CHAPTER 3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

Existing environmental resources and potential direct and indirect impacts of the Proposed Action and Alternatives are described in this chapter. Construction, operation, and reclamation of the Indian Creek Mine and alternatives identified in Chapter 2 would result in irreversible and irretrievable commitments of resources and residual effects to the environment. Irreversible commitments of resources are those that cannot be reversed, except over a very long period of time, and are essentially permanent. Irretrievable commitments are those that are lost for a period of time. Residual effects are those effects that remain after completion of the Proposed Action and implementation of mitigation measures.

Graymont currently operates the Indian Creek Mine under authorization by BLM Plan of Operations MTM 78300 and DEQ MMRA Operating Permit No. 00105. The potential impacts of Graymont's current mine and reclamation plan, Amendment 011, were evaluated in an environmental assessment (EA) in 2001 (DEQ 2001).

This chapter discusses potential environmental or social impacts and mitigation measures. Mitigation measures that would reduce or limit the impacts that could result from the Proposed Action and Alternatives are identified in each resource section. Potential impacts that could result from implementation of these mitigation measures are also included in the analysis of impacts. Mitigation and monitoring measures may be required by BLM or DEQ as a condition or stipulation of approval for authorization of the Plan of Operations. Stipulations or conditions attached to the amended permit would conform to statutory provisions of either 43 CFR 3809 or 82-4-300, MCA.

Figure 3-1 shows the general Study Area for all resources except social and economic resources. The Study Area boundary for social and economic resources extends beyond the boundaries depicted on **Figure 3-1**. Study areas for each resource are based on the predicted locations of direct and indirect impacts that could result from the proposed mine expansion (Proposed Action). A detailed description of the Proposed Action is included in Chapter 2.

Existing mining operations have altered the landscape and represent a portion of the characteristic environment in the Study Area. A description of existing mining operations is included in Chapter 2 of this Draft EIS.

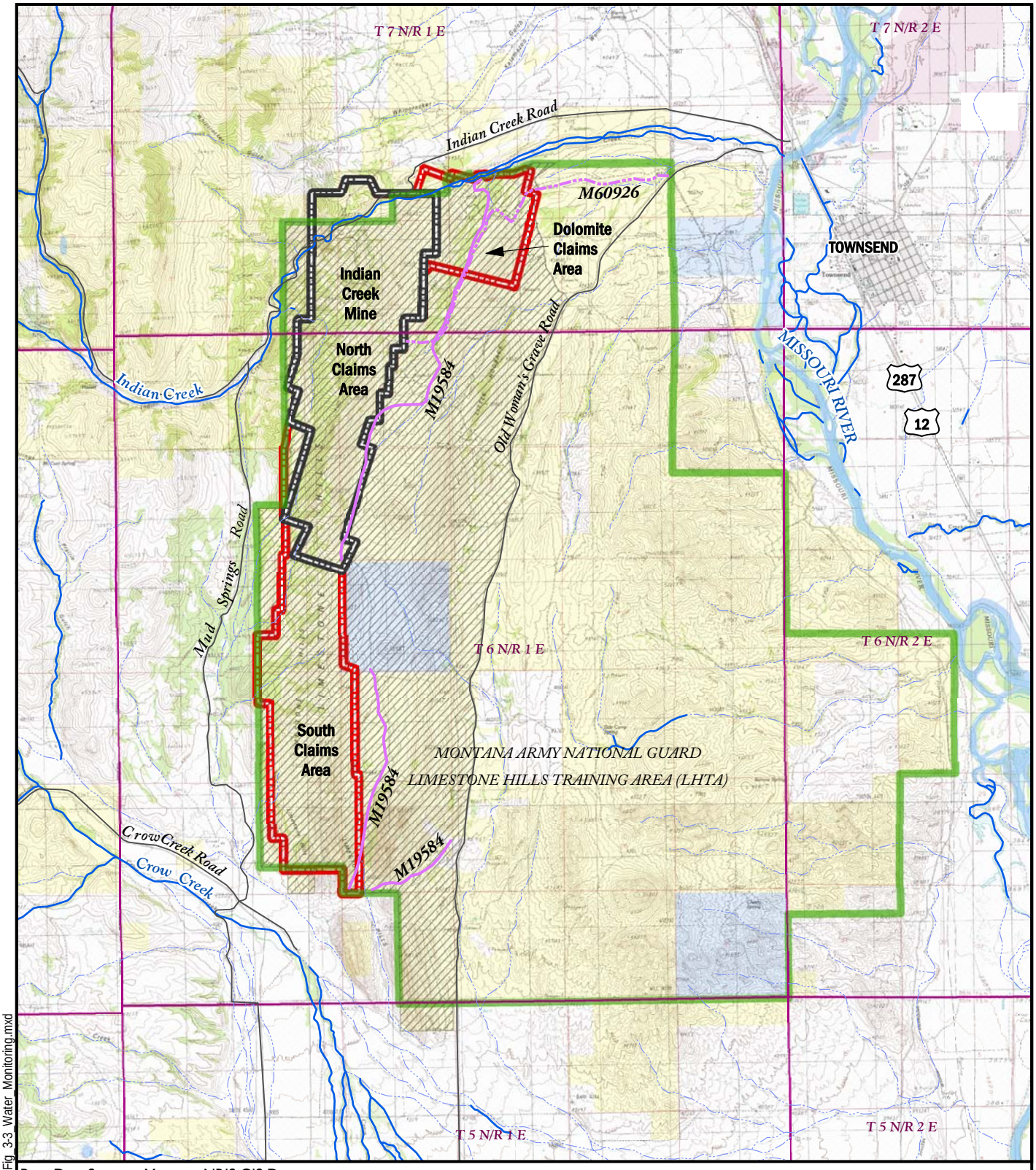
Supplemental Authorities to be Considered

Appendix 1 of BLM's NEPA Handbook (H-1740-1) identifies Supplemental Authorities to be considered in all BLM environmental documents. The Supplemental Authorities for the proposed Project are listed in **Table 3-1**.

This chapter provides a summary of environmental baseline information. In the following sections, "Project area" refers to land associated with the proposed mine expansion within the boundaries of South Claims and Dolomite Claims areas.

TABLE 3-1
Supplemental Authorities

Element	Authority
Air Quality	The Clean Air Act as amended (42 USC 7401 *et seq.*)
	The State of Montana has been granted primacy in administration of the Clean Air Act under Sections 75-2-217 and 218 Montana Code Annotated (MCA), and Administrative Rules of Montana, Title 17.8.12 by the Montana Air Resources Management Bureau.
Cultural Resources	National Historic Preservation Act, as amended (16 USC 470)
Fish Habitat	Magnuson-Stevens Act Provision: Essential Fish Habitat (EFH): Final Rule (50 CFR Part 600; 67 FR 2376, January 17, 2002)
Forest and Rangeland	Healthy Forests Restoration Act of 2003 (P.L. 108-148)
Migratory Birds	Migratory Bird Treaty Act of 1918, as amended (16 USC 703 *et seq.*)
	Executive Order (E.O.) 131186, "Responsibilities of Federal Agencies to Protect Migratory Birds" January 10, 2001.
Native American Religious Concerns	American Indian Religious Freedom Act of 1978 (42 USC 1996)
Threatened or Endangered Species	Endangered Species Act of 1983, as amended (16 USC 1531)
Wastes, Hazardous or Solid	Resource Conservation and Recovery Act of 1976 (43 USC 6901 *et seq.*)
	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (43 USC 9615)
Water Quality	Safe Drinking Water Act, as amended (43 USC 300f *et seq.*)
	Clean water Act of 1977 (33 USC 1251 *et seq.*)
	The State of Montana has been granted primacy in administration of the Clean Water Act under Sections 75-5-101 *et seq.*, Montana Code Annotated (MCA) and Administrative Rules of Montana (ARM) 17.30.101 through 2006 by the Montana Department of Environmental Quality.
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended 16 USC 1271)
Wilderness	Wilderness Act of 1964 (16 USC 1131 *et seq.*)
	Federal Land Policy and Management Act of 1976 (43 USC 1701 *et seq.*)
Environmental Justice	E.O. 12898, "Environmental justice" February 11, 1994
Floodplains	E.O. 11988, as amended, Floodplain Management Act
Wetland and Riparian Zones	E.O. 11990 Protection of Wetlands May 24, 1977



Base Data Source: Montana NRIS GIS Data

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0 Miles 1.5

- Townships
- Existing LHTA Boundary
- Existing Operating Permit Boundary
- Proposed Operating Permit Boundary

Land Ownership
- State of Montana
- Bureau of Land Management
- Bureau of Reclamation

BLM Rights-of-Way
- Road
- Transmission Line
- LHTA Closure Area

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GENERAL STUDY AREA
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FIGURE 3-1

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RESOURCES ELIMINATED FROM FURTHER ANALYSIS

BLM has evaluated the potential impact of the Proposed Action and alternatives to the following resources and has determined that, although present in the Project area, they would not be affected by the Proposed Action and alternatives. Rational for dismissing these resources from further discussion in the document are as follows:

THREATENED AND ENDANGERED SPECIES

No federally listed or proposed threatened or endangered fish, wildlife, or plant species are known to be present in the proposed mine expansion area. Habitat in the area is not suitable for lynx. Wolves have not been documented in the Study Area. As wolves continue to expand in Montana, the Study Area with its high concentration of wintering big game animals may be attractive as a foraging or denning area. The gray wolf was determined to be recovered and de-listed under the Endangered Species Act (ESA). However, U.S. Federal Court issued a preliminary injunction on July 18, 2008 that immediately provided ESA protection to gray wolves in the Northern Rocky Mountains, including Montana. Court action regarding this decision is pending.

FISHERIES AND AQUATIC RESOURCES

Indian Creek is a perennial stream in its upper reaches upstream of the Project area. Indian Creek typically loses water to the subsurface and becomes intermittent as it flows along the northern boundary of the existing mine permit area. This precludes establishment of aquatic habitat, biota, and fish. Aquatic habitat in Indian Creek has been degraded by historic placer, hydraulic, and dredge mining not related to Graymont's operations. Loss of surface water in Indian Creek by infiltration is partly due to disturbance from past placer mining and flow into the karst (cave-forming) Madison Formation. Storm water Best Management Practices (detention ponds, diversion ditches, and berms) have been implemented by Graymont to prevent surface water run-off from degrading Indian Creek.

RESOURCES AND RESOURCE USES EVALUATED IN THE EIS

AIR QUALITY

AFFECTED ENVIRONMENT

Climate

The Indian Creek Mine area is characterized by a semi-arid climate. Mean annual precipitation in the area averages 11.3 inches, with May and June being the wettest months and December and January the driest. Mean annual temperature is 43.7°F. January is the coldest month with a mean temperature of 24°F. July is the hottest month at a mean temperature of 67°F (Graymont 2007a).

Air Quality

Graymont currently operates a limestone quarry, a lime plant, and railroad load-out facility under Air Quality Operating Permit No. 1554 issued in 1981. Sixteen modifications to the permit have been authorized generally in response to emission control equipment upgrades, installation of new equipment to increase efficiency and produce additional lime related products (*e.g.*, hydrated lime), or to allow operational flexibility through use of various fuel mixes (*e.g.*, coal and petroleum coke).

Particulate Emissions (PM_{10})

Particulate emissions (particulate matter with a diameter less than 10 microns [PM_{10}]) in the Indian Creek Mine area are generated by drilling, blasting, loading, and hauling limestone and waste rock from designated quarries. Fugitive dust from haul roads, parking areas, and stockpiles of coal, petroleum coke, overburden, and soil material are also non-point sources of air pollutants.

During 1998, Graymont monitored ambient air quality at two locations near the plant facility. Minimum, maximum, and mean quarterly PM_{10} concentrations measured at the two monitoring sites during the fourth quarter of 1998 were 1, 61, and 17 micrograms per cubic meter ($\mu g/m^3$ or parts per billion), respectively. The overall average annual data recovery rate was 99.6 percent. Effective January 1, 1999, DEQ removed the requirement to monitor PM_{10} from Air Quality Permit 1554-11 (Bison Engineering 1999). The federal and Montana 24-hour ambient air quality standard for PM_{10} is 150 $\mu g/m^3$, which is not to be exceeded more than once per year. All measured values at the Indian Creek Mine are below the ambient air quality standard of 150 $\mu g/m^3$ for a 24-hour sampling period.

Non-particulate (Gaseous) Emissions

Point source emissions are associated with combustion gases from the two coal/coke-fired kilns. Permit stipulations require Graymont to submit annual production and other information for all emission units. These data are necessary to calculate or estimate the amount of air pollutants emitted during each calendar year. Gaseous emissions from the Indian Creek facility include nitrogen oxide(s) (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds (VOCs). Permitted emissions levels and the DEQ Emission Inventory Summary are shown in **Table 3-2**.

In addition to these regulated gaseous pollutants, carbon dioxide (CO_2), an unregulated pollutant, is produced from the kilns when limestone is converted to lime. Graymont uses a maximum of 215,000 tons of limestone per year in the kilns, producing about 120,400 tons of lime. At this maximum, about 156,500 tons of CO_2 would be produced per year.

TABLE 3-2
Non-Particulate Emissions
Indian Creek Mine

Emission	2005[1]	2006[2]	Permitted Level[3]
	Tons per Year		
Sulfur Dioxide	111.11	108.79	278.6
Nitrogen Oxide(s)	334.64	388.11	876.0
Carbon Monoxide	86.2	95.42	1147.6
Volatile Organic Compounds	8.97	10.41	11.0

1 Calculated using the 2005 DEQ Emission Factors.
2 Calculated using the 2006 DEQ Emission Factors.
3 Air Quality Permit No. 1554-16.
Source: DEQ 2004, 2005, 2006a.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Gaseous (SO_2, CO, NO_x, VOCs) and particulate emissions would be generated throughout the life of the mine. Particulate emissions from mining would be caused by drilling, blasting, excavating, loading, hauling, and dumping of overburden and limestone.

