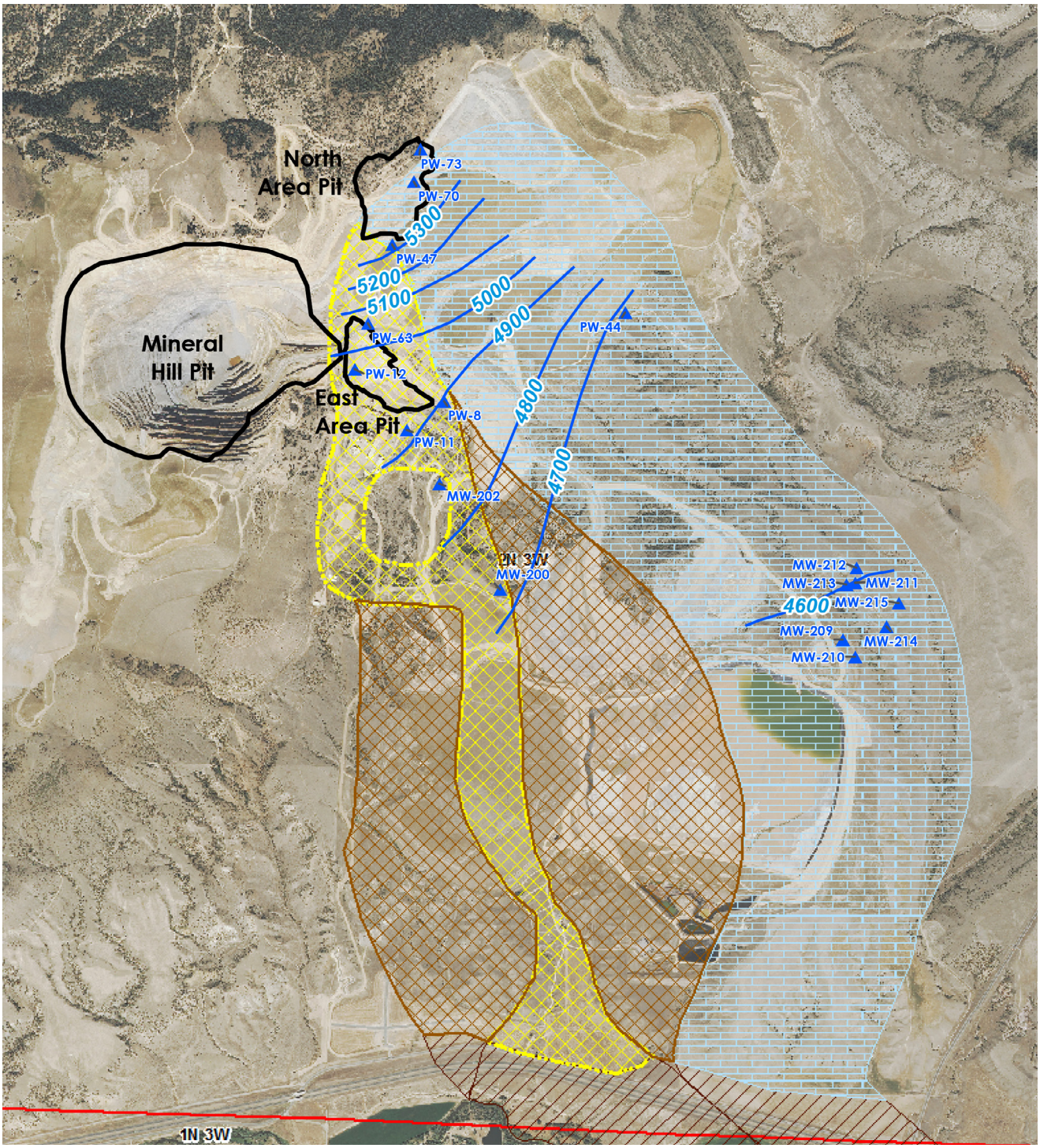


Figure 3-5
Surface Water Features



LEGEND

SCALE: 1" = 2,000 feet

- Tertiary Well Completion
- 100 ft Potentiometric Contour
- Digitzed Area Features

Flowpath/Conduits

- Primary Pit Flow Path
- East Waste Rock DumpComplex Flow Path
- Alluvial Flow Path
- Secondary Pit Flow Path

(SOURCE: 2007 SEIS)

Source: Hydro Solutions - 2011

Figure 3-6
Primary Groundwater Flowpaths

3.4.2.2 Groundwater

Groundwater in the area is present in four lithologic units:

The Tertiary debris flow and landslide formation (Tdf/ls) originates in the north area. Groundwater in the unit is generally perched and discontinuous above the Bozeman Formation which has a lower permeability. In areas where the Bozeman Formation is not present, it is not clear if the Tdf/ls forms a continuous system with the bedrock. The hydraulic conductivity is estimated to be 1×10^{-3} to 1×10^{-4} centimeters per second (cm/s).

The Bozeman Group (Tb) is a combination of unconsolidated and consolidated sand, gravel, silt, and clay. Due to the high clay content this unit generally has low hydraulic conductivity on the order of 2.5×10^{-5} to 7×10^{-6} cm/s. In areas with sand and gravel lenses, the permeability can be higher locally.

Bedrock in the area has low primary permeability and high secondary permeability due to fractures. Flow rates in this unit vary from 2 to 100 gpm depending on location. The average hydraulic conductivity for this unit is 1×10^{-7} cm/s. It is believed that the bedrock system is compartmentalized into blocks that can be easily dewatered, and that in some areas the recovery from dewatering can be rapid. This would affect the dewatering rate required for the North Area Pit.

The Jefferson River alluvium is present along the southern boundary of the property and is connected to the Tertiary debris flow aquifer. The unit is composed of unconsolidated gravel, sand, and finer grained overbank and channel deposits. The approximate hydraulic conductivity is 2×10^{-1} cm/s. In general, flow in this unit is from the west with smaller amounts from the north associated with the mine site.

The primary groundwater flow paths and potentiometric surface are shown in Figure 3-6 for the tertiary aquifer (HydroSolutions 2012). In general, groundwater flow in this aquifer is south to southeast towards the Jefferson River. The hydraulic conductivity of the groundwater provides an indication of the rate that the water flows in the different aquifers. Therefore, travel through the Tdf/ls and Jefferson River alluvium aquifers are higher than travel times through the bedrock aquifer, which is dependent of the secondary porosity of the fractures.

3.4.3 Environmental Consequences

3.4.3.1 No Action Alternative

Surface Water

There would be minimal environmental consequences to surface water if the No Action Alternative is selected. Current surface water drainage patterns and runoff volumes and rates would likely remain substantially as they are now. Over the long-term and as more project facilities are reclaimed and vegetation on reclaimed surfaces becomes more dense, ephemeral surface water runoff rates would likely decrease. GSM would maintain surface water runoff features on the mine site post closure.

Groundwater

There are no additional environmental consequences to groundwater if this alternative is adopted. The groundwater flow paths would remain the same, and the groundwater pumping and capture systems on the site are already designed to address impacts from current operations. GSM would maintain groundwater pumping and capture systems post closure.

3.4.3.2 Proposed Action Alternative

Surface Water

The Proposed Action Alternative would affect surface water in a number of ways. The proposed North Area Pit and South Area Layback extend the surface area of pits at the site. These extensions would capture rainfall and snowmelt that previously contributed to stormwater during runoff events. The proposed EWRDC Expansion area and its associated diversion ditch captures and reroutes stormwater and snowmelt from several unnamed drainages and routes the captured flow into another unnamed drainage on the northeast side of the project area.

The proposed EWRDC Expansion area changes the runoff characteristics during construction and through reclamation. During construction and prior to reclamation, the waste rock dumps would be highly permeable and unvegetated which would likely result in high infiltration with little or no surface runoff and a greater potential contribution to groundwater. Following reclamation, the soiled surface and revegetation would result in more evapotranspiration and limited surface runoff with a smaller contribution to groundwater under the facilities. Detailed descriptions of the consequences of the Proposed Action Alternative are included in the following sections.

North Area Pit

The ephemeral runoff from the undisturbed North Area Pit area generally reports to groundwater and is contained within the mine area. The proposed North Area Pit would modify drainage patterns by creating an internally draining pit on approximately 42 acres. Runoff and precipitation would be captured within the pit and would either pond and evaporate or infiltrate into groundwater. Annual potential evaporation is approximately 30 inches per year which exceeds average annual precipitation of approximately 12 to 14 inches. During operations, GSM would pump the pit sump to the treatment plant or TSF-2 if needed to operate. At closure, most of the precipitation that falls in the North Area Pit would evaporate if the pit bottom is not rocky and fractured. The pit bottom would eventually become covered with rocks raveling off the west pit walls.

At closure, if the pit bottom is rocky and if the Bozeman Group sediments do not seal fractures in the pit bottom during intense precipitation or snowmelt, precipitation and runoff is likely to encounter fractures in the bedrock and would infiltrate into groundwater. The net effect of the proposed North Area Pit would be to diminish surface runoff with a chance of increased runoff and precipitation infiltration into the groundwater under the pit.

A diversion ditch along the uphill (north) edge of the pit would capture runoff from upgradient areas and route it around the pit. Some of the diverted stormwater and snowmelt would be diverted toward Sheep Rock Creek while the remainder would be diverted toward the Jefferson Slough.

South Area Layback

The area that would become the South Area Layback consists of undisturbed ground, reclaimed ground, and portions of the existing Mineral Hill Pit. Stormwater and snowmelt from the undisturbed ground currently flows east and south toward Jefferson Slough. Precipitation and stormwater runoff within the existing Mineral Hill Pit is captured in the underground pit sump. The proposed South Area Layback would modify drainage patterns by capturing additional precipitation and runoff from approximately 19 acres that currently reports to groundwater and is contained within the mine area. Captured runoff would contribute to the water that would be collected in the underground sump.

EWRDC Expansion Area

Currently, the area under the proposed EWRDC Expansion area consists of undisturbed ground, reclaimed ground, and small portions of existing disturbance. Stormwater runoff from this area currently drains either to Sheep Rock Creek or to an unnamed

tributary north of Sheep Rock Creek. The proposed expansion alters runoff patterns in a couple of ways. During construction and prior to reclamation, the waste rock dumps would be highly permeable and unvegetated which would likely result in high infiltration with little or no surface runoff and a greater potential contribution to groundwater. The predicted volume of seepage from the EWRDC was estimated at 6 to 10 gpm from precipitation and run-on (1997 Draft EIS – Appendix I). The additional contribution from the expansion is estimated to be approximately 2.1 gpm. It is anticipated that it would take 33-72 years to saturate the system, and seepage would be attenuated by the Bozeman Group sediments (2007 SEIS). In addition, annual evaporation rates at this site far exceed average precipitation. As a result, infiltration would occur mainly during wet years and when vegetation is dormant.

Following reclamation, the soiled surface and revegetation would result in more evapotranspiration and limited surface runoff with a smaller contribution to groundwater under the facilities. After reclamation of the EWRDC Expansion area, some portion of the stormwater runoff would report to Sheep Rock Creek and its unnamed tributary to the north.

A diversion ditch along the northeast side of the EWRDC Expansion area would intercept runoff from upgradient areas to the east and north of the dump and divert it into another unnamed drainage further to the north. This unnamed drainage does not appear to have a well-defined channel over much of its length and it flows to the Boulder River rather than toward the Jefferson Slough. Although the ephemeral flow is infrequent, a large storm event would result in channel cutting and sediment transport on this unnamed tributary as a result of diverting more flow into this drainage. GSM has proposed an outfall structure that would consist of an energy dissipation basin sized appropriately for the final as-built hydraulic grade break and designed flow capacity. The outfall structure and natural channel below the structure would be monitored and maintained as needed.

In summary, the proposed additional disturbance in the pits would capture more run off and precipitation, and increase potential discharges to groundwater. All water that is treated at closure would be discharged to groundwater. The increase is within the design capacity of the treatment plant - an increase of 10 gpm for the South Area Layback and an increase of 10 to 20 gpm for the North Area Pit would be captured. Water would be captured, treated and discharged to meet groundwater standards, per GSM's existing plan.

Groundwater

The impacts of concern are ability to capture and treat water with potential degradation of groundwater quality and potential changes in groundwater flow paths.