Particulate emissions would be limited by the implementation of Best Management Practices (BMPs), including minimizing drop heights during loading, and watering and chemical stabilization of haul roads.

Particulate Emissions

Fugitive dust emissions would be generated from wind erosion of disturbed areas and road dust. Haul roads would be maintained on a continuous basis for safe and efficient haulage and to minimize fugitive dust emissions. Generation of fugitive dust from ore handling activities would be controlled using direct water application, approved chemical binders or wetting agents, water spray, and revegetation of disturbed areas concurrent with operations.

Gaseous Emissions

The Indian Creek Mine would continue to be a source of gaseous air pollutants including SO_2, CO, NO_x, and VOCs. The primary sources of these emissions would be combustion associated with the two coal/coke-fired kilns and exhaust from diesel engines used to power mining equipment and haul trucks. Gaseous emissions from diesel engines would be minimized through proper operation and maintenance of equipment.

Ammonium nitrate and fuel oil (ANFO) are used as blasting agents and would continue to be a source of gaseous pollutants from the proposed mine expansion area. Use of ANFO can cause fugitive emissions of NO_x, CO, and SO_2.

Production rates associated with the Proposed Action are expected to remain at current levels for about 50 years. PM_{10} and gaseous emissions would remain unchanged. These levels could rise in response to increased production of lime, limestone, and dolomite product. Increases in emissions may require revision to Graymont's current air quality permit. The location of sources of fugitive dust and gaseous emissions would change in response to pit development progressing southward into the South Claims Area and eastward into the Dolomite Claims Area but would be within permitted levels.

Alternative A – Modified Pit Backfill

Impacts to Air Resources resulting from implementation of Alternative A would be similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, currently approved mining operations and related air emissions would continue for approximately 15 years. Potential direct and indirect impacts to air quality associated with the proposed mine expansion in the South Claims and Dolomite Claims areas would not occur.

POTENTIAL MONITORING AND MITIGATION MEASURES

Air pollutant emissions associated with existing operations are within permitted levels. This precludes the need for monitoring or mitigation measures beyond those currently implemented at the Indian Creek Mine.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

No irreversible or irretrievable commitment of air resources would result from either alternative.

RESIDUAL EFFECTS

Residual effects on air resources are not anticipated as a result of implementation of the Proposed Action. After cessation of mining and completion of reclamation activities, air quality would reach pre-mining conditions.

GEOLOGY AND MINERALS

AFFECTED ENVIRONMENT

The Indian Creek Mine is located in the Limestone Hills region on the east flank of the Elkhorn Mountains. The bedrock strata (layers) consist of alternating clastic (cemented fragments) and carbonate (limestone and dolomite) units. These strata have been intensely folded and subsequently eroded. The limestone units are more resistant to erosion and form the prominent, distinctive ridges of the Limestone Hills. The clastic layers are less resistant to erosion and form intervening valleys (**Figure 3-2**).

South Claims Area

The north-south trending Limestone Hills ridge marks the approximate hinge (crest) of an anticline (arch-like fold) that developed during an episode of regional folding and faulting (fracturing and displacement of rock). The limestone ridge coincides approximately with the hinge of the anticline, but the faulted blocks are offset by faults, so that the overburden (non-ore material) thickness changes dramatically across these faults. Limestone in the Indian Creek Mine area occurs as a massive bed varying from 110 to 160 feet in thickness, with an average of 120 feet.

During the Cretaceous Period (65 to 145 million years ago), magma forced its way between existing rock layers. During placement of the magma, heated groundwater (hydrothermal fluids) flowed through fractures and along bedding planes. These reactive hydrothermal fluids dissolved magnesium, silica, and manganese from various rocks along the flowpath, then exchanged the elements (impurities) for calcium in the limestone bed. This process formed irregularly shaped bodies of limestone that contain up to 18 percent magnesium oxide (MgO) and often in excess of 1.0 percent silica (SiO_2).

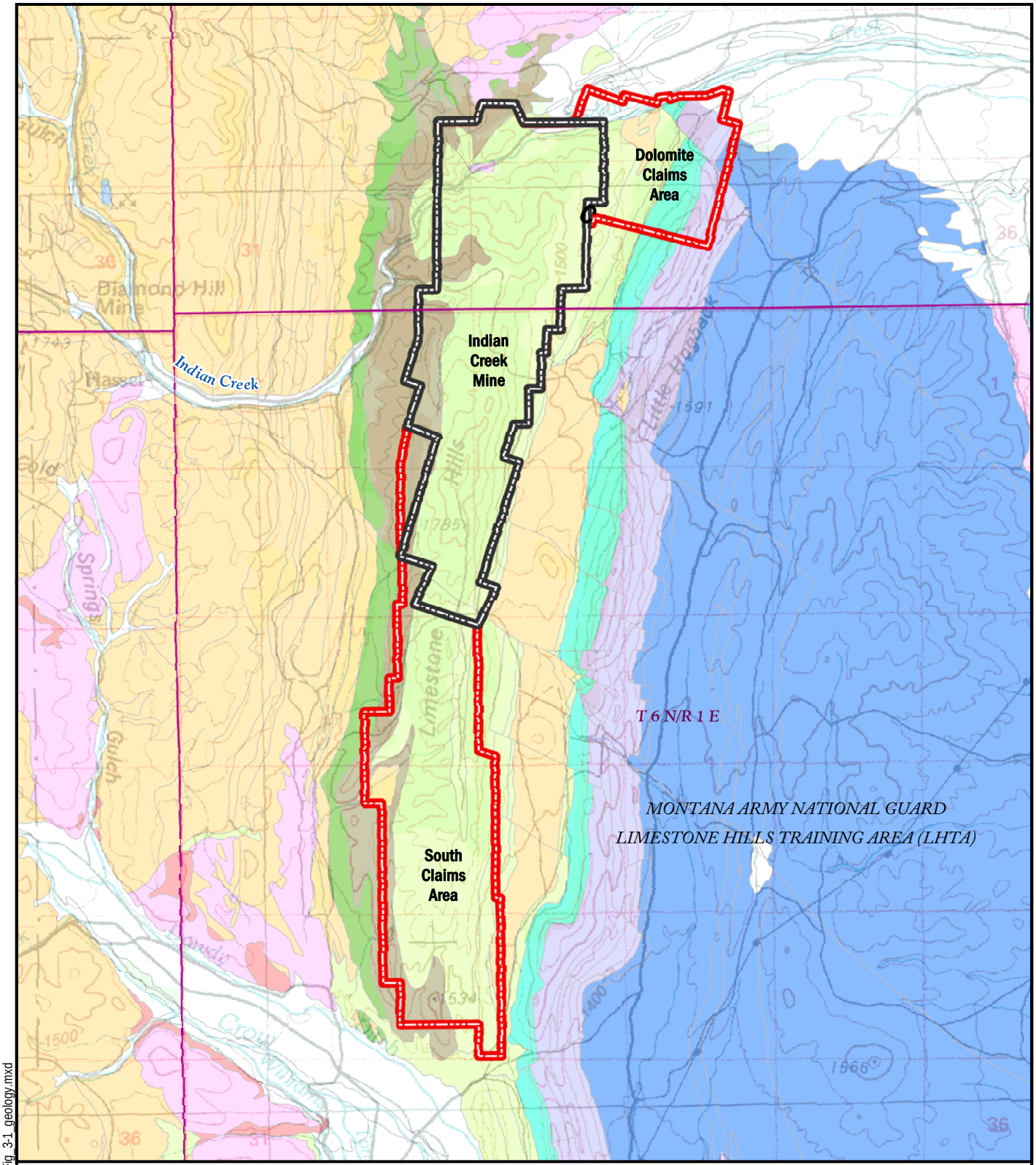
Dolomite Claims Area

The Dolomite Claims Area lies stratigraphically below (consists of rocks much older than those in) the South Claims Area. Two economically favorable dolomite units (Pilgrim and Jefferson) are separated by two other rock formations. Structurally, the dolomite units lie in tilted but not folded layers. Similar to the limestone, tilting of these strata is a result of mountain-building compressional forces. The structure of these units is also complicated by northwest-trending faults. The most favorable dolomite outcrops are located on the crest of the main ridge in the claim block. The Pilgrim dolomite ranges from 350 to 420 feet thick and the Jefferson dolomite is typically 500 feet thick.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Geologic and mineral resources within the South Claims and Dolomite Claims areas would be directly impacted by mining and processing. Approximately 1 million tons of material (waste rock and ore) would be produced annually over the 50-year life-of-mine. Mining in the South Claims Area is expected to produce about 13 million tons of overburden and remove 55 million tons of ore. Up to 50 percent of overburden produced would be



Data Source: USGS 2006, Townsend 30x60 Preliminary Geologic Map.

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Existing Operating Permit Boundary

Proposed Operating Permit Boundary

Geologic Formations

- Cambrian
- Mississippian
- Quaternary
- Devonian
- Ordivician
- PreCambrian
- Jurassic
- Permian
- Cretaceous
- Quaternary Tertiary

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GEOLOGY
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FIGURE 3-2

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used as backfill in mined out portions of mine pits. Amsden Formation overburden encountered during mining operations would be salvaged and used for reclamation. This material has been successfully used in ongoing reclamation activities in the North Claims Area. The remaining overburden would be placed in up to eight disposal areas adjacent to mine pits. The proposed disposal areas would disturb a total of approximately 64 acres. Mine pits in the South Claims Area (**Figure 2-2**) would disturb about 343 acres (see *Proposed Action* in Chapter 2).

The Dolomite Claims Area would be mined from north to south and developed as markets expand. Up to 50 percent of the overburden produced during mining would be used as backfill in previously mined out pits. Approximately 33 acres of overburden disposal would occur outside of pits. Mine pits would disturb approximately 214 acres in the Dolomite Claims area (**Figure 2-3**).

Excavation and removal of limestone would continue within the economic feasibility of the mine expansion project. Although high quality limestone continues at depth below projected pit bottoms, current and projected market values for the products produced by Graymont would not allow recovery of ore below projected pit depths. Backfill of mine pits could preclude future access to limestone ore reserves or result in reserves not being economically recoverable.

Exposure of limestone and dolomite overburden and ore to oxygen and water (precipitation) under the Proposed Action would not result in release of acid or trace elements which could be deleterious to the environment. Laboratory analysis has been performed in accordance with Extraction Procedure Toxicity Test (Federal Register, Vol. 45, No. 98, pp. 33127-33128) on kiln dust to determine leachable concentrations of trace elements. Results showed non-detectable concentrations for arsenic, cadmium, lead, mercury, selenium, and silver. Results for barium and chromium were below the maximum allowable concentration levels (Graymont 2007a). Concentrations of metals in samples of ore and overburden were analyzed in 2005. Results of analysis for 21 trace elements showed non-detectable concentrations or concentrations within typical ranges found in soil (Graymont 2005).

Alternative A – Modified Pit Backfill

Impacts from mining on geology and mineral resources from implementation of Alternative A would be similar to those described for the Proposed Action. Some overburden and reject rock would be relocated from disposal areas for use as backfill at selected sites in mine pits. Backfill of mine pits could preclude future access to limestone ore reserves or result in reserves not being economically recoverable.

No Action Alternative

Approximately 1 million tons of waste rock and ore would be excavated annually over the currently approved 15-year life-of-mine. Mining in the North Claims Area is expected to produce about 8 million tons of overburden and remove 7 million tons of ore from approximately 5,500 linear feet of limestone outcrop. Graymont estimates that based on current operations, up to 50 percent of overburden produced would be used as backfill in mined out portions of mine pits. Remaining overburden would be placed in approved disposal areas adjacent to mine pits. Mine pits in the North Claims Area (**Figure 2-2**) would disturb about 470 acres (see *No Action Alternative* in Chapter 2). Backfill of mine pits could preclude future access to limestone ore reserves or result in reserves not being economically recoverable.

Under the No Action Alternative, potential direct and indirect impacts of the Proposed Action would not occur. This alternative would also eliminate recovery of up to 55 million tons of ore from the geologic resource at the site.

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures for geologic and mineral resources have been identified by BLM or DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 55 million tons of limestone ore would be removed from the geologic resource under the Proposed Action. This action would constitute an irreversible commitment of geologic resources.

Electrical power and fuel (diesel, coal, petroleum coke) would be consumed over the life of the mine to extract ore, process ore, ship products, and reclaim the Project site. Consumption of these energy resources would constitute an irretrievable commitment of resources.

RESIDUAL EFFECTS

No residual effects on physical and biological resources in the proposed mine expansion area are expected to result from excavation, processing, and disposal of ore and overburden associated with the Proposed Action.

WATER QUANTITY AND QUALITY

AFFECTED ENVIRONMENT

The Study Area for water resources (**Figure 3-3**) lies within the Upper Missouri River Basin (hydrologic unit code [HUC] 10030101). Principal surface water bodies within the Study Area are Indian Creek and Crow Creek, both of which are tributary to the Missouri River. The Missouri River is located approximately 4 miles east of the Study Area.

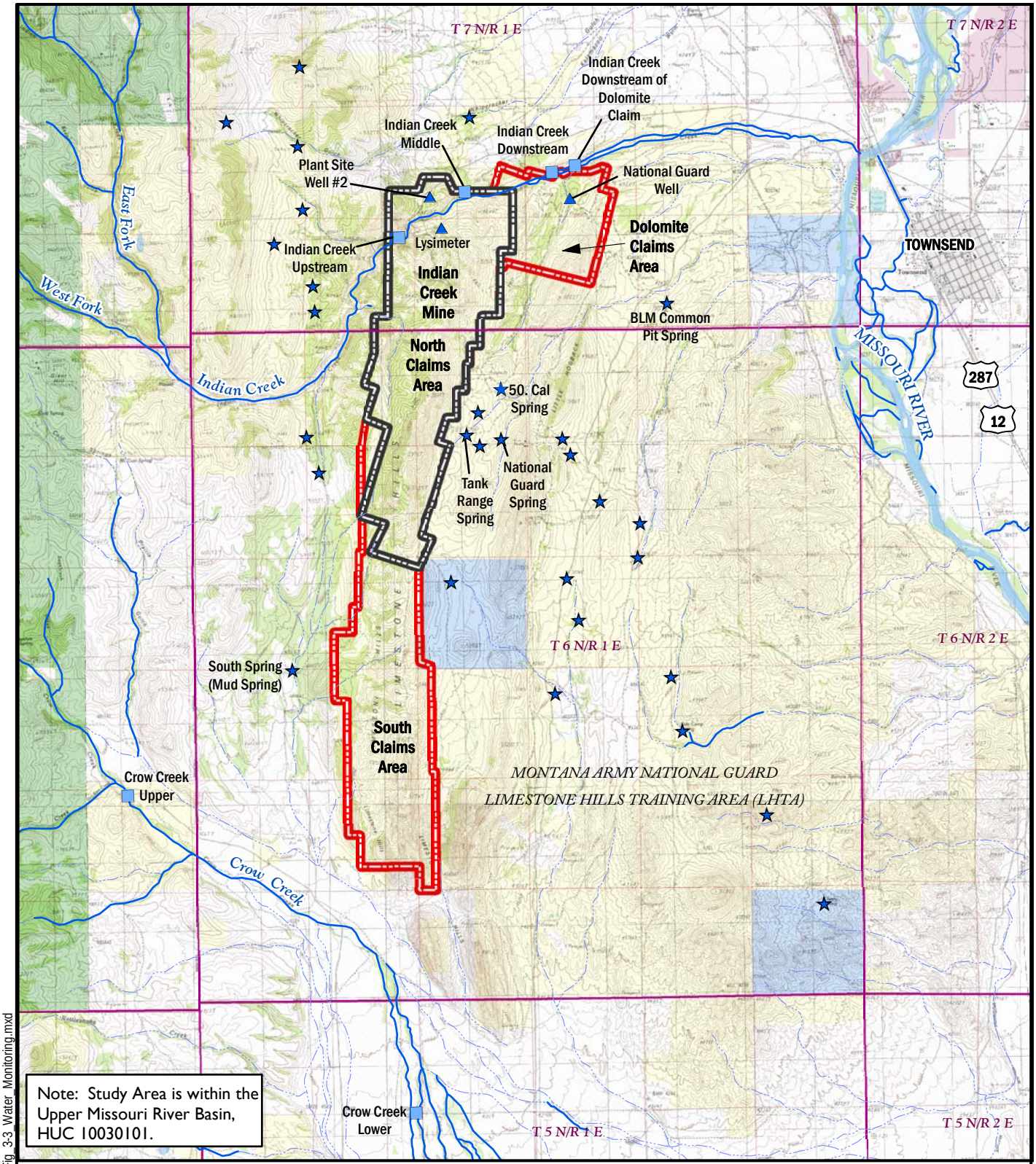
Numerous springs have previously been identified within the Study Area, all of which are outside the proposed mine operating permit boundary. Most springs are seasonal, flowing only during wet periods of the year (**Figure 3-3**).

Thirty-three groundwater wells have been identified within the Study Area. These wells are used for a variety of purposes, including water quality monitoring, domestic water supply, stock watering, industrial use, and irrigation. Static water levels in mine plant site production wells are at levels that are in excess of 100 feet lower than nearby Indian Creek's elevation. Groundwater was not encountered during exploration drilling in the South Claims Area to depths of up to 500 feet below ground surface. Groundwater was not encountered during exploration drilling at depths ranging 135 to 150 feet in the Dolomite Claims Area.

Graymont conducts routine water monitoring of surface water, groundwater, and springs as part of its operational monitoring program. Monitoring sites are shown on **Figure 3-3**, with proposed monitored parameters and frequency summarized in **Table 3-3**.

Surface Water Quantity and Quality

Two perennial streams are located in the Study Area: Indian Creek and Crow Creek (**Figure 3-3**), both of which originate in the Elkhorn Mountains. Tributary channels to these two streams are ephemeral, flowing only during prolonged wet periods, snowmelt, and/or brief heavy rain storms. Indian Creek crosses the northern portion of the current mine operations area, and Crow Creek extends just south of the proposed operation permit boundary.



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HYDROLOGIC FEATURES AND WATER MONITORING SITES
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FIGURE 3-3

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TABLE 3-3
Water Monitoring Sites
Indian Creek Mine

Water Monitoring Site	Frequency	Proposed Parameters								
		TSS/TDS	Nutrients	Metals	Oil & Grease	pH	Water Temp.	Flow	Water Level	Water Vol.
Surface Water Monitoring Sites										
Indian Creek Upstream	Annual	X	X	X	X	X	X	X		
Indian Creek Middle*	Annual	X	X	X	X	X	X	X		
Indian Creek Downstream	Annual	X	X	X	X	X	X	X		
Indian Creek Downstream (d/s) of Dolomite Area	Annual	X	X	X	X	X	X	X		
Crow Creek Upper	Annual	X	X	X	X	X	X	X		
Crow Creek Lower	Annual	X	X	X	X	X	X	X		
Spring Monitoring Sites										
South Spring (Mud Spring)	Annual	X	X	X	X	X	X	X		
Tank Range Spring	Annual	X	X	X	X	X	X	X		
National Guard Spring	Annual	X	X	X	X	X	X	X		
50 Cal Spring	Annual	X	X	X	X	X	X	X		
BLM Common Pit Spring	Annual	X	X	X	X	X	X	X		
Groundwater Monitoring Sites										
National Guard Well	Annual	X	X		X	X	X		X	
Graymont Plant Site Well #2**	Annual		X	X		X		X	X	
Lysimeter	Annual					X				X

Notes:
1. All site locations shown on **Figure 3-3**
2. Annual (once yearly) monitoring typically is performed in May/June.
3. TSS = total suspended solids; TDS = total dissolved solids; temp. = temperature; vol. = volume.
4. Nutrients include: nitrate+nitrite, total Kjeldahl nitrogen (TKN), total nitrogen, and total phosphorus.
5. Metals include dissolved and/or total recoverable aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, copper, chromium, iron, lead, magnesium, manganese, mercury, nickel, selenium, thallium, and/or zinc.

* Staff gage is installed at Indian Creek Middle site.
** Plant Site Well #2 is sampled as part of public water supply requirements.
Source: Resource Management Associates 2006.

Indian Creek, approximately 17 miles long within a watershed area of approximately 13,000 acres, is formed by the confluence of the West Fork, a spring-fed tributary, and the North Fork, which is fed primarily by snowmelt. Although various maps imply that Indian Creek is a perennial stream along its entire length, it is intermittent within the permit boundary (*i.e.*, some reaches periodically become dry). Independent synoptic (comprehensive) flow measurements conducted by the BLM and Graymont in 2006 both indicate that Indian Creek is an influent stream (*i.e.*, loses water to subsurface) (Hydrometrics 2007). Synoptic flow data for Indian Creek measured on October 24, 2006, between the western permit boundary and northeast corner of the permit boundary indicate a decreasing flow from 0.69 cubic feet per second (cfs) upstream, to 0.59 cfs midstream, and to 0.19 cfs downstream near where Indian Creek exits the permit area (Hydrometrics 2007). Indian Creek lies 100 to 200 feet above the bedrock aquifer and may be a perched system with no direct hydraulic connection to the regional groundwater system (Hydrometrics 2006).

Placer mining was conducted along Indian Creek in the 19th Century, resulting in disturbance of the creek bed and riparian (stream bank) areas. In 1999, BLM completed a mine reclamation project on portions of Indian Creek located in Sections 26, 27, and 28; T7N, R1E. Reclamation activities along Indian Creek have included restoring a 2,400-foot-long stream channel, reclaiming adjacent riparian areas affected by placer mining, and removing sediment with elevated metals concentrations from a pond located in the floodplain.

Crow Creek is approximately 15 miles long with a watershed of approximately 50,000 acres. Based on U. S. Geological Survey flow data for Crow Creek near the town of Radersburg, Montana (approximately 3 miles south of Study Area), mean daily flow ranged from about 8 cfs in January to 249 cfs in May for the period of record (1900 to 1990) (USGS 2007). Highest peak flow was 3,640 cfs on May 22, 1981. South of the Study Area, an irrigation network diverts the majority of Crow Creek flow during irrigation season.

Indian Creek is classified "B-1" according to Title 17, Chapter 30, of the Administrative Rules of Montana (ARM). Water classified B-1 is to be maintained suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (ARM 17.30.623).

Indian Creek is listed as impaired under Section 303(d) of the Clean Water Act for both agricultural and drinking water uses due to arsenic, cadmium, lead, and mercury concentrations from historic mining activities (acid mine drainage, mine tailing, and dredge/placer mining) (DEQ 2007b). A summary of 303(d) listing information for Indian Creek for years 1996 and 2006 is presented in **Table 3-4**. For the 2006 303(d) List, 7.9 miles of Indian Creek are designated as impaired, extending from its headwaters to its confluence with the Missouri River.

DEQ collected surface water quality samples from the upper Indian Creek drainage near three abandoned or inactive mine sites upstream from the mine permit boundary along the East Fork (Park Mine) and West Fork (Diamond Hill Mine and St. Louis Mine) of Indian Creek (see **Figure 3-3** for location of East and West Forks of Indian Creek) (DEQ 1997). Arsenic, cadmium, copper, mercury, lead, and zinc concentrations exceeded Montana numeric water quality standards for aquatic life and/or human health in at least one of the surface water samples collected near these mine sites.

TABLE 3-4
Impaired Water Status for Indian and Crow Creeks

Year	Non-Supported Use	Probable Cause	Probable Source	Stream Miles Affected
Indian Creek (confluence of West Fork to mouth at Missouri River)				
1996	Aquatic Life Support; Cold Water Fishery – Trout; Recreation – Swimmable	Flow Alteration; Other Habitat Alterations; Siltation	Agriculture; Mine Tailings; Placer Mining; Resource Extraction; Rangeland	11
2006	Agricultural; Drinking Water	Arsenic Cadmium Lead Mercury	Acid Mine Drainage; Dredge Mining; Impacts from Abandoned Mine Lands (inactive); Mine Tailings	7.9
Crow Creek (from USFS boundary to mouth at Missouri River)				
1996	Aquatic Life Support; Cold Water Fishery – Trout; Recreation – Swimmable	Flow Alteration; Siltation	Agriculture; Irrigated Crop Production; Non-irrigated crop production; Placer Mining	12
2006	Agriculture; Aquatic Life; Cold Water Fishery; Industrial; Primary Contact Recreation	Alteration in Stream-side Vegetative Covers; Low Flow Alterations; Nitrogen (total); Phosphorus (total); Physical Substrate Habitat Alterations; Sedimentation/Siltation	Agriculture; Grazing in Riparian Zones; Habitat Modification – other than Hydromodification; Irrigated Crop Production;	16.2

Source: DEQ 2007b.
Hydromodification is "the alteration of stream flow to serve human objectives that can cause nonpoint source pollution and affect aquatic habitats. Pollutants associated with hydromodification include sediment and temperature; however, nutrients and toxics can also be a factor." DEQ's document – 2004 Annual Report of Montana's Nonpoint Source Management Program (March 31, 2005)

Water quality monitoring of Indian Creek has been conducted by Graymont since 2003 as part of its Operational Monitoring Program and mine expansion permit application (Graymont 2007a). Monitoring is conducted at four stations along Indian Creek: Upstream, Middle, Downstream, and Downstream of the Dolomite Claims Area (**Figure 3-3**). None of the parameter concentrations measured at these sites (**Table 3-5**) has exceeded Montana numeric surface water quality standards (human health and aquatic life). Water quality in Indian Creek is consistent from upstream to downstream locations (**Table 3-5**), indicating that the Graymont Indian Creek Mine is not affecting water quality in Indian Creek. The highest concentrations of most parameters typically occur at the upstream sample site. Specific conductance ranges from 130 to 330 µmhos/cm, and pH ranges 6.0 to 7.7 standard units (Graymont 2007a; Hydrometrics 2006, 2007).

TABLE 3-5
Summary of Indian Creek Water Quality Samples Collected by Graymont Indian Creek Mine

Parameter	Units	Location Along Indian Creek			
		Upstream	Middle	Downstream	Downstream of Dolomite Area
General Parameters					
Total Suspended Solids	mg/L	5 - 37	<0.1 - 4	<0.1 - 9	NM
Specific Conductance	µmhos/cm	132 - 324	129 - 331	152 - 311	308
pH	s.u.	6.36 – 7.51	7.25 - 7.70	6.01 - 7.69	7.68
Temperature	˚C	5.1 - 12.8	4.0 - 9.6	5.3 - 16.8	5.0
Dissolved Oxygen	mg/L	9.49	10.01	9.28	9.31
Flow*	cfs	0.69	0.59	0.19	0.05
Nutrients and Organics					
Nitrate+Nitrite, as N	mg/L	<0.01 - 0.01	<0.01	<0.01	NM
Total Kjeldahl Nitrogen	mg/L	0.2 - 3.2	0.43 - 2.5	0.18 - 2.9	NM
Nitrogen, total	mg/L	0.2 - 3.2	0.43 - 2.5	0.18 - 2.9	NM
Phosphorus, total	mg/L	<0.01 – 0.4	<0.01 – 0.35	<0.01 – 0.32	NM
Oil & Grease	mg/L	<0.1 - 1.7	<1	0.3 – 1.0	NM

Notes:
1. All concentrations in milligrams per liter (mg/L) unless otherwise noted.
2. ND – not detected; NM – not measured; µmhos/cm – micromhos per centimeter; s.u. – standard units; ºC – degrees Celsius; cfs – cubic feet per second; N – nitrogen.
3. See **Figure 3-3** for location of sample sites.