North Area Pit

Baseline groundwater chemistry in the region of the proposed North Area Pit is highly variable and largely dependent upon the geologic unit in which individual wells are completed. Bedrock (Precambrian sedimentary rocks and Cretaceous intrusive rocks) groundwater is generally acidic with pH ranging from 3.2 up to 6.3, and contains elevated sulfate and metals concentrations. Groundwater within the debris flow/landslide deposits is slightly acidic (pH 6.3) with low metals concentrations, and groundwater within the Bozeman Group in this area is slightly alkaline (pH 7.2) with low metals concentrations.

Due to low primary permeability structural controls and lithologic contacts, the bedrock is compartmentalized and groundwater flow through the bedrock is believed to be limited. Groundwater is primarily contained in fractures within the bedrock aquifer. The majority of groundwater flow occurs along the Range Front Fault from the northeast to the southwest through the area where North Area Pit would be. Dewatering of the North Area Pit would reverse the groundwater flow path in the southern half, resulting in groundwater flowing northeastward along the Range Front Fault into the dewatering wells. Although groundwater flow is currently limited due to faulting which offsets the structures along which groundwater can move, an estimated 10 to 20 gpm currently flows southwestward along the Range Front Fault toward the primary pit flow path. It is likely that this groundwater currently either flows into the Mineral Hill Pit sump due to the cone of depression maintained in the groundwater table via continued dewatering of the Mineral Hill Pit sump, or flows toward the Rattlesnake and TSF-1 capture wells. Maintenance of dewatering wells associated with the North Area Pit may intercept groundwater that currently is intercepted by the dewatered Mineral Hill Pit or other existing capture systems.

The Tertiary debris flow aquifer contains perched water, but is not believed to be continuously saturated. The Bozeman Group on the east side of the proposed pit may or may not have permeable lenses. Groundwater within the Bozeman Group likely flows to the southeast along the topographic gradient (Schlumberger 2012) toward the EWRDC flow path. Dewatering of the North Area Pit may redirect some groundwater flow within the Bozeman Group to the northwest, reducing the volume of water moving beneath the EWRDC. This may reduce the flow of seeps such as the Midas Seep, which is currently intercepted where it discharges from beneath the EWRDC.

The North Area Pit would extend approximately 150 feet below the groundwater table, and would need to be dewatered to allow for mining. Continued dewatering would be required to prevent the contamination of groundwater from acid-producing pit walls. Mixing of seepage and runoff from the highwall with underlying groundwater may further lower the pH and increase metals concentrations in groundwater; however, this water would be intercepted by dewatering wells. The water would be used as process

water during mine operations, and sent to the water treatment plant post-closure. The initial dewatering rate in the bedrock would be 50 gpm but would decline to 10 to 20 gpm during mining. If pumping ceases, recharge would be fairly rapid due to the Range Front Fault and water infiltration through fractures to the north. Dewatering of the Bozeman Group would be addressed separately from the bedrock dewatering, if required. Dewatering would keep the pit dry during operations by pumping any water produced from pit seeps, precipitation, and snowmelt to the mill.

If the pit accumulates water at closure, a post-mining pit sump would be used. This would happen if dewatering is incomplete, there is flow from fractures, or there is accumulation of precipitation. To minimize groundwater impacts and maximize potential contaminated groundwater recovery, the pit would not be backfilled. The east wall in the Bozeman Group would be revegetated. The northwest wall would not be covered with soil or revegetated, but would be reclaimed to rockfaces with some bat and raptor habitat. As proposed, the pit would remain open after closure and would be pumped post closure to comply with water quality standards.

Groundwater would be recharged from infiltration in the surrounding area and from the pit. Water that contacts the ore body and waste rock would increase impacts to groundwater. The primary control mechanism for groundwater would be to maintain dewatering long-term. The proposed post-mining dewatering plan assumes that the dewatering or a sump would keep the pit dry and that reclamation on the east side Bozeman Group 2:1 slopes would reduce infiltration. GSM has not provided detailed plans to grade and seal the pit bottom and collect and pump water to the treatment plant at closure.

Because of the compartmentalized nature of the area, and limited knowledge on the interaction between the Tdf/ls and bedrock aquifers, the impacts to groundwater from the North Area Pit should be monitored.

Any water that escapes the North Area Pit would enter the regional groundwater flow path. The groundwater flow path from the proposed North Area Pit would be influenced by the dewatering of the Mineral Hill Pit because the primary flow path would be through the Tertiary debris flow. Groundwater from the North Area Pit would be captured by the North Area Pit dewatering wells, or the dewatering of the Mineral Hill Pit or Rattlesnake drainage capture wells.

Dewatering of the bedrock around the North Area Pit would occur rapidly using a couple of dewatering wells, but additional wells could be required. If the pumps fail or do not completely dewater an area adjacent to the pit, there would be potential for more groundwater to enter the pit and for migration of impacted groundwater to the regional groundwater flow paths. Ground water bypassing the dewatering wells, precipitation, and snowmelt would be pumped out of the pit during operations.

Based on the information available from the pump test at PW-75A, it appears that the influence of dewatering is limited to the immediate pit area or an area less than 1,000 feet. The test reflects the drawdown on the west side of the Range Front Fault. The potentiometric surface shown in **Figure 3-6** (Figure 9, Appendix G, HydroSolutions 2012) for the TDf/ls aquifer could flow to the EWRDC flow path, depending on the continuity of the perched zones and potential contact between the Tertiary debris flow aquifer and the bedrock aquifer. The potentiometric surface for the EWRDC area (northeast of the North Area Pit) indicates that the flow follows the topography and flows southwesterly (**Figure 3-6**). If groundwater from the North Area Pit enters the EWRDC flow path it could enter the primary flow path and would be captured by the Rattlesnake drainage capture systems.

Degradation of groundwater quality resulting from development of the North Area Pit would be limited to the immediate vicinity of the North Area Pit. The majority of this groundwater is already of poor quality and likely currently flows into the Mineral Hill Pit sump where its quality is further reduced, or else flows toward the Rattlesnake and TSF-1 capture wells. Overall, the impacts to groundwater quality would be minor and local. Impacts to long term water management at the Golden Sunlight Mine would be slight (the 10 to 20 gpm intercepted by dewatering wells and/or pit sump would increase the volume of water requiring long term treatment by only a few percent) and may be positive (the water intercepted may reduce the volumes of water currently intercepted in other locations such as the Mineral Hill pit sump and the Midas seep).

South Area Layback

The South Area Layback would be an extension of the Mineral Hill Pit and water from the layback area would drain into the Mineral Hill Pit and would be captured by the underground pit sump. Groundwater enters the Mineral Hill Pit area predominately through the Corridor Fault and fractures. The total additional flow from the South Area Layback would be approximately 10 gpm and would be the result of increased storm water runoff captured by the expanded pit. The current volume of groundwater pumped from the Mineral Hill Pit is 60 gpm so the additional 10 gpm would be a manageable increase.

The mining of the South Area Layback is unlikely to alter any of the existing groundwater flow paths for the Mineral Hill Pit. The dewatering system and post-closure sump are in place and the impacts from mining the South Area Layback on groundwater would be manageable under the currently approved water management and treatment plans.

Because groundwater beneath the proposed South Area Layback currently flows into the Mineral Hill Pit sump and would continue to do so after the pit expansion, no

additional groundwater degradation, and no changes to groundwater flowpaths, are predicted to result from mining of the South Area Layback.

EWRDC Expansion Area

The EWRDC Expansion area has an undifferentiated sedimentary bedrock unit that has produced less than 5 gpm of groundwater. A Quaternary-Tertiary undifferentiated unit with water bearing gravels has produced 15 gpm. The groundwater levels are generally 300 to 450 feet below surface. The groundwater flow is southwest, and would be part of the EWRDC flow path (**Figure 3-7**) (SPSI, 2012). Impacts to groundwater from infiltration are expected to be minimal if the design recommendations are followed to avoid sensitive areas. Water quality would be monitored in downgradient wells to confirm that water quality trends are within the predicted range of concentrations. The currently approved method for monitoring, capturing and routing of any seeps would be applicable to the expansion area.

3.4.3.3 Agency-Modified Alternative

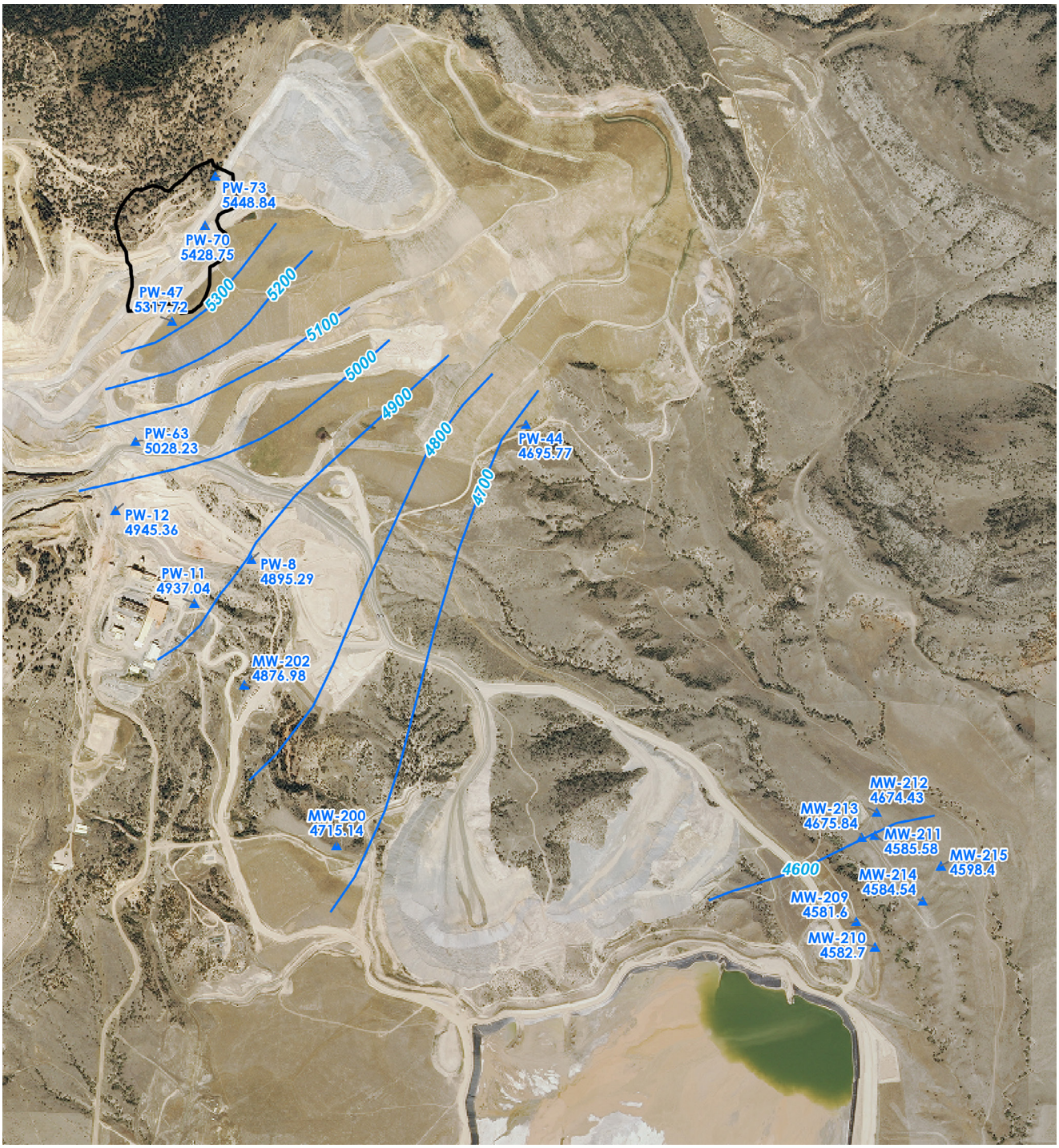
The modifications identified would result in effects the similar to those described for the Proposed Action Alternative, with the following exceptions.

North Area Pit

The Agency Modified Alternative requires the addition of a lined pit sump and grading of the pit with low permeable material to reduce infiltration (**Figure 2.9**). This alternative would collect more water in the pit sump and help reduce the amount of water infiltrating to the groundwater system. It would also provide a mechanism for collecting seepage in the pit during unexpected dewatering system failures or downtime required for maintenance.