* Flow rate measured on October 24, 2006.
Source: Graymont 2007a; Hydrometrics 2006, 2007.

Crow Creek is classified as a B-1 stream according to Title 17, Chapter 30, ARM. Crow Creek is listed as impaired under Section 303(d) of the Clean Water Act (**Table 3-4**). For the 16.2-mile stream reach from the National Forest boundary to the Missouri River, Crow Creek does not support the following beneficial uses (from 2006 303(d) List; DEQ 2007b): agricultural, aquatic life, cold water fishery, industrial, and primary contact recreation. Probable causes for impairment are alteration in stream-side vegetative cover, low flow alterations, high nitrogen and phosphorus concentrations, stream bed alteration, and sedimentation/siltation due to habitat modification and agricultural practices.

Graymont conducted water quality monitoring at two stations on (Upper and Lower) Crow Creek from 2004 to 2006 (**Figure 3-3**) (Hydrometrics 2007). Concentrations of most parameters are similar between the Upper and Lower stations (**Table 3-6**). Although none of the parameter concentrations exceed Montana numeric surface water quality standards, data from both sample locations indicate elevated concentrations of total nitrogen (up to 4.5 mg/L) and total phosphorus (up to 0.6 mg/L).

TABLE 3-6
Summary of Crow Creek Water Quality Samples Collected by Graymont Indian Creek Mine

Parameter	Units	Upper Crow Creek	Lower Crow Creek
General Parameters			
Total Suspended Solids	mg/L	2 - 4	3 -11
Specific Conductance	µmhos/cm	28 - 89	30 – 91
pH	s.u.	NM	NM
Temperature	˚C	NM	NM
Dissolved Oxygen	mg/L	NM	NM
Nutrients and Organics			
Nitrate+Nitrite, as N	mg/L	<0.01 – 0.12	<0..01 – 0.03
Total Kjeldahl Nitrogen	mg/L	<0.010 – 2.9	0.65 – 4.44
Nitrogen, total	mg/L	0.1 – 2.97	0.65 – 4.47
Phosphorus, total	mg/L	<0.01 – 0.61	0.02 – 0.47
Oil & Grease	mg/L	<1 - 1	<1 – 4
Common Ions			
Calcium	mg/L	4.8 - 15	8.92 – 16
Magnesium	mg/L	<0.001 – 2.66	<0.001 – 3.3
Metals			
Aluminum	mg/L	<0.001 – 0.056	<0.001 – 0.056
Antimony	mg/L	<0.001	<0.001 – 0.001
Arsenic	mg/L	<0.001 – 0.002	<0.001
Barium	mg/L	0.005 – 0.008	0.006 – 0.009
Boron	mg/L	0.013 – 0.156	0.082 – 0.134
Chromium	mg/L	<0.001 – 0.002	<0.001 – 0.001
Iron	mg/L	<0.001 – 0.64	<0.001 – 0.72
Molybdenum	mg/L	<0.001 – 0.004	<0.001 – 0.006
Silicon	mg/L	5.25 – 6.5	5 – 5.6
Strontium	mg/L	<0.01 – 0.181	0.107 – 0.173
Vanadium	mg/L	<0.001	<0.001
Zinc	mg/L	<0.001 – 0.019	<0.001

Notes:

1. All concentrations in milligrams per liter (mg/L) unless otherwise noted.
2. NM – not measured; µmhos/cm – micromhos per centimeter; s.u. – standard units; ºC – degrees Celsius; N – nitrogen.
3. Some concentrations of iron from both sites exceed the human health (HH) standard (i.e., drinking water) of 0.3 mg/L from Circular DEQ-7 (DEQ 2006).
4. See **Figure 3-3** for location of sample sites.

Source: Graymont 2007a; Hydrometrics 2006, 2007.

Springs Water Quantity and Quality

Springs in the Study Area (**Figure 3-3**) were mapped in 1979 and described as generally being associated with either alluvium (stream deposits) or bedrock (Davis *et al.* 1980). The majority of springs issue from thin veneers of alluvial deposits in small stream valleys throughout the Study Area. Due to the limited extent and thicknesses of alluvium in most of these drainage bottoms, these springs typically flow only during the spring and early summer period. Some springs located along the east side of the Study Area issue from faults and fractures in bedrock along the lower east flank of the Limestone Hills. Springs from bedrock sources typically flow year-round because the bedrock has a larger recharge area than the smaller alluvial springs.

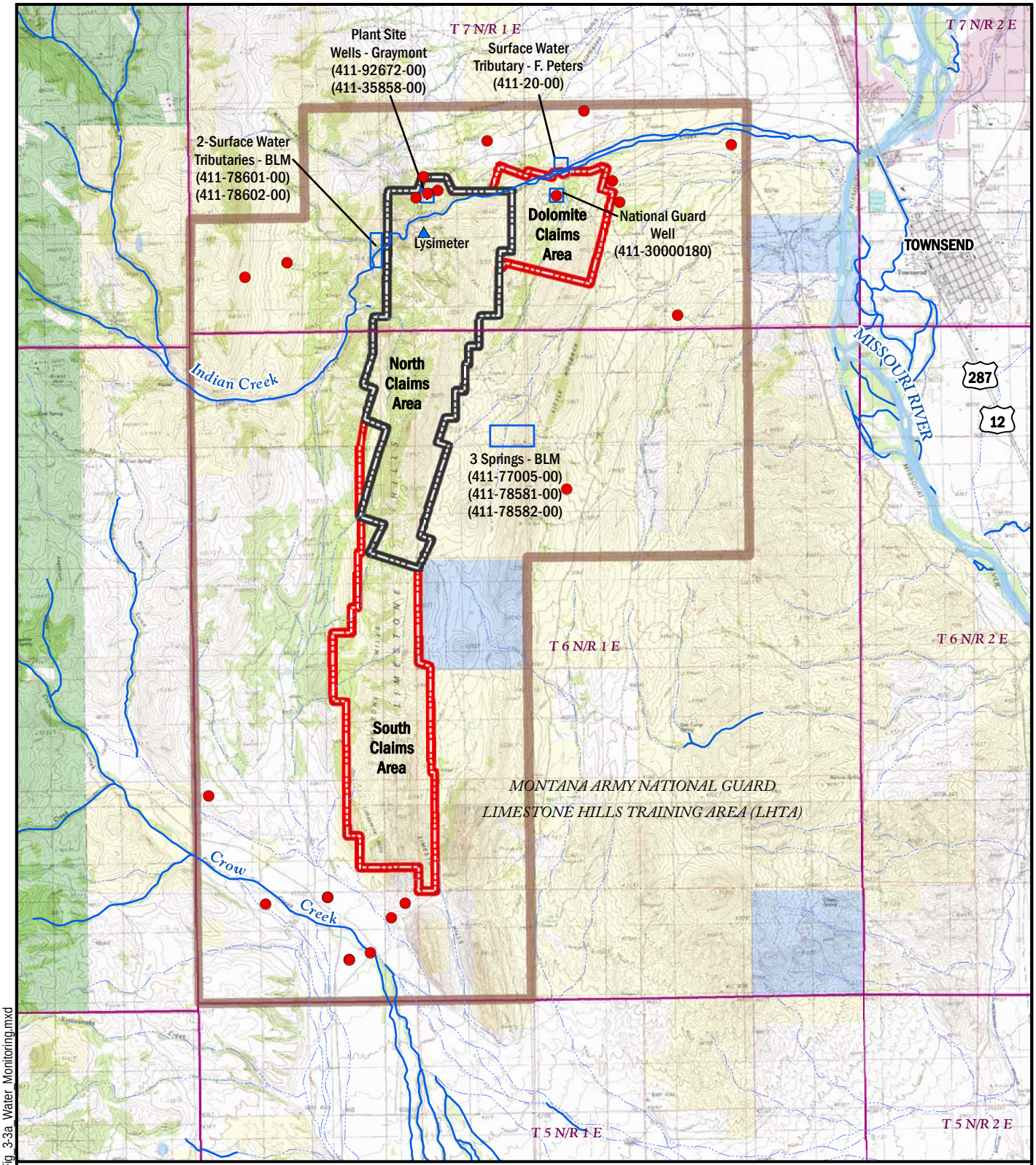
Field investigations conducted by Graymont in 2005-2006 confirmed that most springs identified by Davis *et al.* (1980) are ephemeral, were dry at the time of inspection, and did not appear to have flowed in the recent past. Five year-round or intermittent flowing springs were identified and are monitored in the Study Area: 50 Caliber Spring, National Guard Spring, Tank Range Spring, South Spring (Mud Spring), and BLM Common Pit Spring (**Figure 3-3**) (Hydrometrics 2006, 2007). All but South Spring (Mud Spring) are located along the east flank of the Limestone Hills and appear to be associated with faults in bedrock. Measured flow for these springs ranged from <0.25 gallon per minute (gpm) at 50 Caliber Spring to 0.6 gpm at Tank Range Spring. Available water quality and flow data for the five primary springs within the Study Area are summarized in **Table 3-7**. The springs have low or non-detectable concentrations of nutrients (phosphorus and nitrogen) and metals.

Groundwater Quantity and Quality

Groundwater in the Study Area occurs in Quaternary-age (younger than 1.8 million years) alluvium in stream drainage bottoms, in Tertiary-age (1.8 to 66 million year old) unconsolidated (loose) sediment eroded from the Limestone Hills, and in bedrock aquifers. The Madison Limestone, a regional source of groundwater, is mined at the Graymont facility.

Regional groundwater flow in the Study Area is eastward from the uplands toward the Missouri River (Kendy and Tresch 1996). Smaller-scale groundwater flow systems likely occur and are controlled primarily by local topography and drainage features. As previously discussed, Indian Creek loses some water to the subsurface in the Study Area, indicating localized groundwater flow is not always directed toward streams in the valley bottoms.

Groundwater well information for the Study Area is available from the Montana Bureau of Mines & Geology – Groundwater Information Center (MBMG-GWIC 2007). **Figure 3-4** shows the location of wells in the Study Area. Records indicate that groundwater wells are completed either in unconsolidated deposits or bedrock (limestone or shale). Wells in unconsolidated deposits range in depth from 180 to 300 feet, and the bedrock wells are up to about 600 feet deep. Reported water levels for wells completed in unconsolidated deposits range from 15 to 35 feet, and water levels in bedrock range from 55 to 405 feet below ground surface. Exploration boreholes within the mine operations area and South Claims Area have not encountered groundwater at depths of up to 500 feet below ground surface (Rupke and Knox 2006). Exploration boreholes, completed to depths ranging from 135 to 150 feet in the Dolomite Claims Area, did not encounter groundwater.



Base Data Source: Montana NRIS GIS Data

N

0 Miles 1.5

- Private Well
- Lysimeter
- Water Rights Study Boundary
- Place of Diversion and Water Right Numbers
- Existing Operating Permit Boundary
- Proposed Operating Permit Boundary
- Townships

Land Ownership

- State of Montana
- Bureau of Land Management
- Bureau of Reclamation
- Forest Service

U.S. Department of the Interior
Bureau of Land Management
Butte Field Office
Butte, Montana

WATER RIGHTS AND PRIVATE WELLS
Indian Creek Mine Expansion - Environmental Impact Statement
Broadwater County, Montana

FIGURE
3-4

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TABLE 3-7
Summary of Water Quality and Flow Data for Springs
Indian Creek Mine

Parameter	Units	National Guard Spring	South Spring (Mud Spring)	Tank Range Spring	50 Cal Spring	BLM Common Pit Spring
General Parameters						
SC	µmhos/cm	623 – 746	87* - 594	556 - 630	781	484
pH	s.u.	6.24 – 7.30	NM	7.55	NM	NM
DO	mg/L	4.89	NM	1.83	NM	NM
Temperature	°C	9.1 – 13.6	NM	11.8	NM	NM
TSS	mg/L	<1.0 – 6.0	1.0 – 201*	8.0	6.0	126
Flow	gpm	0.5	NM	0.6	<0.25e	NM or dry
Nutrients and Organics						
NO_3+NO_2	mg/L	<0.01 – 0.05	<0.01	0.17	1.1	0.14
TKN	mg/L	0.32 – 3.0	0.46 – 2.82	1.4	2.6	1.8
Total Nitrogen	mg/L	0.32 – 3.0	0.46 – 2.94	1.6	3.7	1.9
Total Phosphorus	mg/L	0.09 – 27*	<0.01 – 0.21	0.10	0.24	0.34
Oil & Grease	mg/L	<0.1 – 5.2*	<1.0	1.0	<1.0	NM
Common Ions						
Calcium	mg/L	NM	64.4	NM	NM	NM
Magnesium	mg/L	NM	<0.001	NM	NM	NM
Metals (Total)						
Aluminum	mg/L	NM	<0.001	NM	NM	NM
Antimony	mg/L	NM	<0.001	NM	NM	NM
Arsenic	mg/L	NM	<0.001	NM	NM	NM
Barium	mg/L	NM	0.021	NM	NM	NM
Beryllium	mg/L	NM	<0.001	NM	NM	NM
Boron	mg/L	NM	0.348	NM	NM	NM
Cadmium	mg/L	NM	<0.001	NM	NM	NM
Chromium	mg/L	NM	0.013	NM	NM	NM
Cobalt	mg/L	NM	<0.001	NM	NM	NM
Copper	mg/L	NM	<0.001	NM	NM	NM
Iron	mg/L	NM	0.65	NM	NM	NM
Lead	mg/L	NM	<0.001	NM	NM	NM
Manganese	mg/L	NM	<0.001	NM	NM	NM
Molybdenum	mg/L	NM	0.01	NM	NM	NM
Nickel	mg/L	NM	<0.001	NM	NM	NM
Selenium	mg/L	NM	<0.001	NM	NM	NM
Silicon	mg/L	NM	4.78	NM	NM	NM
Silver	mg/L	NM	<0.001	NM	NM	NM
Strontium	mg/L	NM	2.382	NM	NM	NM
Thallium	mg/L	NM	<0.001	NM	NM	NM
Titanium	mg/L	NM	<0.001	NM	NM	NM
Vanadium	mg/L	NM	0.002	NM	NM	NM
Zinc	mg/L	NM	<0.001	NM	NM	NM

Notes:
1. mg/L – milligrams per liter; TSS – total suspended solids; NO_2 – nitrite nitrogen; TKN – total Kjeldahl nitrogen; NO_3 – nitrate nitrogen; DO– dissolved oxygen; SC– specific conductance; e– estimate; gpm– gallons per minute; µmhos/cm – micromhos/centimeter; NM – not measured; °C – degrees Celsius; s.u.– standard units of pH.
2. Concentration of iron (0.65 mg/L) from South Spring exceeds the human health (HH) standard (i.e., drinking water) of 0.3 mg/L from Circular DEQ-7 (DEQ 2006).
3. See **Figure 3-3** for location of springs.
* - data noted by Hydrometrics (2007) as anomalous and not representative of actual water quality, possibly due to laboratory error and/or field meter problems.
Source: Hydrometrics 2007.