Dewatering of the bedrock around the North Area Pit would occur rapidly using a couple of dewatering wells, but additional wells could be required. If the pumps fail or do not completely dewater an area adjacent to the pit, there would be potential for groundwater to enter the pit.

In the Agency Modified Alternative, DEQ would require GSM to re-grade the pit bottom with compacted Bozeman Formation materials from the east wall of the pit if necessary to create a pit floor that can direct water to a low spot which would facilitate collection and minimize infiltration into groundwater. A coarse rock berm would be created to minimize raveling west highwall rock from rolling out onto the pit floor and which would still allow any runoff off the west wall to report to the collection area.



LEGEND

Well Name
SWL (ft AMSL) ▲ Tertiary Well Completion

100 ft Potentiometric Contour

Digitzed Area Features

SCALE: 1" = 1,250 feet

Source: Hydro Solutions - 2011

Figure 3-7
Potentiometric Surface For
East Waste Rock Dump Complex
(EWRDC)

Keeping the pit open and not backfilling it more than is needed to collect water would assure that almost all water collecting in the pit could be collected, and routed to the water treatment facility. The Agency Modified Alternative would minimize inflows into the groundwater system from the pit.

South Area Layback

No modifications were identified. Effects would be the same as the Proposed Action Alternative.

EWRDC Expansion Area

No modifications were identified. Effects would be the same as the Proposed Action Alternative.

3.4.3.4 North Area Pit Backfill Alternative

Surface Water

All stormwater runoff would be routed out of the pit area if it is backfilled. Some of the precipitation would infiltrate the reclamation cover system over the backfill. The 2007 SEIS (DEQ and BLM 2007) estimated rates of infiltration (into reclaimed waste rock dumps, similar to the North Area Pit) to range between 0.5 inches per year and 1.1 inches per year (between 4 percent and 8 percent of average annual rainfall). This water would migrate down through the backfill but would be collected by the downgradient dewatering well(s). The overall effect on surface water from backfilling of the North Area Pit would be to provide up to 42 acres of additional reclaimed land from which storm water could run off and potentially provide additional flow into surface water bodies (Sheep Rock Creek, Jefferson Slough) during extreme precipitation events. During smaller rain or snowmelt events, all runoff from the backfilled pit would likely infiltrate to groundwater prior to reaching surface water bodies.

Groundwater

Dewatering wells in the North Area Pit perimeter could be maintained unlike dewatering wells in the Mineral Hill Pit. The geometry of the North Area Pit and the Range Front Fault through the pit allows for ease of maintaining dewatering wells, if necessary, because no dewatering well would have to be drilled in the acidic backfill. The Mineral Hill Pit highwalls are less stable than the North Area Pit highwalls would be and the Mineral Hill Pit has multiple faults running through it - making long term collection of Mineral Hill Pit water via dewatering wells much less reliable. In addition, the underground sump in the Mineral Hill Pit provides a reliable method of keeping the

water level below the Mineral Hill Pit bottom and ensures the pit is maintained as a sink forcing all regional groundwater to report to the pit where it can be collected for treatment.

As noted above, a fraction (4 to 8 percent) of precipitation that falls on a backfilled, revegetated North Area Pit would infiltrate through the cover soil and result in groundwater recharge. The fate of this infiltrated stormwater would be less certain than in the unbackfilled scenarios evaluated in the Proposed Action Alternative and the Agency Modified Alternative, because there is the potential for lateral flow along compacted layers of waste rock within the backfill. Some precipitation would be absorbed by and retained within the waste rock backfill. Some would migrate through the backfill into the underlying bedrock near the Range Front Fault, where it could be recovered by dewatering wells completed within the fault zone to the north and south of the backfilled pit. As analyzed in the 2007 SEIS (DEQ and BLM 2007), groundwater would be buffered by the heterogeneous Bozeman Group. Because a portion of the North Area Pit would be located at the head of the EWRDC Flow Path, as defined in the 2007 SEIS, infiltration into the eastern portion of the backfilled pit may enter the underlying Bozeman Group and landslide/debris flow materials, from which it may discharge at the Midas Seep or enter the EWRDC flow path.

Assuming an average 8 percent infiltration of precipitation over the entire 42 acre backfilled pit, discharge to groundwater from the North Area Pit backfill could be as much as 2.4 gpm. Under the Proposed Action or Agency Modified Alternatives, this volume of storm water would be slightly more and would either be collected in the pit sump or would infiltrate to groundwater. Pumping rates from the perimeter dewatering wells (predicted to be 10 to 20 gpm under the Proposed Action Alternative) would not likely be altered by the pit backfill alternative. Additional metals loading may occur due to interaction of seepage with the backfilled waste rock; however, these increases may be offset by decreased weathering of sulfide material that would remain exposed in the west highwall under the action alternatives that do not require backfill.

Because the eastern margin of the North Area Pit deposit is already overlain by a portion of the EWRDC, backfilling of the North Area Pit with waste rock is unlikely to alter metals loading to the EWRDC flow path compared with the No Action Alternative. A slight increase in metals loading to groundwater that follows the EWRDC flowpath may occur if the North Area Pit were developed then backfilled, at least when compared with the Proposed Action (no backfill) Alternative. As noted above, alternatives that include development of the North Area Pit followed by reclamation of the pit without backfilling may decrease recharge into the EWRDC flowpath compared with existing conditions because development of the pit would remove a portion of the existing waste rock dump as well as Bozeman Group sediments that currently underlie the waste rock dump near the head of this flowpath.

Overall, the North Area Pit Backfill Alternative is not predicted to substantially alter long-term groundwater management and treatment requirements when compared with the Proposed Action Alternative or Agency Modified Alternative. Backfilling would preclude the construction of an in-pit sump, which would eliminate the option of having a second method of seepage collection in the event that the proposed dewatering wells fail. It is anticipated that any failed wells could be replaced within a reasonable timeframe such that recovery of contaminated groundwater would not be compromised. Backfilling could also eliminate the potential benefit of redirecting groundwater from the head of the EWRDC flowpath into the North Area Pit, where it could be more easily captured.

3.5 Wildlife and Fisheries

3.5.1 Analysis Methods

Habitat for Montana species of concern may be disturbed by the Proposed Action Alternative. Endangered Species Act listed or candidate species (black-footed ferret, bull trout, Canada lynx, wolverine, and Sprague's pipet) may occur in Jefferson County (US Fish and Wildlife Service 2013), but the project area does not provide suitable habitat, so they are not discussed further.

Information on species' presence is from biological field surveys in 2011 and 2012 (Garcia and Associates [GANDA] 2012), other reports for the mine, and a desktop review of available literature and databases. These sources included the Montana Field Guide (Montana Natural Heritage Program [MTNHP] and Montana Fish, Wildlife and Parks [MFWP] 2013), MTNHP Animal Species of Concern Database, Birds of North America Online (Birds of North America [BNA] 2013), and Nature Serve Explorer (Nature Serve 2013).

3.5.2 Montana Species of Concern

Table 3-1 lists the Montana species of concern tracked by MTNHP in Jefferson County whose habitat may be affected by the project. The Project area does not provide suitable habitat for other wildlife or fish species of concern in Jefferson County.

TABLE 3-1
MONTANA SPECIES OF CONCERN THAT MAY BE IN THE PROJECT AREA

SPECIES	HABITAT AND GEOGRAPHIC RANGE IN MONTANA	CONSIDERATION FOR ANALYSIS
Mammals		
Black-tailed Prairie Dog (*Cynomys ludovicianus*)	Central and eastern Montana, east of the Rocky Mountains.	Project area provides suitable habitat and is located in this species' geographic range. Known to occur near the Project area.
Fringed Myotis (*Myotis thysanodes*)	Likely occurs throughout Montana except for the most northern latitudes.	Project area provides suitable forest habitat and caves are in the vicinity. There are records of the species from the region around the mine.
Hoary Bat (*Lasiurus cinereus*)	All of Montana.	Project area provides suitable forest habitat and is in this species' geographic range.
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	All of Montana except north-central portions of the state. Distribution is strongly correlated with available cave and mines for roosting.	Project area provides suitable forest habitat and caves are in the vicinity. There are records of the species from the region around the mine.
Birds		
Brewer's Sparrow (*Spizella breweri*)	Breeds throughout Montana where habitat is suitable.	Documented in the Project area in 2011/2012.
Cassin's Finch (*Haemorhous cassinii*)	Year-round in western, central, and south-central Montana.	Documented in the Project area in 2011/2012.
Clark's Nutcracker (*Nucifraga columbiana*)	Found year-round throughout Montana with the exception of the northeast portion of the state.	Documented in the Project area in 2011/2012.
Ferruginous Hawk (*Buteo regalis*)	Breeds east of the Continental Divide.	The Project area provides suitable breeding habitat.
Flammulated Owl (*Otus flammeolus*)	Breeds in western Montana.	May occur in coniferous forest in the Project area.
Golden Eagle (*Aquila chrysaetos*)	All of Montana	Documented in the Project area in 2011/2012.
Loggerhead Shrike (Lanius ludovicianus)	Breeds east of the Rocky Mountains.	The Project area provides suitable breeding habitat.
Long-billed Curlew (Numenius americanus)	Breeds throughout Montana.	The Project area provides suitable grassland habitat. Known to occur near the Project area.
Mountain Plover (Charadrius montanus)	Breeds east of the Continental Divide.	The Project area provides suitable grassland habitat. Known to occur near the Project area.
Peregrine Falcon (Falco peregrinus)	Occurs throughout Montana year-round.	Falcons nesting nearby may hunt in the Project area.
Pinyon Jay (Gymnorhinus cyanocephalus)	Year-round resident in south-central Montana.	Has been documented near the Project area.

Source: MTNHP and MFWP 2013, MTNHP Animal Species of Concern Database, BNA 2013, and Nature Serve 2013.

3.5.3 Environmental Consequences

3.5.3.1 No Action Alternative

There would be no additional effects on wildlife or fish species in or adjacent to the Project area from the No Action Alternative. Areas of disturbance other than open pits and rock faces are being reclaimed for wildlife habitat. GSM is required to revegetate portions of the highwall which will serve as wildlife habitat. GSM is also required to construct bat a raptor habitat nesting sites in the remaining highwall (DEQ and BLM, 2007).

3.5.3.2 Proposed Action Alternative

Operations. Construction and operational noise may cause a short-term, temporary disturbance. Approximately 75 acres of grassland (previously reclaimed areas) that may be used by ground nesting birds or for forage would be redisturbed. This disturbance would have a minimal effect on habitat or individuals. There is sufficient available habitat adjacent to the disturbance areas to supply adequate nesting habitat. No forest habitat used by some bat and bird species would be affected. Raptors would not be affected as no raptor nests are in or near the area where activities would occur.

Closure. Portions of the pits will be revegetated. GSM would cover 22 acres of the South Area Layback and 30 acres of the North Area Pit with growth medium and then revegetate those acres.

The remaining 23 acres of the highwalls would be reclaimed as rock faces. Bat and raptor habitat/nesting sites and mountain sheep habitat will be created in the highwalls that remain. GSM has not discussed how the new pit and layback would modify the 37 acres of bat and raptor habitat approved in the 2007 ROD.

3.5.3.3 Agency-Modified Alternative

The modifications for the Agency Modified Alternative would have the similar effects on wildlife and fisheries as described for the Proposed Action Alternative.

GSM would be required to document the loss of bat and raptor habitat in the Mineral Hill Pit resulting from the South Area Layback expansion. GSM would propose additional bat and raptor habitat in the South Area Layback upper highwalls and the North Area Pit highwall to mitigate the loss of the bat and raptor habitat. The plan for replacement bat and raptor habitat would be due by the date of the first annual report if this alternative is selected.

3.5.3.4 North Area Pit Backfill Alternative

Under this alternative, the North Area Pit highwall would not be reclaimed as rock faces, which would reduce the amount of raptor, bat, and big horn sheep habitat, while increasing the amount of grassland habitat re-established following closure. Backfilling would produce another 12 acres of revegetated habitat in the North Area Pit.

3.6 Aesthetic Resources

This section discusses the aesthetic resources in the GSM area which were addressed in the 1997 Draft EIS (DEQ and BLM 1997) and referenced in the 2007 SEIS (DEQ and BLM 2007).