TABLE 3-8
Summary of Groundwater Quality Data for Two Wells in Study Area
Indian Creek Mine

Parameter	Units	National Guard Well	Graymont Plant Site Well #2
Sample Period		5/2003 – 6/2006	5/1994 – 5/2006
Number of Samples		4	13**
General Parameters			
SC	µmhos/cm	344 - 448	513
pH	s.u.	6.60 – 7.35	8.08
Temperature	°C	15.4 – 17.0	NM
TSS	mg/L	<1.0 – 1.0	NM
Fluoride	mg/L	NM	0.17
Alkalinity, total	mg/L	NM	144
Hardness, total	mg/L	NM	221
Organics			
Oil & Grease	mg/L	<0.1 – 2.7*	NM
VOC	mg/L	NM	ND
Pesticides	mg/L	NM	ND
Herbicides	mg/L	NM	ND
Nutrients			
NO_3+NO_2	mg/L	0.62 – 0.81	0.38 – 1.92
NO_2	mg/L	NM	<0.01
TKN	mg/L	0.19 – 3.0	NM
Total Nitrogen	mg/L	0.96 – 3.7	NM
Total Phosphorus	mg/L	<0.01 – 0.09	NM
Common Ions			
Calcium	mg/L	NM	64
Magnesium	mg/L	NM	14.8
Sodium	mg/L	NM	14.2
Metals (total)			
Antimony	mg/L	NM	<0.001
Arsenic	mg/L	NM	<0.001 – 0.002
Barium	mg/L	NM	0.047 – 0.053
Beryllium	mg/L	NM	<0.001
Cadmium	mg/L	NM	<0.001
Chromium	mg/L	NM	<0.001
Copper	mg/L	NM	<0.01 – 0.13
Iron	mg/L	NM	<0.01
Lead	mg/L	NM	<0.001 - <0.005
Manganese	mg/L	NM	<0.005
Mercury	mg/L	NM	<0.0002
Nickel	mg/L	NM	<0.01
Selenium	mg/L	NM	0.001 – 0.002
Thallium	mg/L	NM	<0.001

Notes:

1. mg/L – milligrams per liter; TSS – total suspended solids; NO_2 – nitrite nitrogen; NO_3 – nitrate nitrogen; TKN – total Kjeldahl nitrogen; SC – specific conductance; e – estimate; VOC – volatile organic compounds; µmhos/cm – micromhos/centimeter; NM – not measured; °C – degrees Celsius; ND – not detected; s.u. – standard units of pH.

2. None of the reported concentrations exceed human health standards for groundwater from Circular DEQ-7 (DEQ 2006).

3. See **Figure 3-3** for location of wells.

* - data noted by Hydrometrics (2007) as anomalous and not representative of actual water quality, possibly due to laboratory error. ** - Not all parameters were analyzed for each sample event.

Source: Hydrometrics 2007.

Storm Water Management

Graymont manages storm water run-off from its mine area in accordance with a DEQ-approved Storm Water Pollution Prevention Plan (SWPPP). The current version of the SWPPP, which is part of general storm water Montana Pollutant Discharge Elimination System (MPDES) permit no. MTR000090, was updated September 29, 2006 (Graymont 2006). Currently, two storm water outfalls are monitored as part of permit requirements: (1) Outfall 001A – discharge from kiln-site detention pond; and (2) Outfall 003A – discharge from quarry/crusher-site detention pond. Water that discharges from these outfalls would flow into Indian Creek. As part of overall storm water monitoring for the Project site, the Life of Mine Permit (stipulation 105-11-002 in Amendment 011) includes monitoring Indian Creek upgradient and downgradient of the mine site.

Storm water sampling and visual monitoring are performed at specific locations throughout the mine site during and immediately following precipitation events. Results of water samples collected from the upstream and downstream Indian Creek stations are summarized in **Table 3-5**. These data show that the upstream and downstream sites have similar values for many parameters. Temperature generally increases downstream, and TSS and flow decrease downstream.

Water Rights and Water Use

The Upper Missouri River Basin includes all surface water in the Study Area and has been closed to further surface water appropriations and reservations since April 16, 1993. The closure is temporary until final decrees have been issued for all sub-basins within the Upper Missouri River Basin (Montana Department of Natural Resources and Conservation (DNRC 2003). Groundwater appropriations are still allowed, provided that groundwater is not immediately or directly connected to surface water. Individual real property owners are allowed to appropriate up to 35 gpm or 10 acre-feet per year without obtaining a water right permit.

The Natural Resource Information System Water Rights Query System was used to identify existing water rights within the permit boundary, plus a buffer of approximately 1 mile beyond the proposed permit boundary (NRIS 2007). A total of 99 water rights were listed from this query for surface water, developed springs, and groundwater.

Nine water rights were found that, based on information contained in the Water Rights Query System, appear to be located in or near the permit boundary. These water rights are shown on **Figure 3-4**.

- Graymont Western U.S., Inc. holds two Provisional Permits for groundwater withdrawal from water supply wells located on its Indian Creek Mine plant site in Section 28, T7N, R1E.

- The U.S. Department of Military Affairs has a Groundwater Certificate for a water supply well (National Guard Well) in Section 27, T7N, R1E.

- The BLM holds the following water rights for livestock use:
    - One Groundwater Certificate for a developed spring in Section 4, T6N, R1E.
    - Two Claims for springs in an unnamed tributary to Missouri River in Section 4, T6N, R1E.
    - Two Claims for surface water in an unnamed tributary to Missouri River in Section 32, T7N, R1E.

- Franklin Peters has one Claim for surface water (irrigation) in an unnamed tributary in Section 27, T7N, R1E, which lies north of Indian Creek outside the proposed operating permit boundary.

DIRECT AND INDIRECT IMPACTS

Proposed Action

The Proposed Action is an amendment to the existing permit for a life-of-mine expansion which would increase the total permitted area from 1,735 acres to approximately 3,675 acres (an expansion of 1,940 acres). The area permitted to be disturbed would expand from 757 acres to approximately 2,070 acres (an expansion of 1,313 acres), and include 343 acres of mine pit operations in the South Claims Area, and 214 acres of mining in the Dolomite Claims Area. In the Dolomite Claims Area, the anticipated deepest portion of the north mine pit would be at an elevation of approximately 4,070 feet. The deepest portion of the mine pit in the South Claims Area would extend to an elevation of approximately 5,020 feet.

Under the Proposed Action, Graymont would implement water resource protection practices throughout the entire permitted area. Management of water resources would be conducted by Graymont in accordance with its Operating and Reclamation Plan (Graymont 2007a) and in accordance with all applicable state and federal requirements. Water rights and water withdrawals would continue to be managed by DNRC. Storm water run-off would continue to be managed under a storm water permit issued by DEQ.

Water Quantity

Under the Proposed Action, the total area of disturbance would be increased to include new open mine pits, overburden disposal areas, soil stockpiles, haul roads, and a new rock crusher and associated reject pile. Potential impacts could occur to surface water quantity in drainages where excess run-off would leave the permit boundary.

For the Proposed Action, applications for additional storm water discharge outfalls would be submitted for new disturbance areas. Exhibit F (Storm Water Pollution Prevention Plan Map) in the Operating and Reclamation Plan (Graymont 2007a) shows proposed diversion channels, detention basins, and rip-rap rock structures. The majority of these structures would be located along the west and north sides of proposed mine expansion areas. Run-off along the east side of mine expansion areas would report to the mine pits. Best Management Practices would be constructed as needed in disturbed areas to dissipate energy of flowing water and capture suspended sediment. Detention ponds would be designed to contain run-off from a 10-year, 24-hour storm in each affected basin, as specified in the mine Plan of Operations (Graymont 2007a). The extended permit and disturbance boundaries would result in the need for new permitted outfalls under Graymont's Storm Water Permit.

All drainages within the proposed disturbance areas are ephemeral, flowing only in response to storm events and possibly snow-melt. Storm water run-off typically occurs only for a few brief events per year, usually in the spring. The volume of storm water run-off that flows from mine-related disturbance areas usually is contained within the detention ponds with no resultant discharge. From 1996 to 2007, there were only two discharge events from the outfalls (December 1996 and December 1998) (DEQ 2007c). Infrequent discharge of storm water run-off would also occur for the proposed mine expansion area. Any discharge that occurs from mine area outfalls would report to Indian Creek and/or ephemeral drainages that report to Crow Creek. The

impact of mine storm water discharge on either creek would be minor because the volume of discharge is expected to be low compared to stream flow.

No surface water rights are located in the South Claims or Dolomite Claims areas.

The proposed northern-most mine pit in the Dolomite Claims Area would extend to within about 500 feet of Indian Creek (**Figure 2-3**). The mine pit would not intercept any alluvium along the creek. Indian Creek in this reach is intermittent and loses flow to the subsurface and would not be affected by the proposed expansion.

With respect to potential impacts to groundwater quantity, including flow from springs, the proposed expansion in the South Claims Area would have no adverse effect. No groundwater rights are present in the South Claims Area that could be affected by mining. Based on exploratory drilling observations, groundwater has not been encountered within 500 feet of ground surface. It is possible that recharge to groundwater could be increased by capture and infiltration of precipitation into bedrock through the mine pits.

In the Dolomite Claims Area, the northern-most mine pit would eventually extend below the groundwater level. The pit bottom is projected to extend to an ultimate elevation of about 4,070 feet, which is 155 feet below the groundwater level elevation in the nearby National Guard Well (water right no. 411 30000180) of 4,225 feet (Hydrometrics 2007). The pit bottom is projected to be 45 feet below the total depth of this well (elevation 4,115).

The National Guard Well is located approximately 400 feet southwest of the northern-most mine pit and within the proposed permit boundary. The well is used for stock watering during spring, summer, and fall. Pit dewatering may adversely impact the National Guard Well by lowering the groundwater level in the vicinity of the well, possibly to a depth below the current pumping level or below the bottom of the well. If necessary, Graymont would replace the water source under MMRA requirements if it is determined that the mine pit development has affected the water source.

The north mine pit in the Dolomite Claims Area would eventually be backfilled with overburden to an elevation above the groundwater level. The groundwater level would be re-established to pre-mine levels, restoring the water level in the National Guard Well.

The ultimate pit bottom elevation proposed for the southern-most mine pit in the Dolomite Claims Area is 4,265 feet, which is about 40 feet above the water level measured in the National Guard Well. Groundwater would not be encountered, so dewatering would not be required for this pit, and no adverse impact is expected to occur to the National Guard Well.

Impacts to flow from springs in the Dolomite Claims and South Claims areas are not expected to occur due to the Proposed Action because the five permanent or intermittent flowing springs identified in the Study Area (50 Caliber Spring, National Guard Spring, Tank Range Spring, South Spring (Mud Spring), and BLM Common Pit Spring) are located at least 1,000 feet from any proposed disturbance (**Figure 3-3**). All but South Spring (Mud Spring) are located along the east flank of the Limestone Hills and appear to be associated with faults in bedrock. Recharge areas for these springs are likely in the mountains and foothills to the west. As stated above, it is possible that recharge to groundwater could be increased by capture and infiltration of precipitation into bedrock through the mine pits.

Water Quality

The only water quality concern in run-off water from the Project area is suspended sediment. Concentrations of metals in samples of ore and overburden were analyzed in 2005. Results of analysis for 21 trace elements showed non-detectable concentrations or concentrations within typical ranges found in soil (Graymont 2005). Due to the rock being primarily limestone and dolomite, acid mine drainage at this site and associated increased concentrations of metals are not expected.

Best management practices (BMPs) would be used to control and contain run-off water from all mine-related disturbance areas. With the exception of extreme storm events, all run-off water is expected to be retained on-site in the detention ponds. Any discharges from these ponds would flow to Indian Creek and/or Crow Creek under a DEQ-approved Storm Water Permit. Water samples previously collected from two permitted storm water outfalls (001A and 003A) at the Indian Creek Mine show elevated levels of total suspended solids. From 1996 to 2007, only two discharge events occurred (December 1996 and December 1998) with resultant total suspended solids concentrations of 6,000 mg/L and 24,280 mg/L, respectively (DEQ 2007c). Therefore, BMPs would be an important part of mine operations and reclamation in order to reduce potential sediment load to nearby streams if discharge occurs from the outfalls.