3.6.1 Analysis Methods

Aesthetic resources were addressed in the earlier EIS documents which compared the existing scenic quality, viewer sensitivity, and distance zone with post-mining conditions.

3.6.2 Affected Environment

The areas around the mine support wooded mountain slopes, shrub and grass covered open ranges, and intervening river valleys. The mine is located on the southern flank of Bull Mountain at the southern tip of a prominent north-south trending ridgeline. The Jefferson Slough and Jefferson River flow west to east approximately two miles south of the mine and the Boulder River runs north to south through the valley approximately two to three miles east of GSM. The towns of Whitehall and Cardwell are each located within five miles of the mine.

The primary viewers include travelers on the major roadways, local residents, recreationists, and workers at the mine. As discussed in the 1997 Draft EIS (DEQ and BLM 1997), recreational use in the mine area includes hunting, hiking, and fishing along the Jefferson and Boulder Rivers and most users are local residents.

The GSM area contains a variety of vegetation including limber pine, Douglas-fir, and juniper trees. Open areas support a mixture of sagebrush, other shrubs, grasses, flowers, and herbaceous species.

3.6.3 Environmental Consequences

3.6.3.1 No Action Alternative

The existing mine waste rock dumps are visible from the west and east while the Mineral Hill Pit highwall and portions of the pit benches are only visible from the east. The unvegetated mine features have contrasting colors and shades compared to the vegetated natural landscape. The more pronounced horizontal and vertical lines, and geometric forms of mine features contrast with the softer and more rounded and rolling forms of the natural landscape. The mine is visible from up to 15 miles from I-90 and State Highway 69.

Post closure, portions of the highwalls and benches will remain visible. Overall visual contrasts would be reduced to a level where they are noticeable but not dominant in the landscape, following successful reclamation and revegetation of some areas of the pit highwall.

GSM is required under Stipulation 011-15 (SEIS Mitigation Measure 21) to mitigate aesthetic impacts associated with their existing mine operations. Under this stipulation, about 37 acres in the Mineral Hill Pit would be treated with the following measures to reduce the visual contrast with adjacent lands, if the work can be accomplished safely:

- End dumping and/or cast blasting will occur along the upper portion of the northwest and west highwalls, and these areas will be covered with soil, seeded, and planted with trees.
- Dozer work will be completed on the area of the west highwall that sloughed in 2005 or a replacement area approved by DEQ, and this area covered with soil, seeded, and planted with trees.
- Soil sampling on the old slide area on the northwest highwall of the Mineral Hill Pit will be completed, and this area seeded and planted with trees.
- Soil will be placed on the highwall bench above the 5,700-foot safety bench, and the area seeded and planted with trees, if it is safe to do so.
- Trees will be planted where possible on the 5,700- and 5,400-foot safety benches.

3.6.3.2 Proposed Action Alternative

Impacts to aesthetic resources would be similar to those described under the No Action Alternative but would apply to additional disturbed areas including the expanded and new pit highwalls. GSM is required to mitigate visual contrast with the adjacent lands by revegetating 37 acres around the existing Mineral Hill Pit, if it is safe to do so. GSM has proposed to complete additional revegetation efforts on 22 acres of the South Area

Layback and 30 acres of the North Area Pit by covering these areas with soil (plant growth medium) and then seeding with grasses. Some of the additional 52 acres of pit revegetation should be planted with trees to help reduce visual contrast with adjacent lands.

Mining in the South Area Layback area would do away with some of the pit areas and benches in the Mineral Hill Pit designated for revegetating and planting trees. The areas designated for revegetating under Stipulation 011-15, but impacted by the proposed South Area Layback mining, would need to be replaced with other areas of the Mineral Hill Pit.

The north and west portions of the North Area Pit highwall would remain visible as rock faces to travelers on I-90 and State Highway 69.

3.6.3.3 Agency-Modified Alternative

The modifications for the Agency Modified Alternative would have the similar effects on aesthetic resources as described for the Proposed Action Alternative. GSM would be required to identify replacement areas for the portions of the 37 acres of designated revegetation under Stipulation 011-15 for the Mineral Hill Pit that would be eliminated by the South Area Layback mining operations. Reclamation and revegetation practices similar to those prescribed under Stipulation 011-15 to mitigate aesthetic impacts from the Mineral Hill Pit would be applied to the proposed North Area Pit highwall. GSM would modify their visual mitigation plan that was approved and bonded for the 2007 SEIS. The modified visual mitigation plan would be due to DEQ concurrent with the first annual report, if this Alternative is selected. This alternative may reduce visual impacts slightly over the Proposed Action Alternative.

3.6.3.4 North Area Pit Backfill Alternative

Under this alternative, all areas within the North Area Pit would be regraded, covered with plant growth medium, and suitable for seeding and planting with trees. Backfilling the North Area Pit would produce an additional 12 acres for seeding and tree planting that when successful established would help reduce visual contrast with adjacent lands.

3.7 Social and Economic Conditions

3.7.1 Analysis Methods

The social and economic conditions analysis area will be Jefferson County for employment, income, and property taxes. The analysis area for other taxes will be the GSM's operation. Current and predicted rates, amounts, and percentages will be

compared between the mine and the county or even state averages for context. The analysis period will include current operation (as measured by 2012 data) through the end of calendar year 2016 when the mine would go into closure under the Proposed Action Alternative.

Because impacts of the current operations are known and measureable, no modeling will be done to calculate the impacts. Data from GSM, Jefferson County, and the State of Montana was used.

3.7.1.1 Issues

Employment and Income

There was public concern about the continuing employment offered by the mine and the benefits that contributed to the community and county. The mining industry frequently pays a higher than average wage, so income from mine employment is important to the economy.

Tax Revenues

GSM pays several different types of taxes and fees to the county and the state and employees pay income and property taxes. This revenue and potential changes in the amounts over time are important to the community and state.

3.7.2 Affected Environment

3.7.2.1 Employment and Income

In Jefferson County, mining is an important employment sector, accounting for 12.6 percent of the total employment in 2011, compared to 1.9 percent of the total employment in Montana (U.S. Department of Commerce 2012a). To protect the identity and trade information of business and personal identity, the Bureau of Labor Statistics does not publish mining sector annual wages and employment for Jefferson County due to the low number of proprietors. The Bureau does report that average annual wages for a mining sector job in Montana was $80,743, higher than the overall average of $36,543. The same trend is visible in the U.S. as a whole, where mining sector wages average $72,542 per year compared to the overall average of $49,049. One can assume that Jefferson County wages for mining are similar at least to the extent that they are higher than the average of all sectors.

Table 3-2 compares three measures of individual prosperity (unemployment, average earnings per job, and per capita income) for the overall economy. These measures are different from the mining sector information provided above.

TABLE 3-2
SELECTED EMPLOYMENT AND INCOME MEASURES, 2011

LOCATION	ANNUAL UNEMPLOYMENT[1]	AVERAGE EARNINGS PER JOB[2]	PER CAPITA INCOME[3]
Jefferson County	5.5%	$32,806	$40,047
Montana	6.6%	$39,684	$36,772
US	8.9%	$54,897	$42,433

Source: (US Department of Commerce 2012b), (US Department of Labor 2013)
1 Unemployment Rate: The sum of total unemployment divided by the sum of the labor force.
2 Average Earnings per Job: The sum of wage and salary disbursements plus other labor and proprietors' income divided by total full-time and part-time employment.
3 Per Capita Income: The sum of total personal income divided by the sum of total population.

Unemployment Rate: The number of people who are jobless, looking for jobs, and available for work divided by the labor force.

Average Earnings per Job: Total earnings divided by total employment. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included.

Per Capita Income is the total personal income (from labor and non-labor sources) divided by total population.

3.7.2.2 Tax Revenues

The individual income tax is the largest source of state tax revenue for Montana. Income tax revenue is collected primarily through withholding from wages and other periodic payments, quarterly estimated tax payments, and payments made when a return is filed. In 2012, Montana collected $898,851,201 in income tax.

The mine operates 22-hours per day, 7 days per week, with mining occurring during a 10-hour day shift and a 12-hour night shift. The mill operates 24-hours per day, 7 days per week on 12-hour shifts. GSM currently employs approximately 205 workers. Additional contract manpower is used for blasting, service, repair, maintenance, contract mining, reclamation, and construction of mine facilities. Approximately 75 contract personnel are currently engaged at the mine (GSM 2012).

In 2012, Golden Sunlight produced 98,000 ounces of gold at total cash costs of $708 per ounce. Proven and probable mineral reserves as of December 31, 2012, were 318,000 ounces of gold (Barrick 2013). The estimated total Montana taxes paid by GSM in 2012 are shown in **Table 3-3.**

TABLE 3-3
STATEWIDE ESTIMATED TAXES PAID IN TAX YEAR 2012

	PROPERTY	METAL MINES GROSS PROCEEDS [1]	METAL MINES LICENSE	TOTAL OF SELECTED TAXES PAID
FY 2012	$1,342 million	$16.4 million	$17.6 million	1,359.6 million

Source (MDOR 2013)
1 The Metal Mines Gross Proceeds tax is a property tax included in the total property tax.

3.7.2.3 Property Taxes

Property taxes are collected by the county based on the value of the property. In 2012, Jefferson County collected $14,533,743 in property taxes and fees (special improvement districts and fees) (Jefferson County Treasurer 2013). Property taxes collected are shared with the state of Montana.

3.7.2.4 Montana Metal Mines Gross Proceeds Tax

This tax is a property tax collected by the county treasurer. Generally, the tax base is allocated to taxing jurisdictions based on their associated relative economic impacts.

A yearly ad-valorem tax is imposed on the gross proceeds of metal mines, pursuant to MCA 15-23-801. Gross proceeds means the monetary payment or refined metal received by the mining company from the metal trader, smelter, roaster, or refinery, determined by multiplying the quantity of metal received by the quoted price for the metal and then subtracting basic treatment and refinery charges, quantity deductions, price deductions, interest and penalty, metal impurity, and moisture deductions as specified by contract.

The taxable value of metal mines is equal to three percent of annual gross proceeds. This amount is subject to local mill levies in the jurisdiction in which the taxable value of the mining operation is allocated.

3.7.2.5 Montana Metal Mines License Tax

Metal mining operations are subject to a license tax, based on the gross value of the product. Revenue from this tax mostly goes into the general fund (58 percent) and counties experiencing fiscal and economic impacts under an impact plan (24 percent),

while the rest is split up into the abandoned mines, reclamation and development grants, and hard rock mining impact trust.

3.7.3 Environmental Consequences

3.7.3.1 No Action Alternative

Employment and Income

By 2015, GSM would temporarily suspend or permanently cease operations resulting in layoff of a trained work force. **Table 3-4** displays GSM's estimated salaries, wages, bonus, and fringe benefits that would be paid during the life of mine under the No Action Alternative. Employees pay income tax on the salary, wages, and bonuses that go to the state of Montana. Additionally, employees' real property (largely within Jefferson and Silverbow Counties) is taxed with revenue going to the county.

TABLE 3-4
ESTIMATED EMPLOYMENT COSTS UNDER NO ACTION ALTERNATIVE

	2012	2013	2014	2015	2016
Salaries	$3,633,480	$4,116,576	$3,170,024	$1,154,752	$0
Wages	$8,461,683	$9,228,432	$5,905,628	$1,814,662	$0
Wages Premium Operations	$1,163,806	$714,323	$499,865	$13,709	$0
Restricted Share Units (RSU)	$195,409	$253,405	$253,405	$0	$0
Bonus Expense- Year End/Bos	$553,726	$148,583	$125,673	$48,247	$0
Bonus Expense- Production/Safety	$652,873	$1,381,643	$909,540	$260,348	$0
Employee Severance / Redundancies	$61,635	$61,636	$2,596,636	$2,545,273	$0
Fringe Benefit (Allocation)	$4,994,774	$5,764,326	$3,925,962	$1,223,080	$0
	$19,717,386	$21,668,924	$17,386,733	$7,060,071	$0

Estimates provided by GSM, June 18, 2013.
Metal production subject to the metal mines license tax is exempt from Resource Indemnity and Groundwater Assessment Tax. (MDOR 2013)

Tax Revenue Paid by the GSM

GSM would continue to pay taxes for two years at a rate similar to what was paid in 2012. **Table 3.5** shows the estimate tax contribution GSM would make over the period of 2012 through 2017 under the No Action Alternative.