Analysis of surface water samples collected in the Study Area show that Indian and Crow creeks contain good quality water downstream from the Indian Creek Mine area. No aquatic life standards are known to have been exceeded in surface water samples collected in the vicinity of the Indian Creek Mine site. Some iron concentrations in Crow Creek (up to 0.72 mg/L) have exceeded the secondary aesthetic standard of 0.3 mg/L (**Table 3-6**). Concentrations of arsenic, cadmium, copper, lead, mercury, and zinc have exceeded aquatic life and/or human health standards in samples from upper Indian Creek drainage in the vicinity of some abandoned or inactive mine sites, including the Park, St. Louis, and Diamond Hill mines (DEQ 1997). Reclamation at the Park Mine was performed by DEQ in 1997 under the Abandoned Mine Reclamation Program.

With the exception of one iron concentration in a South Spring sample, water quality data from springs and wells in the Study Area do not exceed Montana's standards for human health and aquatic life. Specific conductance for these springs is higher (344 to 781 µmhos/cm) than surface water samples (28 to 331 µmhos/cm) in the Study Area.

As stated above, the north mine pit in the Dolomite Claims Area would intercept the water table, but would be backfilled with overburden to an elevation above the water table. Nitrate from ANFO used in blasting could result in increased concentrations in groundwater for a period of time after pit backfill is completed. Groundwater quality would not be adversely affected by backfilling this pit, because it would consist primarily of dolomite and limestone rock, and there is no evidence that metals would be leached from this rock allowing groundwater quality to return to pre-mine levels (Graymont 2005).

Alternative A – Modified Pit Backfill

Impacts on water quantity and quality from implementation of Alternative A would be similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, existing mine operations would continue as currently approved for about 15 years. The proposed

additional disturbance, and associated impacts to water resources, would not occur. Existing uses of proposed expansion areas by livestock would persist, and the effects of this use, including some erosion, increased nutrient loading to streams, and potential increased sedimentation to drainages, would continue.

POTENTIAL MONITORING AND MITIGATION MEASURES

Mitigation would be required for the National Guard Well (water right no. 411-30000180) if groundwater drawdown during development of the Dolomite Claims north mine pit affects this well. Should the National Guard Well be affected by the mine pit development, DEQ would require Graymont to replace this source of water under 82-4-355 MCA.

Wells installed around the north mine pit in the Dolomite Claims Area to draw the groundwater level down below the pit as mining occurs could be used to limit potential contamination of groundwater by nitrates from blasting residue. Groundwater in the overburden placed as backfill in the north mine pit would be monitored for quality.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

There would be no irreversible commitments of water resources. Approximately 5 million gallons per year would be consumed for ore processing, dust suppression and potable water supply. This water use would last 15 years or 50 years depending on the alternative selected. Precipitation not intercepted by mine pits could contribute to intermittent surface water flow in drainages downstream from the Project site during storm events or run-off from snow melt. Precipitation falling into the pits would likely collect in the pits and evaporate and/or infiltrate to the subsurface.

RESIDUAL EFFECTS

No residual effects to water resources would be expected as a result of the Proposed Action and alternatives.

SOIL RESOURCES

AFFECTED ENVIRONMENT

Soil resources within the proposed mine expansion disturbance boundary are shown on **Figure 3-5**. Soil information for most of this area was obtained from site-specific field data collected as part of Graymont's mining operations and includes areas proposed for disturbance.

The Study Area is located on the western slope of the Townsend Basin between the Big Belt and Elkhorn mountains. The terrain consists of steep north-south trending limestone, igneous, argillite, and tertiary sediment ridges and valleys in the Study Area. Alternating beds of limestone, argillite, and intrusive igneous materials have been chemically and physically altered, uplifted, and eroded to create the Limestone Hills geomorphic terrain. Most soil within the Study Area developed from limestone bedrock, calcium and clay-rich sediment, igneous rock, and unconsolidated rock transported downslope by water and gravity. The various soil types developed from the differences in these parent materials.

Soil types in the Study Area have been delineated and described in conjunction with four separate survey efforts. Map units and typical soil properties of Broadwater County were described in a soil survey conducted by NRCS (NRCS 2007). Subsequent surveys were conducted in the Study Area to collect information for use in reclamation planning.

Soil types in the existing permit area, and portions of the proposed North-South Haul Road to the South Claims Area, were delineated and described by ECON, Inc. (1980). Detailed surveys of the South Claims and Dolomite Claims areas were completed in 2004 and 2006, respectively (Resource Management Associates 2006).

The detailed surveys include observation and description of soil and associated vegetation at sites distributed throughout the Study Area. Soil pits were excavated to a depth where the content of materials greater than 0.5 inch in size (coarse fragments) exceeded 40 percent (above which soil is no longer considered suitable for salvage). These observations were used to delineate map units, prepare attendant descriptions and estimate salvage depths in each unit. Although the map units are more precisely delineated, they were not prepared as a refinement of the NRCS survey.

Characteristics of soil types and relative distribution in the Study Area are presented in **Table 3-9**.

Data from the NRCS survey were used to address data gaps for small areas missed during the subsequent surveys. The Pensore, very stony-rock outcrop-Crago, stony complex and Whitecow, stony-Lap, very stony-rock outcrop complex delineated by the NRCS (2007) in these areas are comparable to soil types found elsewhere in the Study Area.

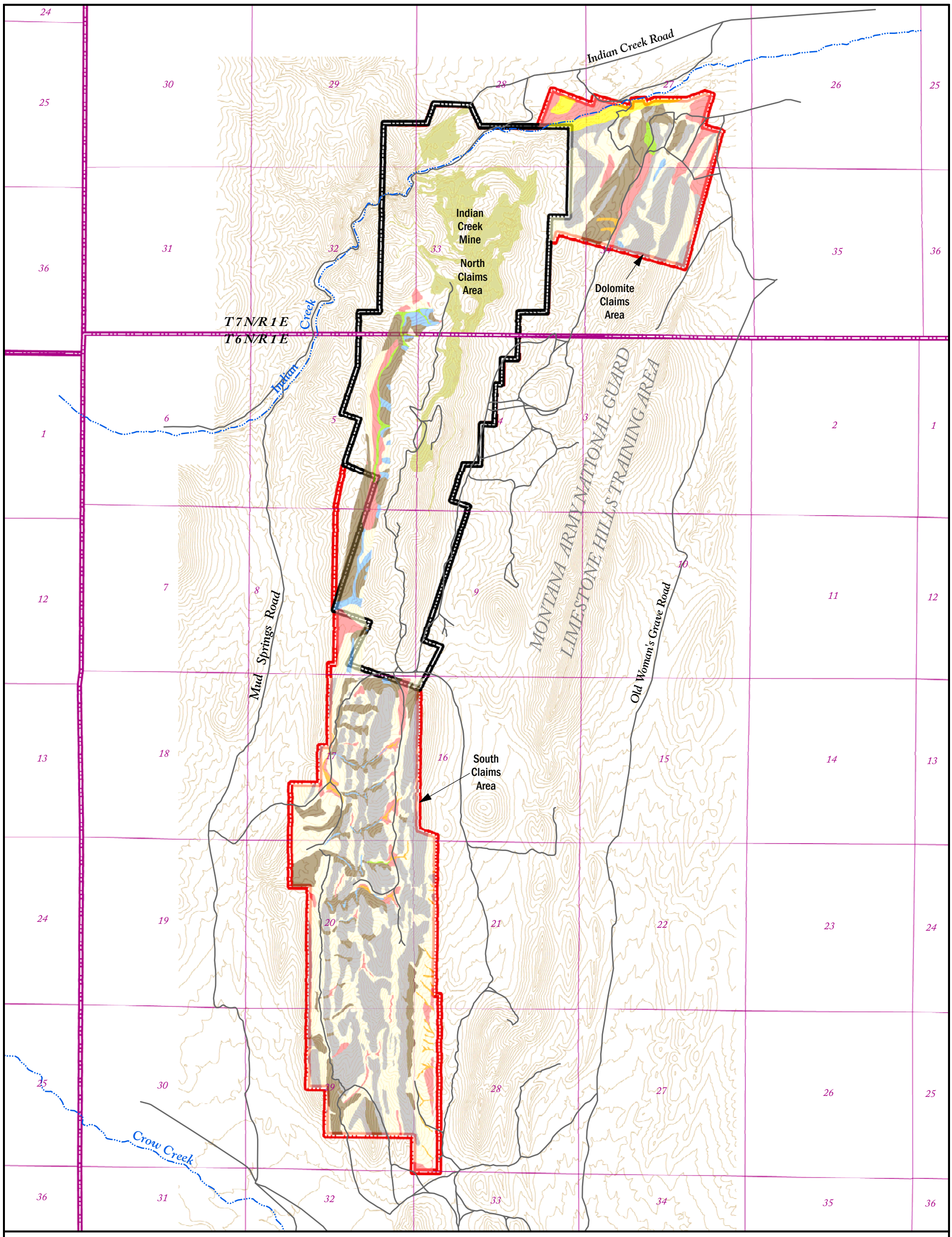
The Study Area is comprised of loamy textured soil with high coarse fragment content and extensive areas of rock outcrop. Limestone parent materials affect nearly all soil in the area with coarse fragment content increasing with depth and bedrock contact commonly occurring at depths less than 20 inches. These characteristics and the prevalent steep slopes yield four dominant ecological sites including: very shallow limy; shallow limy droughty; limy droughty; and loamy droughty steep. No wetlands or hydric soil types occur within the Study Area.

Depth of soil suitable for salvage ranges from zero (rock outcrops) to 84 inches across all units. Coarse fragment content and bedrock contact are the primary factors limiting suitability, although high salt and lime content occur in some areas. The deepest soil occurs in drainage bottoms (alluvium) and toe slopes, with the latter being more prevalent. While the shallowest soil is found in the southern half of the South Claims Area, the average salvage depth across the Dolomite Claims Area as a whole is slightly less than that of the South Claims area as a whole.

The north end of the Study Area lies within the Indian Creek drainage, which was historically placer mined for gold. Placer mining disturbed the original drainage by removing finer particles and leaving river rock (*i.e.*, placer tailing, soil type "T"), which is now present over most of the surface. This area is considered previously disturbed and has no salvageable soil.

Soil Salvage

Potential soil salvage by classification unit for the South Claims and Dolomite Claims areas is shown in **Table 3-10**. Soil salvage is described in Chapter 2 – *Proposed Action.* In areas where no detailed soil data are available, the depth of material available for salvage is represented by a weighted average of the salvage depths from the inventoried area.



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SOIL RESOURCES
Indian Creek Mine Expansion - Environmental Impact Statement
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FIGURE
3-5

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TABLE 3-9
Characteristics of Various Soil Types within Life-of-Mine Disturbance Area
Indian Creek Mine

Unit	Map Unit Name[1]	Dominant Soil Series	Primary Vegetation Physiognomic Types	Portion of Life-of-Mine Expansion (percent)	Topsoil Textures	Subsoil Textures	Depth to Bedrock (inches)	Parent Material[1]	Slope Range[2]
1	Deep Alluvium (Forested)	Whitecow	Conifer Forest, Pine Savannah, Juniper and Low Shrub	1.3	Gravelly Loam	Gravelly Loam to Very Gravelly Loam	100+	Alluvial Deposits	0 to 5+%
2	Moderately Deep Colluvium (Forested)	Windham & Whitecow	Juniper and Pine Savannah	0.8	Loam	Gravelly to Very Gravelly Loam and Sandy Clay Loam	100+	Colluvium influenced by the Amsden Formation	10 to 40+%
3	Shallow Colluvium (Grassy)	Pensore & Lap	Juniper and Pine Savannah and Low Shrub	8.2	Loam and Sandy Loam	Gravelly Loam and Sandy Loam	Approx. 30	Colluvium with some aeolian influences	<5 to 35%
4	Shallow Colluvium (Forested)	Whitecow	Conifer Forest and Pine Savannah	2.8	Gravelly Loam	Gravelly Loam over Very Gravelly or Sandy Loam	Varies from rock outcrop to 75	Colluvium with some rock outcrops	5 to 15%
5	Residuum/Very Shallow (Grassy)	Pensore & Crago	Tall Shrub, Juniper and Pine Savannah, Low Shrub and Grasslands	34.5	Very Gravelly Loam	Very Gravelly Sandy Loam	Approx. 20	Colluvium over fractured limestone residuum	10 to 25+%
6	Residuum/Very Shallow (Forest/Shrub)	Whitecow & Pensore	Pine Savannah, Tall Shrub, Conifer Forest	19.7	Very Gravelly Loam and Sandy Loam	Very Gravelly Loam and Sandy Loam	Approx. 25	Colluvium over slightly weathered limestone	10 to 40%
R	Rock	Rock Outcrop	Tall Shrub & Conifer Forest	30.4	Not Analyzed	Not Analyzed	0	Limestone Residuum.	<10 to 75+%
T	Placer Tailing	Dumps	Juniper and Pine Communities	< 0.01	Not Analyzed	Not Analyzed	Not Analyzed	Mine Tailing and Alluvium	0 to 15+%
--	No Detailed Survey	Pensore, Whitecow, & Lap	Conifer Forest& Juniper & Pine Savannah	2.1	Loam to Very Gravelly Loam	Often Gravelly Loam to Very Gravelly Loam	0 to 100+	Expected to be comparable to adjacent soil types.	0 to 40%

Source: Resource Management Associates 2006; NRCS 2007.
[1] Colluvium – material transported by gravity then weathered to become soil; Alluvium – material transported by water then weathered to become soil; Residuum – material transported by gravity then weathered to become soil. [2] Slopes determined from comparison to USGS topographic quadrangles encompassing the Study Area.

TABLE 3-10
Potential Soil Salvage within Study Area

Unit	Map Unit Name	Average Depth (feet)	Estimated Disturbance (acres)	Potential Soil Salvage (cubic yards)
South Claims Area				
1	Deep Alluvium (Forested)	3.4	12.2	66,866
2	Moderately Deep Colluvium (Forested)	4	7.7	49,497
3	Shallow Colluvium (Grassy)	2.3	76.1	282,270
4	Shallow Colluvium (Forested)	2.4	34.5	133,661
5	Residuum/Very Shallow (Grassy)	1.3	350.1	734,360
6	Residuum/Very Shallow (Forest/Shrub)	1.3	196.2	411,413
R	Rock	none	284.0	--
--	No Soil Data (average depth used)	1.1	7.4	13,133
Subtotal			**968.2**	**1,691,201**
Dolomite Claims Area				
1	Deep Alluvium (Forested)	3.4	5.2	28,469
2	Moderately Deep Colluvium (Forested)	4	3.2	20,393
3	Shallow Colluvium (Grassy)	2.3	31.2	115,847
4	Shallow Colluvium (Forested)	2.4	2.6	9,912
5	Residuum/Very Shallow (Grassy)	1.3	103.3	216,592
6	Residuum/Very Shallow (Forest/Shrub)	1.3	63.0	132,216
R	Rock	0	115.7	--
T	Placer Mine Tailings	0	0.1	--
--	No Soil Data (average depth used)	1	20.5	33,073
Subtotal			**344.7**	**556,502**
TOTAL			**1,312.9**	**2,247,703**

Source: Resource Management Associates 2006.

DIRECT AND INDIRECT IMPACTS

Soil is directly impacted by mine development when salvage operations and other surface disturbances alter the natural horizon development thereby affecting soil conditions existing in the natural setting. Direct impacts that result through mixing and handling of soil resources include soil loss due to erosion and alteration of soil chemical, physical, and biological properties. Effects occur during two separate stages of mining operations: 1) initial disturbance including salvage and stockpiling operations; and 2) in conjunction with replacement and final reclamation activities.

Proposed Action

Direct impacts on soil resources resulting from the Proposed Action would include loss of soil from wind and water erosion, alteration of soil chemical and physical properties, and decreased soil biological activity. Aside from the differences in the area of disturbance and the

amount to be salvaged and ultimately replaced in the reclaimed landscape, the effects to soil in the Dolomite Claims and the South Claims areas are expected to be comparable.

Erosion

Soil erosion occurs as a result of the alteration of soil structure, reduction of binding components such as roots, and the elimination of protective plant cover that result from mining activities. While the greatest potential for erosion occurs immediately following replacement of soil on the graded landscape, soil loss can occur from the time plant cover is first removed and soil is first disturbed. The amount of erosion (soil loss) is often directly related to the surface area of exposure.

Proposed environmental control measures (outlined in Chapter 2 – *Proposed Action*) include several practices that would help reduce erosion. Graymont proposes to limit the acreage of land clearing and soil salvage in advance of mining thereby reducing the amount of soil exposed to erosional forces. Graymont also proposes to conduct concurrent reclamation and promptly plant areas following soil preparation. This action would further limit the amount of soil exposure through reestablishment of perennial plant cover. Proposed Best Management Practices include construction of sediment containment structures and silt fencing that further limit soil movement offsite that may result from disturbed areas. These practices are expected to maintain low levels of soil loss during all phases of mining and reclamation.

Timing of soil removal and placement is another key factor affecting erosion, where risk for erosion is reduced by limiting the period of exposure during salvage and reclamation operations. Prompt removal and stockpiling of soil following clearing of trees and brush reduces the time that soil is exposed to wind and precipitation during the initial phases of mining activity. Prompt establishment of a vegetative cover reduces the period between soil preparation and final seeding and helps limit the period of soil exposure. The reclamation plan and best management practices incorporate strategies for limiting time of exposure (see Chapter 2 – *Proposed Action*).

Actual amount of soil loss from wind and water erosion resulting from the Proposed Action cannot be predicted. Erosion is largely dependent on weather, intensity of rainfall events or wind speed equating to the greatest risk of erosion. Natural characteristics of soil that would be salvaged in the proposed mine expansion area are expected to limit the amount of soil loss, including coarse textures of soil to be disturbed. This characteristic would likely allow for moderate to rapid permeability, reducing the amount of run-off that occurs. In addition, the high coarse fragment content in mixed soil materials placed on the regraded landscape would likely further reduce the potential for sheet (via water) or wind erosion on reclaimed landscapes through natural surface armoring. Grooves created from tracking soil would further reduce run-off, thereby reducing water erosion and improving soil moisture.

Installation of sediment control structures and measures (*e.g.*, run-on control / diversion ditches; run-off control ditches; sediment ponds; silt fences; cover crop on soil stockpiles) would arrest soil movement from the site. Graymont would also maintain these structures and systems and return soil and sediment trapped by these structures to soil stockpiles and/or reclaimed areas.

Physical and Chemical Properties

Mixing topsoil and subsoil during salvage operations would affect the chemical and physical properties of soil. Potential effects to chemical properties include reduced organic

matter content (decreased fertility) relative to pre-mine conditions. Physical effects would include change in soil structure and an increase in coarse fragment content, especially in near-surface soil. Increase in coarse fragment content would decrease effective water holding capacity of some soil, but may decrease erosion potential, improve permeability and reduce potential for compaction.

Organic matter content is expected to be low in weakly developed soil that dominates soil types found in the proposed disturbance area. The ability of these low-nutrient soil types to support shrub and tree communities suggests that these impacts are not necessarily negative. However, reduced fertility may impair the ability of soil to support grass species. The proposed use of high coarse fragment materials in some reclamation types would further reduce the fertility and productivity of surface soil materials in favor of materials more suitable for shrub and tree establishment.

Physical properties would also be affected through mixing of horizons and compaction and changes in soil structure that occur during soil handling operations. Some decrease in permeability and water holding capacity may occur.

Coarse-textured soil types in the proposed disturbance area are not as susceptible to compaction. However, compaction can occur where soil handling and reclamation efforts require numerous equipment passes. Frequent passes combined with change in soil structure during handling can cause compaction in finer-textured soil such as that in the near-surface horizons of the grassy shallow colluvium and residuum soil units. Where it occurs, compaction may retard root growth or reduce infiltration and permeability.

Incorporation of coarse fragments and other coarse-textured materials into surface soil types during handling and replacement in the reclaimed landscape would help reduce these effects. Use of tracked equipment (*e.g.*, dozers) rather than rubber-tired equipment would further reduce potential for compaction. These practices and the resultant conditions would likely minimize the amount of compaction that occurs.

Soil Biological Properties

The most notable effects to biological characteristics of soil are likely to occur during soil stockpiling. Thickness of stockpiled soil effectively reduces the amount of biological activity per unit of volume, where only the near-surface soil in the stockpile would likely maintain plant and microbial populations necessary to sustain biological processes. Long-term storage may further reduce activity as seeds lose viability and buried plants decay.

The Proposed Action includes direct-haul placement of soil where feasible, negating the need to stockpile all soil salvaged. Where stockpiling is required, contemporaneous reclamation limits the amount of time soil is stockpiled. These practices improve the likelihood of maintaining soil biological processes and preserving other natural chemical and physical soil characteristics. These practices also support rapid plant establishment and growth, which encourage reestablishment of interrupted biological processes, including nutrient cycling, in reclaimed soil.

Soil Replacement Thicknesses

Based on findings of the baseline soil survey, adequate suitable soil material is available to meet or exceed the proposed soil cover

replacement thickness ranging from 2 to 9 inches depending on the proposed revegetation plan. The balance suggests that the volume of material would be adequate to replace 12 and 13 inches of soil on areas disturbed in conjunction with the Dolomite Claims and South Claims areas, respectively. While replacement of these thicknesses in the reclaimed landscape may improve establishment and production of select plants, especially grasses, these thicknesses are not necessarily conducive to establishment of trees and shrubs. As previously noted, salvaged materials would be replaced in accordance with the reclamation plan described in the *Proposed Action* section of Chapter 2. Based on the current plan and volume requirements, available soil and growth media materials are adequate to support reclamation activities.

Alternative A – Modified Pit Backfill

Impacts on soil resources from implementation of Alternative A would be similar to those described for the Proposed Action. Some growth media would be used in conjunction with mixed reject rock and overburden used in the various modified pit backfill methods described in Chapter 2.

No Action

Under this alternative, existing mine operations would continue as currently approved and impacts to soil associated with proposed mine expansion would not occur. Graymont has identified soil resources within the existing permitted disturbance area to provide an adequate volume of soil for reclamation. DEQ and BLM have addressed the issue by requiring bonding for 1 percent organic amendments in limestone rejects to produce the growth medium needed. Limestone would provide adequate reclamation material for shallow soil types proposed to replace substrate for the mountain mahogany vegetation type needed for big game winter range (DEQ 2001).

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures have been identified by BLM or DEQ for soil resources.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Many of the potential effects to soil are reversible and retrievable, including soil loss from erosion. Soil washed downslope to containment structures can be retrieved and replaced into soil stockpiles or reclaimed areas, if necessary. However, some soil would be lost during soil handling operations and wind erosion. Potential impacts to chemical and physical soil characteristics would require extended periods of time to recover and are considered irreversible over the life of the Project.

RESIDUAL EFFECTS

Although some soil would be lost due to wind and water erosion as a result of soil handling and stockpiling, residual effects to soil resources are expected to be minimized after implementation of BMPs and other control measures proposed by Graymont.

VEGETATION

AFFECTED ENVIRONMENT

The Study Area for vegetation includes the proposed mine expansion in the South Claims and Dolomite Claims areas.

Vegetation Community Types

A variety of native plant-dominated vegetation community types occur within the Study Area. To simplify discussion and map presentation, vegetation community types were combined into seven physiognomic types as shown on **Figure 3-6** and listed in **Table 3-11**. A cross-reference between community types mapped by Scow (2005) and physiognomic types is also included in **Table 3-11**. Vegetation community types are similar to "habitat types" defined in Pfister *et al.* (1977) and Mueggler and Stewart (1980). Vegetation community type descriptions low shrubs such as black sagebrush. Areas dominated by tall shrubs include the mountain mahogany/Rocky Mountain juniper community type. This is the most common community type within the Study Area, occupying over one-third of the acreage within the site. Mountain mahogany communities typically occur on limestone rock outcrops or shallow soils over rock outcrops. Slope angles vary widely from relatively flat to very steep, and among all aspects depending upon ridge alignment. Common species include mountain mahogany, are based on dominant existing vegetation and depart somewhat from the predicted "climax habitat types." Vegetation community types were used in the baseline vegetation inventories and as the basis for this analysis since they describe current conditions within the Study Area and are more relevant to reclamation standards.

Tall Shrub and Low Shrub

Two general shrub types occur within the Study Area and include community types dominated by tall shrubs, such as mountain mahogany, and Rocky Mountain juniper, black sagebrush, bluebunch wheatgrass, and Indian ricegrass. Mean shrub density within types dominated by mountain mahogany is 3,658 plants per acre of which 80 percent is mountain mahogany, 8 percent is black sagebrush, and 6 percent is shrubby cinquefoil. The remaining woody plant density is comprised of a variety of species, such as winterfat, skunkbush sumac, and slenderbush buckwheat.

TABLE 3-11
Vegetation Community Types within Study Area[1]

Physiognomic Type	Community Type[2]	Acreage
Tall Shrub	Mountain mahogany/Rocky Mountain juniper	768
Juniper Savannah	Rocky Mountain juniper phases (bluebunch wheatgrass, black sagebrush, Idaho fescue)	517
Pine Savannah	Limber pine/Rocky Mountain juniper	421
Low Shrub	Black sagebrush/bluebunch wheatgrass	117
Conifer Forest	Douglas-fir/Rocky Mountain juniper	61
Grassland	Bluebunch wheatgrass/Sandberg bluegrass	29
Disturbance Types	Historical Placer/Dredge Tailing	22
	Grassland Reclamation	5
TOTAL[3]		**1,940**

[1] Portions of the current Study Area occur outside the boundaries mapped by Scow (2005). In these cases, EIS preparers contacted Mr. Scow to determine mapping conventions and methods used in the 2005 report in order to map areas outside the original 2005 report boundary in a consistent manner (Scow 2008.). The community type acreages reported in the Scow report will not match those presented in **Table 3-11**.

[2] Dominant community types within the Study Area. Phases of each dominant type and mapping complexes within each type have been combined for brevity. Specific community type phases and mapping complexes are presented in Scow 2005 and 2006.

[3] Total acreage based on vegetation types within the proposed mine expansion Study Area boundary. The majority of community type acreage was determined from Scow (2005). Areas within the Study Area that are outside the boundary sampled and mapped by Scow (2005) were mapped using the same types and mapping conventions.

Indian Creek Road
Indian Creek Mine
North Claims Area
Dolomite Claims Area
South Claims Area
T7N/R1E
T6N/R1E
Indian Creek
Mud Springs Road
Old Woman's Grave Road
MONTANA ARMY NATIONAL GUARD
LIMESTONE HILLS TRAINING AREA
Crow Creek

Data Source: Westech, 2005/2006.