TABLE 3-5 GSM ESTIMATED TAXES PAID 2012 THROUGH 2017 UNDER NO ACTION ALTERNATIVE						
	PROPERTY	METAL MINES LICENSE		METAL MINES GROSS PROCEEDS		TOTAL RANGE
2012 (actual)	$656,750	$2.374 million		$1.921 million		$4.952 million
	Projected	Price of Gold				
		$1,300/oz.	$1,700/oz.	$1,300/oz.	$1,700/oz.	$1,300-$1,700/oz.
2013	$592,800	$2.299 million	$3.009 million	$1.723 million	$2.254 million	$4.615-$5.855 million
2014	$703,200	$1.623 million	$2.125 million	$1.217 million	$1.592 million	$3.544-$4.420 million
2015	$130,000	$0.499 million	$0.654 million	$0.376 million	$0.492 million	$1.005-$1.2760 million
2016	$416,600	$0	$0	$0	$0	$0.416 million
2017	$65,000	$0	$0	$0	$0	$ 0.065 million

3.7.3.2 Proposed Action Alternative

Employment and Income

Employment at the mine would be extended for two years for the current work force. It is not anticipated that the number of employees would increase. **Table 3-6** displays GSM's estimated salaries, wages, bonuses, and fringe benefits that would be paid during the life of mine under the Proposed Action Alternative. Employees pay income tax on the salary, wages, and bonuses that go to the state of Montana. Additionally, employees' real property (largely within Jefferson and Silverbow Counties) is taxed with revenue going to the county.

TABLE 3-6 ESTIMATED EMPLOYMENT COSTS UNDER PROPOSED ACTION ALTERNATIVE					
	2012	2013	2014	2015	2016
Salaries	$3,633,480	$4,409,880	$4,409,880	$4,409,880	$1,879,743
Wages	$8,461,683	$9,228,432	$9,228,432	$9,436,104	$3,430,686
Wages Premium Operations	$1,163,806	$714,323	$714,323	$714,323	$296,219
Restricted Share Units (RSU)	$195,409	$253,405	$253,405	$0	$0
Bonus Expense- Year End/Bos	$553,726	$148,583	$148,583	$148,583	$75,655
Bonus Expense-Production/Safety	$652,873	$1,381,643	$1,381,643	$1,381,643	$529,276
Employee Severance / Redundancies	$61,635	$61,636	$61,636	$10,273	$5,070,000
Fringe Benefit (Allocation)	$4,994,774	$5,884,580	$5,884,580	$5,969,726	$2,298,726
	$19,717,386	$22,082,483	$22,082,483	$22,070,532	$13,580,305

Estimates provided by GSM, June 18, 2013.

Tax Revenue

There would be tax revenue for two additional years compared to the No Action Alternative. GSM would continue to pay taxes for four years at a rate similar to what was paid in 2012. **Table 3-7** shows the estimate tax contribution GSM would make over the period of 2012 through 2017 under the Proposed Action Alternative, depending on the price of gold.

TABLE 3-7
GSM ESTIMATED TAXES PAID 2012 THROUGH 2017 UNDER PROPOSED ACTION ALTERNATIVE

	PROPERTY	METAL MINES LICENSE		METAL MINES GROSS PROCEEDS		TOTAL RANGE
2012 (actual)	$656,750	$2.374 million		$1.921 million		$4,951,750
Projected	Price Of Gold	$1,300/oz.	$1,700/oz.	$1,300/oz.	$1,700/oz.	$1,300-$1,700/oz.
2013	$651,600	$2.299 Million	$3.009 Million	$1.723 Million	$2.254 Million	$4.677 - $5.915 Million
2014	$703,200	$1.997 Million	$2.614 Million	$1.497 Million	$1.958 Million	$4.197 - $5.275 Million
2015	$652,000	$1.268 Million	$1.660 Million	$0.951 Million	$1.244 Million	$2.871 - $3.556 Million
2016	$255,000	$1.304 Million	$1.707 Million	$0.978 Million	$1.280 Million	$2.538. -$3.242 Million

Projected taxes paid are indicated for the year they would be generated. Actual payment would be later.

3.7.3.3 Agency Modified Alternative

The effects of the Agency Modified Alternative on social and economic conditions would be the same as described for the Proposed Action Alternative.

3.7.3.4 North Area Pit Backfill Alternative

This would be similar to the Proposed Action Alternative with some minor differences in cost. Hauling backfill material from the South Area Layback to the North Area Pit would decrease truck hauling distance and cost, including Employment Costs (**Table 3-6**). However, scheduling issues may mean double handling of any stockpiled ore near the mill and some increased employee cost.

Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts

4.1 Cumulative Adverse Impacts

Cumulative effects are the collective effects on the human environment when considered in conjunction with other past, present, and future actions by location and generic type. Cumulative impact analysis under the MEPA Model Rules requires an agency to consider all past and present state and non-state actions. For future actions, an agency need evaluate only those actions under concurrent consideration by any state agency. Concurrent actions include state agency actions though pre-impact statement studies, separate impact statement evaluation, or permit process procedures. Analysis of cumulative environmental effects includes other actions that are related to all action alternatives by location or generic type, recognizing that effects on biological resources, socioeconomics, water, and other resources might be manifested beyond the project site.

The geographical extent of the study area was selected for each resource evaluated in this EIS based on the extent and duration of anticipated effects caused by the Proposed Action Alternative. The cumulative effects region of influence includes all areas in which planned or expected actions might affect one or more study areas.

Resource	Study Area
Geotechnical Engineering	Permit boundary
Soil, Vegetation, and Reclamation	Permit boundary
Groundwater and Surface Water	Permit boundary, Sheep Rock Creek, and Jefferson River Slough
Wildlife	Permit boundary
Social and Economic	Jefferson County
Aesthetics	Permit Boundary

The purpose of this cumulative effects analysis is to ensure that DEQ's decisions consider the full range of effects of its action on the human environment.

Future actions near the project area are described in Section 2.8. Present and past actions near the mine that may have similar impacts include mining, reclamation, grazing, hunting, general recreation, weed management, fire/fuel mitigation, and road maintenance. DEQ evaluated the following sources for the most up-to-date information regarding ongoing projects and activities in the mine area:

- DEQ Environmental Management Bureau regarding new hardrock mines or small miners (Rolfes 2013). The proposed Butte Highlands Joint Venture have a signed memorandum of understanding (MOU) with GSM (January 5, 2010) for processing ore from the Butte Highlands Project at the GSM mill. Cumulative effects from the Butte Highlands Mine are discussed below.
- DEQ Industrial and Energy Minerals Bureau regarding opencut mining sites (Mapping DEQ's Data Website, Montana DEQ, July 5, 2013). Three permitted opencut mining sites are located south and east of Whitehall, MT in the Jefferson River valley. The opencut mines are about 4 miles from the Golden Sunlight Mine. No cumulative effects would be expected.
- DEQ regarding the reprocessing of legacy mine waste rock and tailings from abandoned mine reclamation projects in the area (Rolfes 2013). Cumulative effects from the processing of the legacy mine wastes are discussed below.
- Jefferson Local Development Corporation regarding use of existing Sunlight Business Park and other areas of the mine after closure (Harrington 2013). Cumulative effects from the development of the Sunlight Business Park and use of other areas of the mine after mine closure are discussed below.

The following projects or activities were identified as reasonably foreseeable in the cumulative effects study area for the mine: (1) processing of the proposed Butte Highlands Mine ore, (2) reprocessing of legacy mine wastes from reclamation of abandoned mines in the area, and (3) development of the GSM Industrial Park by the Jefferson Local Development Corporation and use of some mine facilities after closure. Only the projects in the resource study areas that affect those resources are discussed for these projects or activities.

Proposed Butte Highlands Mine

The Butte Highlands mining project is owned and operated by the Butte Highlands Joint Venture (JV), LLC. The mine has not proposed building an on-site mill therefore the ore would need to be transported to another mill for processing. An MOU was signed by the Butte Highlands JV and GSM on January 5, 2010 for processing the Butte Highlands Project ore at the GSM mill facility. However, the MOU is not binding and the Butte Highlands Mine could process their ore at a different mill or build their own mill. The Butte Highlands mine project is currently proposed as a five year project with an additional year for development before mining starts. Additional mineable ore resources could be identified to extend the mine life. Processing the Butte Highland ore at GSM would cumulatively affect social and economic considerations but would have minimal effects on geotechnical engineering; soils, vegetation, and other reclamation resources; groundwater and surface water resources; wildlife; and aesthetic resources. The amount of ore currently proposed to be removed from the mine would be 1.2

million tons over a five year period. The ore would add less than three percent to the tailings in TSF-2.

Social and Economic Considerations. If the Butte Highlands Mine decides to use the GSM mill facility to process their ore, the mill could retain a small staff and other areas of the mine would remain operational beyond the time period for the Proposed Action Alternative. The volume of ore from the Butte Highlands Mine (i.e.400 tons/day) to be processed would not be sufficient to keep the GSM mill (i.e. 7,000 tons/day) operating by itself. The GSM employees would continue to pay taxes and help benefit local businesses by purchasing goods and services in the area. Depending on the agreement with GSM, either GSM or Butte Highlands could pay additional Mineral Mines License Tax or Resource Indemnity and Groundwater Tax, and Metal Mines Gross Proceeds Tax. Information is not available to estimate the increased taxes, or when or where they would be paid.

Soils, Vegetation, and Reclamation. The mill processing of Butte Highlands Mine ore could require some mine areas to remain operational beyond the estimated two more years for the Proposed Action Alternative. Tailings could continue to be generated and would require disposal in TSF-2, delaying final reclamation of TSF-2. A continued need for water in the mill processes would delay the need to construct a post-mining water treatment plant. The cumulative effects on soil, vegetation, and reclamation caused by the Butte Highlands Mine ore processing would be the same as those described for the Proposed Action Alternative, although the effects could extend into the future if mixing of Butte Highlands ore can be done operationally while GSM is still mining Mineral Hill Pit, North Area Pit, and South Area Layback ores, or if processing of legacy waste rock and tailings, or stockpiled low grade ores continues. The overall affect would be minimal as only approximately 1.2 million tons of ore from Butte Highlands could be processed. This is about 1.8 percent of the total ore produced at GSM to date.

Reclamation of Abandoned Mines

Numerous abandoned hardrock mine sites with waste rock piles and tailings are located near the mine. Several previous abandoned mine reclamation projects in the area have hauled legacy mine wastes to the mine for processing.

Social and Economic Considerations. Continued reprocessing of legacy mine wastes from abandoned mine reclamation projects in the Mine area could provide some continued operations for the GSM mill to process the ore, but the volume of legacy mine wastes would not be of sufficient quantity to keep the mill operating without other sources of ore. Depending on the reclamation schedules, the GSM mill could retain mill facility staff beyond the 2 year extension for the Proposed Action Alternative. Mill facility workers would continue to pay taxes and help benefit local businesses by purchasing goods and services in the area. GSM would continue to pay taxes on the

revenue generated from this reprocessing when necessary. Historically, the cost of the reprocessing has equaled the value of the minerals obtained, but without other sources of ore, the volume of legacy mine waste would not be sufficient to keep the mill operating.

Soils, Vegetation, and Reclamation. The mill processing of the legacy mine wastes could require some mine areas to remain operational beyond the period for the Proposed Action Alternative. An area for handling the legacy mine waste could remain unreclaimed and tailings could continue to be generated. Final closure and reclamation of TSF-2 could be delayed.

Development of the GSM Industrial Park and Other Post Mine Uses

The 48.2-acre Sunlight Business Park along the south side of the GSM permit area currently has thirteen lots in Phase 1 of a planned 200-acre Business Park. The land use was changed from mining to light industrial use and the Business Park has all zoning and infrastructure approvals for development. An additional 10 acres could be added to the 48.2 acres if needed. Potential businesses that would locate in the Sunlight Business Park are warehouses and construction companies.

An MOU has been executed between the Jefferson Local Development Corporation (JLDC) and GSM to be implemented at the end of mining. The MOU states that the JLDC will be allowed to complete an assessment and inspection of all buildings and infrastructure on the mine and determine which facilities would be donated and transferred for reuse by the JLDC. The MOU also contains a tabulated list of mine facilities designed to remain after mine closure.

Social and Economic Considerations. If the Sunlight Business Park is a successful venture, additional property taxes and income taxes may be collected by the county and the state. Information is not available to estimate the increased taxes, or when or where they would be paid. A successful Business Park and reuse of buildings and areas on the mine would lessen impacts to social and economic resource areas after mine closure.

4.2 Unavoidable Adverse Effects

4.2.1 Geotechnical Engineering

Under the Proposed Action Alternative and Agency Modified Alternative, a new North Area Pit would be created and the South Area Layback in the Mineral Hill Pit would be developed. The mine expansion would result in additional pit highwall areas that would expose weaker rock in some of the highwalls resulting in potential short-term

highwall instability in small localized portions of the pits. See the discussion in Section 3.3, Geotechnical Engineering.

4.2.2 Soil, Vegetation, Reclamation

Loss of soil development, soil compaction, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels are adverse soil impacts that cannot be avoided. The degree, level, and timeframe of impacts determine, in part, the potential success of reclaiming the areas to forested areas, grazing lands, and wildlife habitat. Revegetated communities would develop comparable vegetation productivity and canopy cover but the species diversity of the premine plant communities would not be reestablished. Native species reestablishment would be limited by the indirect impacts from weed control programs.

4.2.3 Groundwater and Surface Water Resources

The creation of the 49.4 acre North Area Pit and expansion of the Mineral Hill Pit by 69.4 acres with the South Area Layback would increase the surface water catchment areas of the open pits. The increased capture and diversion of surface water by the open pits would be an unavoidable adverse impact to existing surface water flows and captured surface water and groundwater reporting to the North Area Pit would need to be treated in the water treatment plant. Treated water could be released to groundwater.

4.2.4 Wildlife

There would be no unavoidable adverse impacts on wildlife as the Proposed Action Alternative is a short-term continuation of current activities. Impacts to wildlife populations may never return to pre-mine levels because of mine disturbances. Some raptor and bat habitat would be created on the North Area Pit highwall.

4.2.5 Aesthetics

The mine expansion alternatives would result in additional exposed pit highwalls in the Mineral Hill Pit and North Area Pit areas creating additional visible highwalls that would contrast with the adjacent hillsides and mountain slopes. Under the North Area Pit Backfill Alternative, visual impacts would be reduced for the North Area Pit. The additional visual impacts would be unavoidable adverse impacts. The visual contrasts could be reduced by successful establishment of vegetation and trees on the highwall benches and slopes but the pre-mine terrain and appearance can be not be reestablished.

4.2.6 Social and Economic Considerations

Social and economic changes in Jefferson County would include the long-term adverse impact of the loss of approximately 200 full-time jobs in Jefferson County in 2015 under the No Action Alternative and two years' mineral taxes compared to the retention of these jobs if the operation ran to 2017 under the Proposed Action, Agency-Modified, and North Area Pit alternatives. Ultimately, southern Jefferson County residents would be adversely impacted at a personal level by loss of wages, and county government would be impacted by the loss of royalty and tax income.

4.3 Irreversible and Irretrievable Commitment of Resources

Irreversible resource commitments are generally related to the use of nonrenewable resources, such as minerals or cultural resources, and the effects this use could have on future use options. Irreversible commitments are usually permanent, or at least persist for a long time. Irretrievable resource commitments involve a temporary loss of the resource or loss in its value.

Irreversible or irretrievable commitments of resources are described below for those disciplines where they were identified. Irreversible or irretrievable commitments of resources were not identified for several disciplines, including geotechnical engineering and socioeconomics.

4.3.1 Soil, Vegetation, Reclamation

The impacts to soil would be considered irreversible because natural soil development and mine soil redevelopment are continual processes, but would take decades. The redeveloped mine soils could ultimately achieve a similar level of soil quality as the premine soils.

Irretrievable impacts to vegetation resources would occur under all EIS alternatives. Soil and nonacid generating geologic materials would be salvaged and redistributed over most areas, and all covered areas would be reseeded with the approved reclamation seed mixtures. As a result, the loss of soil and vegetation habitat would not likely be permanent. Noxious weeds and weed control would increase and would decrease native species in reclaimed communities. Pit highwalls reclaimed as rock faces would not be soiled and vegetated. Loss of vegetation on the acid-producing rock faces would be irretrievable. Diverse native plant communities would be lost because of the presence of aggressive invasive species as well as indirect losses due to weed control efforts.

4.3.2 Groundwater and Surface Water

Groundwater would be contaminated as it flows through the pit areas and the EWRDC Expansion area. GSM would have to collect and treat contaminated groundwater long term at the water treatment plant. No irreversible commitments of groundwater have been identified.

The new North Area Pit and the expanded Mineral Hill Pit would increase the surface water catchment areas by approximately 105.8 acres. The loss of surface water flows to the GSM drainages would be an unavoidable impact.

4.4 Regulatory Restrictions

Alternatives and mitigation measures are designed to further protect environmental, cultural, visual, and social resources, but they also add to the cost of the Project. MEPA requires state agencies to evaluate the regulatory restrictions proposed to be imposed on the proponent's use of private property (Section 75-1-201(1)(b)(iv)(D), MCA). Alternatives and mitigation measures required by federal or state laws and regulations to meet minimum environmental standards do not need to be evaluated for extra costs to the proponent.

A regulatory restrictions analysis was performed for the mine operations in the 1997 Draft EIS and referenced in the 2007 SEIS. Costs for the No Pit Pond Alternative, Partial Pit Backfill Alternatives, and Underground Sump Alternative were provided and referenced in those documents.

All of the components of the Agency Modified Alternative and the North Area Pit Alternative for the current GSM Amendment 015 that might be imposed by DEQ are required by federal or state laws and regulations to meet minimum environmental standards and therefore do not need to be evaluated for costs. The complete description of the Agency Modified Alternative DEQ may adopt is provided in Section 2.4.

Comparison of Alternatives

5.1 Comparison of Alternatives

Table 5-1 summarizes important components of the alternatives and the effects of implementing each alternative. Information in **Table 5-1** quantitatively or qualitatively lists effects among the No Action Alternative (status quo), Proposed Action Alternative (Amendment 015 Expansion), the Agency Modified Alternative, and the North Area Pit Backfill Alternative.

The alternatives compared are described in detail in Chapter 2 and summarized below.

5.1.1 No Action Alternative

GSM's Operating Permit No. 00065 was issued by the Department of State Lands, now DEQ, on June 27, 1975. Operating Permit No. 00165 has been modified a number of times since then, including major amendments allowing expansion. The most recent modification, Amendment 14, was approved in November of 2010. The No Action Alternative consists of the current approved operating plan, including all previously approved major and minor amendments and revisions through Amendment 014.

The main mine facilities include the Mineral Hill Pit, milling and ore processing complex, two tailings storage facilities (one active and one decommissioned), and five rock disposal areas located east, west, and south of the Mineral Hill Pit. Mine support facilities include maintenance shops, an assay lab, fuel bays, a blasting contractor facility, administration buildings, and other infrastructure such as roads, water tanks, and power lines.

5.1.2 Proposed Action Alternative

GSM proposes to expand its mining operations by extracting ore at a new North Area Pit and at an expansion of the Mineral Hill Pit known as the South Area Layback (**Figure 2-3**). The mine expansions would allow GSM to mine approximately 4.2 million tons of additional ore, to be processed at the existing mill. Mining at the North Area Pit and the South Area Layback would generate up to 52.6 million tons of waste rock. All proposed facilities are on land owned by GSM.

Up to 48.6 million tons of acid-producing waste rock from the North Area Pit and South Area Layback areas would be placed in the EWRDC Expansion Area (**Figure 2-3**). Up to 6 million tons of waste rock could also be placed in the Buttress Dump Extension. Approximately 4 million tons of non-acid generating waste rock from the Bozeman Group/Landslide Debris material excavated from the east wall of the North Area Pit

would be stockpiled and used for reclamation growth media materials. GSM would not salvage some fine-grained lakebed sediments in the east wall of the North Area Pit.

Mining activity at the North Area Pit and South Area Layback would be completed in late 2016 or early 2017. The proposed amendment would extend the mine life by approximately two years beyond the current operating permit. GSM also processes off-site ore in their mill, mostly from legacy mining materials in southwest Montana. The proposed amendment would facilitate an additional two years of processing these legacy materials, depending on gold prices and grade of the materials.

5.1.3 Agency-Modified Alternative

Modifications to the Proposed Action Alternative are discussed in Section 2.4. Specific modifications would be incorporated into the Agency-Modified Alternative to address specific issues. Modifications are described below.

Issue 1: Capture and Routing of Seeps in the EWRDC Expansion Area

Agency Modification:

1. GSM would provide a conceptual plan for how to collect and route EWRDC Expansion area seepage water to water treatment plant.

Issue 2: Capture and Routing of North Area Pit Surface Water Runoff and Groundwater after Mine Closure

Agency Modification:

1. GSM would provide a conceptual design to capture and convey pit water to the water treatment plant after mining, including:

    - final pit regrading plan;
    - partial pit backfill with compacted Bozeman Group materials, as needed, to direct groundwater, precipitation, and snowmelt to a closure pit sump and to create a safe pit floor working surface;
    - cover soil/growth media appropriate for the 2H:1V slope angles, and seed; design collect water and convey to the closure water treatment plant;
    - plan for location and maintenance of access road into the pit to service the sump, pump, and water lines; and install a berm in the bottom of the

pit to capture north and west wall pit raveling rock which would protect workers in the pit bottom.

Issue 3: Implement Closure Geodetic and Ground Movement Monitoring for the North Area Pit and EWRDC Expansion area to ensure safe access and to keep reclamation cover systems working

Agency Modification:

1. GSM would develop a conceptual post-mining geodetic and groundwater monitoring plan.

Issue 4: Salvage Available Fine-grained Lakebed Sediments in the North Area Pit and Incorporate Organic Amendments in the Sediments when the Sediments are used as Growth Media in Reclamation Cover Systems.

Agency Modification:

1. GSM would salvage and stockpile silt-textured lake bed sediments. GSM would incorporate compost or other organic matter to achieve 1 percent by volume organic matter when the sediments are used for reclamation growth media.

Issue 5: Wildlife and visual mitigations

1. The documentation of loss of bat and raptor habitat in the Mineral Hill Pit and plan for replacement of habitat.
2. The identification of replacement areas for the portion of the 37 acres of designated revegetation for the Mineral Hill Pit that would be eliminated by the South Area Layback.

5.1.4 North Area Pit Backfill Alternative

Under the North Area Pit Backfill Alternative, the North Area Pit would likely be mined before the South Area Layback. Ore extracted from the North Area Pit would be stockpiled in the mill area. During preparation for and mining of the South Area Layback, up to 9.2 million tons of the 44.6 million tons of acid producing waste rock from the South Area Layback would be used to backfill the North Area Pit rather than hauling the waste rock to the EWRDC Expansion area or the Buttress Dump Extension area.

The North Area Pit would be backfilled to achieve a 2H:1V waste rock dump slope from the top of the pit west highwall. The 2H:1V waste rock dump slope would toe into the east wall of the North Area Pit. Final adjustments would be needed to ensure the backfilled pit would be free-draining to prevent precipitation and snowmelt from collecting in the pit area where it may infiltrate into underlying acid-producing waste rock. If the surface flow of precipitation and snow melt could not be routed safely to drainages below acid-producing waste rock, then the water would be routed to a lined pond and gravity fed to a drainage channel below acid-producing materials or routed to the treatment plant.

Reclamation of the backfilled pit would be consistent with the reclamation of other 2H:1V slopes in the waste rock dump complexes. The 2H:1V slopes would be covered with growth media containing the necessary rock content to control erosion. The slopes on the east side of the pit also would be covered with growth media and seeded.

All acidic waste rock in the pit would be covered with backfill and revegetated. Pit dewatering wells located outside the pit would continue to keep the water table depressed below the level of the pit backfill. The downgradient dewatering well would collect some of the water that infiltrates through the backfill.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
	Disturbed Acreage			
Permit Boundary and Permitted Disturbance Boundary	Disturbance area = 3,104 acres Permit area = 6,125 acres	Increase permitted disturbance boundary by 87.4 acres (55.1 acres outside permitted disturbance boundary + 32.3 acres in Buffer Area)	Similar to the Proposed Action Alternative but would increase permitted disturbance boundary by 19.3 acres to include the Buffer Area around the southeast portion of the EWRDC Expansion area.	Same as Agency Modified Alternative.
North Area Pit	No acres of disturbance	Expand 1,000 feet northeast of Mineral Hill Pit Total disturbance = 49.4 acres; New disturbance = 15 acres	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
South Area Layback	No additional acres of disturbance	Layback along southern wall of Mineral Hill Pit Total disturbance = 69.4 acres; New disturbance = 10.9 acres	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
East Waste Rock Dump Complex (EWRDC) Expansion	EWRDC permitted for 174 million tons of waste rock with a disturbed area of about 683 acres. Includes 5B Optimization. Maximum elevation is 5,850 feet which is approximately 520 feet above the natural topography.	Increase EWRDC dump size to permitted disturbance boundary 721 acres; Total new disturbance = 179.6 acres; Disturbance within permitted disturbance boundary = 141.9 acres; Disturbance outside permitted disturbance boundary = 37.7 acres; Up to additional 48.6 million tons of waste rock; Maximum height above natural topography is approximately 290 feet. Up to 6 Mt of waste rock could go to permitted Buttress Dump Extension.	Similar to the Proposed Action Alternative with modification to add additional seep monitoring and to define collection and routing methods for water from mining-related seeps in the EWRDC Expansion area.	Same as Agency Modified Alternative except dump may be not as tall if South Area layback waste rock backfills the pit rather than going to EWRDC Expansion area.
Tailings Disposal	TSF-1 ceased in 1995 and has been reclaimed. GSM would continue to treat drainage water from TSF-1 at 8 to 23 gpm. TSF-2 began receiving tailings in 1993. Approved for storage of 42 million tons of tailings at an embankment elevation of 4,770 feet. Includes 5B Optimization.	Increase TSF-2 tailings height by 4 feet with a corresponding 4.5 acres of additional disturbance. Approximately 5.0 million tons of tailings (4.2 million tons from mine + legacy mine materials) would be stored with a new ultimate embankment elevation of 4,774.5 feet.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Haul and Access Roads	Mine contains an extensive network of access and haul roads from 100 feet wide to two-tracks. Road disturbances are included in the 198.5 acres approved for "Stockpiles, borrow areas, roads, and miscellaneous".	Construction of new access road in East Waste Rock Dump Complex across Sheep Rock Creek Drainage. The road across Sheep Rock Creek has been approved and permitted but portion of road on the 37.7 acre EWRDC Expansion would be bonded under Amendment 015.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Reclamation	GSM is currently approved for mining and associated facilities disturbance on 3,104 acres in a permit boundary of 6,125 acres. As of December 31, 2012 (2012 Annual Report), the actual disturbance was 2,361 acres. GSM reports 1,168 acres of reclamation successfully revegetated (2012 Annual Report).	About 75.4 acres (91 - 15.6) of previously reclaimed land would be redisturbed by the North Area Pit, South Area Layback, and East Waste Rock Dump Complex Expansion. GSM would revegetate 22 acres of South Area layback and 12 acres of the east wall of the North Area Pit. EWRDC Expansion would be reclaimed at 2H:1V slope angles.	Same as Proposed Action Alternative except GSM would provide plans for bat and raptor habitat in new pit highwalls and how visual contrasts with adjoining areas would be mitigated in the new pits.	Same as AMA except the North Area Pit would be backfilled and all acres would be covered with growth medium and revegetated.
General Plant Operations				
Mill Processing	May be completed in early 2015	Continuous through 2017.	Same as the Proposed Action Alternative.	Same as Proposed Action Alternative.
Ore Recovery and Processing	Same as current until closure.	4.2 million tons added; Processes same as No Action until closure.	Same as the Proposed Action Alternative.	Same as Proposed Action Alternative.

TABLE 5-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mining and Geotechnical Engineering				
North Pit Area	Would not be constructed	Some erosion of the North Area Pit highwall and raveling of material onto benches would likely continue during the life of mine. The North Area Pit would expose zones of poor rock quality within some of the highwalls resulting in more potential small highwall instability problems, especially in and around the Range Front Fault. Bozeman area clay seams could potentially be encountered in the east wall locations. If this layer is extensive and prevalent over large horizontal extent in stratigraphy it could affect stability of benches in local areas and require adjusting the pit wall design.	Similar to the Proposed Action Alternative with modifications to design method to convey water to the water treatment plant at closure; grade, cover with low-permeable materials, cover with soil, and seed a portion of the pit; and line the sump area in the bottom of the pit.	North Area Pit would be backfilled and all acres would be covered with growth medium and revegetated eliminating any instability problems.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	Some erosion of the Mineral Hill Pit highwalls and raveling of material onto benches would likely continue during the life of mine and after mining. GSM has to maintain access into pit by maintaining 5,700-foot pit bench. GSM has to maintain access to underground workings to repair water collection and routing equipment to get underground pit sump water to treatment plant.	Structure is favorable for pit highwall stability. However, some areas would be developed in the hanging wall of the Corridor Fault, the Telluride Fault, and the Splay Fault which are associated with poor rock quality. Careful controlled blasting and scaling should mitigate rockfall concerns and stability risks associated with lower rock mass quality. After mining, GSM would have to maintain Mineral Hill Pit access the same as No Action.	Similar to the Proposed Action Alternative with modifications for additional ground movement monitoring to identify potential for mass movement after mining in the South Area Layback if needed to access the Mineral Hill Pit after closure.	
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	Pit highwall stability would continue to be monitored using the existing system of survey prisms and extensometers. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and to minimize potential damage to mining equipment. Discuss monitoring currently approved after closure if any	During operations, effective groundwater depressurization would be required and controlled blasting techniques would be used in the South Area Layback mine pit development to maintain the integrity of the benches and minimize raveling to ensure the benches remain capable of containing future rock falls. No additional monitoring is proposed after closure	Same as the Proposed Action Alternative GSM would be required to do additional monitoring if South Area Layback affects access into the Mineral Hill Pit at closure.	Same as PAA Same as AMA

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
Mineral Hill-Pit Only (No Action Alternative) South Area Layback (Action Alternatives)	There would be the potential for smaller scale slope failures on pit highwalls and release of rock into the mine pit during operations. SEIS discussed potential raveling and failures after mining.	Discuss how new pit would affect operational smaller scale slope failures on pit highwalls and release of rock into the layback. Discuss how new pit layback would affect SEIS prediction for failures and raveling after mining. The proposed mine pit development should relieve loading pressures in the head area of the Swimming Pool Earth Block thus likely relieve loading pressures in the head area and is not predicted to instigate further movement in the block.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Tailings Storage Facility-2 and Embankment	The final surface of the tailings would have a 0.5-percent to 5-percent slope toward the east end of the embankment to facilitate surface water drainage to the spillway. The outside slope of the tailings storage facility embankment would be reclaimed by reducing the slope to 2.5H: 1V.	The final surface of the tailings storage facility and outside slope slopes would be graded the same as the No Action Alternative.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE 5-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES				
Resource, Land Use, or Activity	**General Impact**			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Soil, Vegetation, and Reclamation				
Soil and Other Growth Medium Resources	Loss of soil development and horizons, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. Reclamation and revegetation would minimize long-term effects.	Impacts to soils, vegetation, and reclamation would be similar to those described under the No Action Alternative but would apply to a larger area of disturbance. An additional 302.9 acres would be disturbed or redisturbed as a part of this action. 152.1 acres of new disturbance outside of permitted disturbance boundary and not previously disturbed and 150.8 acres in permitted disturbance boundary and previously disturbed.	Similar to the Proposed Action Alternative with modification to salvage and stockpile fine-grained lakebed sediment materials for reclamation of gently and flat slope areas.	Same as the Agency Modified Alternative.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Vegetation and Reclamation	Reclamation seed mixtures have been developed for various slope configurations and facilities. Mine operations have not successfully reclaimed any areas to Douglas-fir or mixed shrub plant communities. Noxious weed infestations are monitored and treated every year, 159 acres of the Mineral Hill Pit would be regraded to 2H:1V slopes, covered with soil, and revegetated. The remaining 158 acres of the pit would be left unvegetated as rock faces with some bat and raptor habitat.	The seedbed preparation and revegetation plans for the additional areas under the Proposed Action would be similar to the No Action Alternative. Same as the No Action Alternative. Approximately 30 acres of the North Area Pit and 22 acres of the South Area Layback would be regraded to 2H:1V slopes, covered with soil, and revegetated.	Same as the Proposed Action Alternative	Same as Proposed Action except the North Area pit would be completely backfilled and all 49.4 acres of the North Area Pit would be covered with growth medium and revegetated.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
Water Resources				
Surface Water	There are minimal environmental consequences to surface water under this alternative. Surface water drainage patterns and runoff volumes and rates would remain as approved. Over the long-term and as more project facilities are reclaimed and vegetation on reclaimed surfaces becomes more dense, ephemeral surface water runoff rates would decrease.	The increased pit disturbance areas would capture more rainfall and snowmelt and contribute to stormwater during runoff events. The disturbed EWRDC Expansion surfaces would be more permeable with less surface runoff but with a greater contribution to groundwater. Following reclamation, the revegetated surfaces would result in some surface runoff with a smaller contribution to groundwater.	Similar to the Proposed Action Alternative.	Same as Agency Modified Alternative except the North Area Pit would be backfilled and more captured precipitation would be routed out of the backfilled pit.
Groundwater South Area Layback	The South Area Layback would not be constructed.	The groundwater flow paths for the Mineral Hill Pit would remain the same, and the groundwater pumping and capture systems on the site are designed to address impacts from Mineral Hill Pit operations. The South Area Layback would be an extension of the Mineral Hill Pit and would drain into the main pit where water would be captured by the underground pit sump and pumped from the pit to the WTP.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	**Proposed Action Alternative (Extended Mine Life)**	**Agency Modified Alternative**	**North Area Pit Backfill Alternative**
Groundwater North Area Pit	The North Area Pit would not be constructed.	The North Area Pit would be dewatered using two vertical dewatering wells around the perimeter of the pit. If vertical dewatering wells are not successful horizontal dewatering wells may be needed. If dewatering is incomplete, some groundwater would report to the pit and migration of the impacted groundwater out of the pit could occur. The water would report to the identified pit flowpaths and water would have to be captured by the Rattlesnake drainage capture wells.	Similar to the Proposed Action Alternative with modification to prepare design to convey pit water to the water treatment plant; regrade, cover with low permeable materials, cover with soil, and seed a portion of the pit; and line the sump area in the bottom of the pit. This would limit the amount of water that could seep into groundwater.	Same as Agency Modified Alternative except stormwater and snowmelt runoff would be routed out of the backfilled pit limiting the amount of water reporting to groundwater through acidic waste rock backfill.
Groundwater EWRDC Expansion	The EWRDC Expansion Area would not be constructed.	Discuss how long it is predicted for water to migrate through the dump to groundwater and the amount of water 2.1 gpm that would seep out at the base or report to groundwater. Discuss GSM proposed monitoring for seeps from the EWRDC Expansion area and plans if any to capture and treat the water to minimize impacts to groundwater.	Similar to the Proposed Action Alternative with modifications to monitor for toe seeps associated in the EWRDC Expansion area GSM would provide a detailed plan for after mining, on how seepage water would be collected and routed at the water treatment plant.	Same as the Agency Modified Alternative.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact			
	No Action Alternative (Current Operating Permit)	Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
Wildlife and Fisheries				
South Area Layback/ North Area Pit	There would be no additional effects on wildlife or fish species within or adjacent to the Project area.	Construction and operational noise may cause a continued short-term, temporary disturbance to wildlife. The South Area Layback may reduce the approved wildlife highwall habitat approved in the 2007 SEIS. 22 acres would be covered with growth medium and reclaimed to grassland habitat. No detailed plan provided for bat and raptor habitat in the new pit. 30 acres would be covered with growth medium and reclaimed to grassland habitat.	Same as the Proposed Action Alternative except GSM would provide a plan to provide bat and raptor habitat in South Area Layback highwalls to provide some utility to the environment. GSM would provide a plan to provide bat and raptor habitat in North Area Pit highwalls to provide some utility to the environment.	Same as the Agency Modified Alternative except North Area Pit would be backfilled creating more vegetated grassland habitat and less bat and raptor habitat.

TABLE 5-1
SUMMARY OF IMPACTS FROM ALL ALTERNATIVES

Resource, Land Use, or Activity	General Impact				
	No Action Alternative (Current Operating Permit)		Proposed Action Alternative (Extended Mine Life)	Agency Modified Alternative	North Area Pit Backfill Alternative
Social and Economic Conditions					
Additional wages, salaries, and benefits paid in 2016	$0		$13,580,305	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
Tax Revenues paid 2013-2016		Price of gold $1,300-$1,700/oz.	Price of gold $1,300-$1,700/oz.	Same as the Proposed Action Alternative.	Same as the Proposed Action Alternative.
	2013	$4.615-$5.855 million	$4.677 - $5.915 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2014	$3.544-$4.420 million	$4.197 - $5.275 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2015	$1.005-$1.276 million	$2.871 - $3.556 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.
	2016	$0.416 million	$2.538. -$3.242 million	Same as the Proposed Action Alternative	Same as the Proposed Action Alternative.

Notes:

2H:1V	Two horizontal to one vertical
DEQ	Montana Department of Environmental Quality
EWRDC	East Waste Rock Dump Complex
GPS	Global positioning system
GSM	Golden Sunlight Mines, Inc.

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amsl	above mean sea level
BLM	Bureau of Land Management
BMP	Best Management Practice
BNA	Birds of North America
cfs	Cubic feet per second
cm / sec	Centimeters per second
CY	Cubic Yard
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality (Montana)
EIS	Environmental Impact Statement
EWRDC	East Waste Rock Dump Complex
FEIS	Final Environmental Impact Statement
FOS	Factor of Safety
GANDA	Garcia and Associates
gpm	Gallons per minute
GSM	Golden Sunlight Mine, Inc. and Golden Sunlight Mine
HDPE	high-density polyethylene
HDS	High Density Sludge
IDT	Interdisciplinary Team
JLDC	Jefferson Local Development Corporation
MCA	Montana Code Annotated
MDOR	Montana Department of Revenue
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife and Parks
mil	millimeter thick
MMRA	Metal Mine Reclamation Act
MOU	Memorandum of Understanding
MPDES	Montana Pollutant Discharge Elimination System
MSHA	Mine Safety and Health Administration
MT	Montana
MTNHP	Montana Natural Heritage Program
NEPA	National Environmental Policy Act
NRIS	Natural Resource Information System
RMR	Rock Mass Rating
ROD	Record of Decision
RQD	Rock Quality Designation
RSU	Restricted Share Units
SEIS	Supplemental Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
Tdf/ls	Tertiary debris flow and landslide formation
TSF	Tailings Storage Facility
USDA	US Department of Agriculture

USFWS	US Fish and Wildlife Service
WWRDC	West Waste Rock Dump Complex

Acid Rock Drainage – Water from pits, underground workings, waste rock, and tailings containing free sulfuric acid.

Best Management Practice - Structural, non-structural, and managerial techniques that are recognized to be the most effective and practical means to control non-point source pollutants.

Bond – Financial assurance posted by an applicant/permittee to guarantee performance by the state and/or federal agencies of all the reclamation obligation associated with an operating permit or license, including water treatment if needed, in the event the permittee is unable to unwilling to do so.

Buffer Area - a minimal area delineated around a disturbance area for the purpose of providing a buffer adjacent to all disturbances.

Cyanide leach Process– Recovery of gold and other metals by soaking an ore in a cyanide solution.

Deficiency Letter – In this case, DEQ's response to an operating permit amendment application identifying additional items needing clarification so an application can be called complete and compliant with the MMRA.

Draft Operating Permit/Operating Permit Amendment– Permit or permit amendment issued upon completion of the completeness and compliance review, prior to the completion of the required MEPA review.

Factor of Safety - A calculation defining the relationship of the strength of the resisting force on an element (C) to the demand or stress on the disturbing force (D) where Force = C/D. When F is less than 1, failure can occur.

Geotechnical - Pertaining to the application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the earth's crust for the solution of engineering problems. It embraces the fields of soil mechanics and rock mechanics, and many of the engineering aspects of geology, geophysics, hydrology, and related sciences.

Highwall - The face of overburden and ore in an open pit mine

Highwall stability – The potential for a highwall to have a structural failure

Interdisciplinary team – A group of technical experts conducting an impact analysis

Legacy mining materials – Processed ore (tailings) or waste rock from closed or abandoned mines. These materials may have recoverable minerals because of inefficiencies in earlier processing methods or changes in

mineral prices making recovery profitable at this time. Reprocessing offers an opportunity to safely dispose of the mining materials

Mitigation - A measure used to reduce impacts by (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Montana Environmental Policy Act – Title 71, Chapter 1 of the Montana Code Annotated.

Open pit mining – A surface mining method where rock is ripped or drilled and blasted if necessary, then removed as overburden or removed as ore for further processing.

Operating Permit –Permit issued by DEQ to mine, process ore, construct or operate a hard-rock mill, use cyanide ore-processing reagents or other metal leaching solvents or reagents, or disturb land in anticipation of those activities in the state.

Ore – A mineral or an aggregate of minerals from which a commodity can be profitably mined or extracted.

Permitted disturbance boundary – The area in an operating permit that is designated to be disturbed.

Permit Area or Boundary- The disturbed land as defined in 82-4-303 , MCA, and a minimal area delineated around a disturbance area for the purposes of providing a buffer adjacent to all disturbances.

Reclamation – Returning a surface disturbance to support desired post-mining uses, including recontouring and plant growth, and minimizing hazardous conditions, ensuring stability, and protecting against wind or water erosion.

Scoping – Determining the scope of the analysis, i.e. the range of reasonable alternatives, mitigation, issues, and potential impacts to be considered in an environmental assessment or an environmental impact statement.

Soil salvage – Soil or other growth media removed and saved for use during future reclamation.

Sump – The bottom of a shaft or any other place in a mine that is used as a collecting point for drainage water.

Tailings – The non-economic constituents of processed ore material that remain after the valuable minerals have been removed from raw materials by milling.

Tailings storage facility – The engineered location where tailings are stored

Waste rock - Rock that is removed for access, but does not contain enough mineral to be mined and processed at a profit.

Waste rock dump – Engineered location where waste rock is stored.

AMEC. 2012. Main Dam Raise to Elevation 4,774 Feet, Tailings Storage Facility No. 2, Golden Sunlight Mine, Jefferson County, Montana. Prepared for Barrick Golden Sunlight Mines, Whitehall, Montana. June.

Barrick. Golden Sunlight operations. Available online at http://barrick.com/operations/north-america/golden-sunlight/default.aspx. Accessed April 24, 2013.

Bighorn Environmental Services. 2011. Vegetation Update 2011, South and North Pit Areas, Mineral Hill Mine.

BNA. 2013. The Birds of North America Online. Various species. (A. Poole, ed.). Ithaca: Cornell Lab of Ornithology. Available http://bna.birds.cornell.edu/. Accessed June 2013.

GANDA. 2012. Garcia and Associates. Golden Sunlight Mine bird and general wildlife surveys; 2011 and 2012. Golden Sunlight Mine.

Golden Sunlight Mines, Inc. (GSM). 1995. Hard Rock Mining and Plan of Operations for an Amendment to Operating Permit 00065, Appendix 3.5-1, Volume 2. August 1995, Updated January 16, 1996.

GSM. 2012a. Draft Application for Amendment 015 to Operating Permit No. 00065. September.

GSM 2012b. Revised Application for Amendment 015 to Operating Permit No. 00065. December.

GSM 2013. Golden Sunlight Mines, Inc. 2012 Annual Permit Report for the Period January 1, 2012 through December 31, 2012. Submitted to Montana DEQ and US Department of the Interior, BLM. June.

Golder Associates. 2012a. Letter Report: Slope Stability Evaluation, Far East Rock Disposal Area, Golden Sunlight Mine, Whitehall, Montana. Prepared for Paul Buckley, Barrick Golden Sunlight Mine, Whitehall, Montana. June 29.

Golder Associates. 2012b. Technical Memorandum: Draft Effects of the North Area Pit, South Area Layback, and Far East Rock Disposal Area on Stability of the Earth Blocks. From Rhonda Knupp (Golder) to Paul Buckley Golden Sunlight Mines. July 18.

Harrington, T. 2013. Personal communication T. Harrington, Jefferson Local Development Corporation with J. Edward Surbrugg, Tetra Tech EIS Project Manager. July 9.

Herbort. D. 1985. Cultural Resource Investigation and Assessment of the Golden Sunlight Mine/State of Montana Land Exchange. GCM Services, Inc., Butte, MT. September 1985.

HydroSolutions, Inc., 2012. Hydrogeologic Assessment of Barrick Golden Sunlight Mine's Amendment for North Area Pit Project, March 27, 2012.

Jefferson County Treasurer. Property Tax Records for Golden Sunlight Mines, Inc. in Jefferson County, Montana. Available online at http://webtax.csa-inc.net/jeffersonmt/list.aspx for Golden Sunlight Mines. Accessed April 24. 2013.

Montana Department of Environmental Quality (DEQ) and U.S. Bureau of Land Management (BLM). 2007. Final Supplemental Environmental Impact Statement, Golden Sunlight Mine Pit Reclamation. July.

Montana Department of Revenue. Biennial Report 2010 to 2012. Available online at http://revenue.mt.gov/content/publications/biennial_reports/2010-2012/Biennial-Report-2010-2012.pdf. Accessed date 2013.

Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. 2013. Various species. Montana Field Guide. Available http://FieldGuide.mt.gov. Accessed June 2013.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Accessed June 2013.

Peterson, R.R., Jr. 1996. A Cultural Resources Inventory of 340 Acres and Testing/Evaluation of Eight Sites for the Golden Sunlight Mine Land Exchange in Jefferson County, Montana. Western Cultural Resource Management, Inc., Sparks, NV. January 1006.

Peterson, R.R., Jr., S.F. Mehls, and T.J. Lennon, 1994. Preliminary Draft: A Class III Cultural Resources Inventory of Approximately 3,278 Acres for Golden Sunlight Mines, Inc. in Jefferson County, Montana. Western Cultural Resource Management, Inc. Sparks, NV. January 1994.

Read, J., & Stacey, P. 2009. Guidelines for Open Pit Slope Design. CRC Press/Balkema, 512pp.

RocScience. 2009. DIPS V.5.108.

RocScience. 2010. SLIDE V.5.004.

Rolfes. 2013. Personal communication H. Rolfes, Montana Department of Environmental Quality, Environmental Management Bureau, Operating Permit Section with J. Edward Surbrugg, Tetra Tech EIS Project Manager. July 11.

Schlumberger Water Services (SWS). 2012. Golden Sunlight Mine, North Area Hydrogeology and Dewatering Investigation, May 2012.

SWS. 2011. Golden Sunlight Mine North Area Hydrogeology and Dewatering Investigation Draft. Report Prepared for Golden Sunlight Mine, December.

SPSI. 2010. Operating and Reclamation Plan. Prepared for Barrick Golden Sunlight Mine, Inc. June (Revised February 2011 and May 2011).

SPSI. 2012. Far East Rock Disposal Area Hydrogeologic Evaluation Golden Sunlight Mine, June 2012.

Telesto Solutions Inc. (Telesto) 2007. Technical Memorandum: East Waste Rock Dump (Natural Regrade Design). Prepared for Golden Sunlight Mine and submitted with MR07-002 request. April 6.

Tetra Tech. 2013. Scoping Report for the Environmental Impact Statement, Golden Sunlight Mines, Inc. May 24.

Westech Environmental Services. 1995. Baseline vegetation inventory Phase 2, Golden Sunlight Mine.

US Department of Agriculture, Natural Resources Conservation Service. 2003. Soil Survey of Jefferson County Area and Part of Silver Bow County, Montana (MT627). Field work completed in 1996. Maps included.

US Fish and Wildlife Service. 2013. Letter Re: List of threatened and endangered species that may occur in your proposed project location, and /or may be affected by your proposed project. Golden Sunlight Mine. Consultation Tracking Number 06E11000-2013-SLI-0162. June 18, 2013.

US Department of Commerce. Bureau of Economic Analysis, Regional Economic Information System, Table CA25N. 2012a.

US Department of Commerce. Bureau of Economic Analysis, Regional Economic Information System, Washington, DC. Tables CA05N & CA 30. 2012b.

US Department of Labor. Bureau of Labor Statistics, Local Area Unemployment Statistics, Washington DC. 2013.

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