Vegetation Types

- Streams
- Roads
- Township/Range
- Sections
- Existing Operating Permit Boundary
- Proposed Operating Permit Boundary
- Existing Mine Disturbance
- Tall Shrub
- Juniper Savannah
- Pine Savannah
- Low Shrub
- Conifer Forest
- Grassland
- Disturbance Types

N

0 Feet 4,000

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FIGURE
3-6

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Within the low shrub type, black sagebrush/bluebunch wheatgrass is a relatively common, although not abundant, community type within the Study Area. This type occurs primarily on lower to lower-midslopes of moderate to steep angle and southeasterly to easterly aspect. Predominant range sites are shallow to very shallow soil. Common species within the type include bluebunch wheatgrass, prairie junegrass, fringed sage, black sagebrush, and Rocky Mountain juniper. Big sagebrush occurs in limited areas within the Study Area and was not described as a community type (Scow 2005). Mean shrub density within the black sagebrush type is 8,350 plants per acre of which 80 percent is black sagebrush, 8 percent is mountain mahogany, and 8 percent is yucca. The remaining woody plant density is comprised of a variety of species such as big sagebrush, rubber rabbitbrush, and skunkbush sumac.

Conifer Forest/Juniper Savannah/Pine Savannah

Three forest and savannah community types occur within the Study Area. Community types dominated by Rocky Mountain juniper and the limber pine/Rocky Mountain juniper type represent savannah, open-canopy habitats, while the Douglas-fir/Rocky Mountain juniper type represents a conifer forest, closed-canopy habitat. Sites dominated by Rocky Mountain juniper cover a large portion of the Study Area. Three co-dominant understory species (bluebunch wheatgrass, black sagebrush, and Idaho fescue) define the Rocky Mountain juniper vegetation types within the Study Area. All three types typically occur on shallow to very shallow soil range sites. The bluebunch wheatgrass phase occupies warmer aspects; aspect varies within the Rocky Mountainjuniper/black sagebrush type; while the Idaho fescue phase occupies cooler aspects. Common species within these community types include Rocky Mountain juniper, limber pine, black sagebrush, clubmoss, bluebunch wheatgrass, prairie junegrass, and needle-and-thread grass. Mean shrub density within types dominated by Rocky Mountain juniper is 4,096 plants per acre of which 86 percent is black sagebrush. Mean tree density within these types is 756 plants per acre of which 68 percent is Rocky Mountain juniper, 18 percent is Douglas-fir, and 13 percent is limber pine.

Limber pine/Rocky Mountain juniper is a common type within the Study Area and occurs on moderate to steep angle slopes of various aspects. Common species within the limber pine type include limber pine, Rocky Mountain juniper, black sagebrush, fringed sage, bluebunch wheatgrass, and prairie junegrass. Douglas-fir/Rocky Mountain juniper occurs in relatively limited areas on slopes of various angles, typically with a northerly or northwesterly aspect. Common species within the Douglas-fir type include Douglas-fir, Rocky Mountain juniper, Idaho fescue, and bluebunch wheatgrass. Both limber pine and Douglas-fir types occur on very shallow soil range sites. Mean shrub density within types dominated by limber pine and Douglas-fir is 2,075 plants per acre and 518 plants per acre, respectively. Black sagebrush is the most common shrub species within the limber pine type, accounting for 54 percent of shrub density, while wax currant is the most common shrub within the Douglas-fir type, accounting for 91 percent of shrub density. Mean tree density within these types is 961 plants per acre and 1,728 plants per acre, respectively. Rocky Mountain juniper is the most common tree within both types, accounting for 80 percent of tree density within the limber pine type and 72 percent of tree density within the Douglas-fir type. Limber pine accounts for 18 percent of tree density within the limber pine type, while Douglas-fir accounts for 26 percent of tree density within the Douglas-fir type.

Grassland

The bluebunch wheatgrass/Sandberg bluegrass community type is the only grassland type occurring within the South Claims and Dolomite Claims areas. This limited type occurs on shallow-soil range sites and is dominated by bluebunch wheatgrass, prairie junegrass, and Sandberg bluegrass. Encroachment of shrubs and trees into this grassland type limits its extent. In the absence of fire, much of this community type would likely convert to forest/savannah dominated by Rocky Mountain juniper.

Historical Placer/Dredge Tailing

The historical placer/dredge tailing type includes the riparian or wooded portions of the Indian Creek drainage where historical mining has occurred in the northwestern corner of the Dolomite Claims Area. More introduced plant species are found on these disturbed sites. Vegetation occupies mined terraces and tailing dumps comprised of coarse fragments and rubble piles with limited soil development. Three vegetation subtypes were identified within the mapping unit including forested riparian vegetation dominated by narrowleaf cottonwood; shrub riparian vegetation dominated by Woods' rose and snowberry with a weedy herbaceous understory; and side draws and benches dominated by Rocky Mountain juniper or limber pine. Common species within these subtypes include the trees and shrubs previously mentioned, as well as introduced species such as dandelion, yellow sweetclover, spotted knapweed, and Kentucky bluegrass.

Grassland Reclamation

Portions of the historical placer/dredged tailing along Indian Creek have been recontoured and revegetated with herbaceous species. Dominant species include native thickspike wheatgrass and introduced species such as intermediate wheatgrass and crested wheatgrass. Introduced weedy forbs, such as dandelion, yellow sweetclover, and spotted knapweed, also occur within the reclaimed areas.

Range Condition

Range condition is a rating system developed by the Natural Resources Conservation Service (NRCS) for determining grazing capacity and vegetation status. Baseline studies have used range condition as an indicator of ecological condition. Range condition within the Study Area was calculated according to the NRCS (formerly Soil Conservation Service) Technical Guide for Foothills and Mountains within the 10 to 14-inch precipitation zone of southwestern Montana (SCS 1985).

Most portions of the South Claims Area are too steep and/or rocky for cattle grazing. Limited grazing occurs within the Dolomite Claims Area. Similar to the baseline studies, range condition is used in this EIS as an indicator of ecological condition rather than as an analysis of grazing management or options in the Study Area.

Various species compositions are allowed under the NRCS range condition rating system for different soil types. In general, the greater the amount of native perennial grasses within a soil mapping unit, the higher the range condition scores for the unit. Range condition is rated from early seral to potential natural community and was determined for vegetation community types within the South Claims Area (Scow 2005). Range condition was not determined for the Dolomite Claims Area. Further, range condition rating systems have not been developed by the NRCS for disturbed types (*e.g.* tailing areas or reclamation) nor are range condition ratings relevant to non-grazing areas such as rock outcrops. Consequently, these areas were not evaluated. Range condition for the Study Area is presented in **Table 3-12**.

TABLE 3-12
Range Condition of Vegetation Types within Study Area

Vegetation Type	Predominant Range Site	Average Range Condition	Acreage
Tall Shrub and Low Shrub			
Tall Shrub Mountain mahogany	Very Shallow (10-19 inch p. z.)	Late Seral	768
Low Shrub Black sagebrush	Very Shallow (10-19 inch p. z.)	Late Seral	117
Conifer Forest/Juniper Savannah/Pine Savannah			
Rocky Mountain juniper	Very Shallow (10-19 inch p. z.)	Late Seral	517
Limber pine	Grazeable Woodland Very Shallow (10-19 inch p. z.)	Late Seral	421
Douglas-fir	Grazeable Woodland Very Shallow (10-19 inch p. z.)	Early Seral	61
Grassland			
Bluebunch wheatgrass	Shallow (10-14 inch p. z.)	Mid Seral	29
TOTAL			**1,913**

Note: p.z. = precipitation zone.
Source: Scow 2005 for range condition classification. See **Table 3-11** for an explanation of mapping and acreage sources.

Most of the Study Area is in Late Seral condition, with only limited areas in Early to Mid Seral condition. The one area of Early Seral condition occurs within the Douglas-fir type. This type was ranked in Early Seral condition due to the dense canopy cover within this community type and the limited herbaceous understory (less than 8 percent herbaceous cover) (Scow 2005).

The Montana Natural Heritage Program (MTNHP) lists and tracks plant species of special concern within the state. Two species tracked by the MTNHP, lesser rushy milkvetch and sword townsendia, have been identified within the Study Area (Scow 2005, 2006). One population of lesser rushy milkvetch was located within the South Claims Area at a Rocky Mountain juniper/Idaho fescue sample site. Typical habitat for this species includes open grasslands of Idaho fescue, bluebunch wheatgrass, and rough fescue; and, savannah woodlands of Rocky Mountain juniper, Douglas-fir, and ponderosa pine.

Special Status Plant Species

Lesser rushy milkvetch is a locally rare species that occurs within the Study Area and surrounding local region. Lesser rushy milkvetch is listed "G5S2" by the MTNHP indicating that it is globally secure, but within Montana it is considered at risk due to limited or declining population, range, or habitat (MTNHP 2007). The species is also listed as sensitive by BLM. BLM Sensitive species are known to occur on BLM-administered land for which BLM has the capability to affect the conservation status of the species through management, or known to occur on land affected by BLM-authorized actions.

Three populations of sword townsendia were located on the South Claims Area, while 23 populations were located within the Dolomite Claims Area. All populations occurred on limestone gravels within mountain mahogany communities (Scow 2005, 2006). Sword townsendia is listed "S3" by the MTNHP, indicating that it is potentially at risk because of limited or declining population, range, or habitat both globally and within the state (MTNHP 2007). Sword townsendia has a limited distribution in limestone areas of southwest and south-central Montana and the population in the Limestone Hills may be negatively impacted by the proposed mine expansion. (MTNHP 2008). The species has no federal listing or rank.

Invasive, Non-native Species (Noxious Weeds)

Montana's county noxious weed list determines noxious weeds for the state pursuant to the County Weed Control Act 7-22-2101(5), MCA. Several noxious weed species were located within the Study Area during vegetation surveys including: spotted knapweed, leafy spurge, Dalmatian toadflax, butter-and-eggs or yellow toadflax, Canada thistle, musk thistle, whitetop, and houndstongue (Scow 2005, 2006).

Noxious weeds and invasive, non-native species occur primarily around roads and other disturbances. The majority of the noxious weeds occurring within the Study Area are spotted knapweed and thistle species. Dense patches of spotted knapweed occur in the historical dredge and tailing area along Indian Creek and in shrub and conifer communities near roads. Leafy spurge was recorded at one site in the southwestern corner of the Dolomite Claims Area, while musk thistle was noted at one site within a mountain mahogany stand in the South Claims Area. The remaining weed species typically occur as small, scattered populations on disturbances throughout the Study Area. Field investigators speculated that these small, scattered populations were likely established by animal-transport (Scow 2005).

Wetlands

A wetland and non-wetland jurisdictional Waters of the U.S. survey of the LHTA, including the Study Area for the Proposed Action, was completed in 1998 (Tetra Tech EMI 1998). Areas supporting the three U.S. Army Corps of Engineers wetlands criteria (hydrophytic vegetation, hydric soil, and wetland hydrology) were not recorded within the Study Area, although limited wetlands do exist on the LHTA south of the Study Area. Limited hydrophytic vegetation occurs along the Indian Creek dredge and tailing reclamation area; however, hydric soil is not present (Scow 2007a). Consequently, no jurisdictional wetlands were recorded within the Dolomite Claims Area. A subsequent survey of hydrophytic vegetation did not reveal any wetlands in the South Claims Area (Scow 2005).

Several incised, ephemeral drainages that were considered jurisdictional non-wetland Waters of the U.S. were recorded within the Study Area during the 1998 survey. Wetland delineations are valid for 5 years following submittal (U.S. Army Corps of Engineers Regulatory Guidance Letter 94-01). Consequently, the jurisdictional status of these non-wetland drainages may fall under a recent U.S. Supreme Court ruling. In 2006, the U.S. Supreme Court ruled in "*Rapanos v. U.S.*", that ephemeral drainages are required to exhibit a "significant nexus" (physical, chemical, biological, or hydrological connection) to traditional navigable waters in order to be considered jurisdictional. The U.S. Army Corps of Engineers issued guidance on determining jurisdictional waters of the U.S. in its handbook *U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Handbook* (U.S.

Army Corps of Engineers 2007). The small ephemeral drainages that could be filled as a part of the Proposed Action occur in two areas: 1) unnamed tributaries to Indian Creek, a seasonal tributary to the Missouri River, occur in Section 34 of the Dolomite Claims Area; and 2) unnamed tributaries to Crow Creek, a perennial tributary to the Missouri River, occur in Section 17 of the South Claims Area. Jurisdictional status of these ephemeral drainages would be determined during the U.S. Army Corps of Engineers 404 permit process when Graymont files a pre-construction notification with the Corps of Engineers.

DIRECT AND INDIRECT IMPACTS

Proposed Action

The Proposed Action would result in direct loss of native species-dominated vegetation communities as shown in **Table 3-13.** Acreages include those areas that would be disturbed by mine-related activities within the South Claims and Dolomite Claims areas.

Reclamation procedures, including growth media replacement depths, have been developed by Graymont, BLM, and DEQ and are designed to replace the dominant species removed by mining with the same or similar species. Native grass species are used in reclamation seed mixes, while shrub and tree seedlings grown from seed collected from native plants in the Study Area are planted in the mountain mahogany/juniper and Douglas-fir reclamation types. Recently, Graymont has undertaken experimental seeding of shrubs. During spring 2007, the following species were seeded: black sagebrush (0.5 lb. PLS/acre), yucca (2 lbs PLS/acre), skunkbush sumac (4 lbs PLS/acre), and rubber rabbitbrush (1 lb. PLS/acre). Two additional species, mountain mahogany and golden currant, would be included in the seed mix in 2008.

A listing of grass, forb, shrub, and tree species proposed for use in reclamation is contained in the *Reclamation Plan* section of Chapter 2. Reclamation monitoring of previously disturbed areas at the Indian Creek Mine has shown that native perennial grasses have attained canopy cover levels similar to pre-mine conditions in a period ranging from 10 to 15 years (Scow 2007b).

TABLE 3-13
Disturbance Area per Community Type[1]

Physiognomic Type	Community Type	Acreage
Tall Shrub	Mountain mahogany/Rocky Mountain juniper	451
Juniper Savannah	Rocky Mountain juniper phases (bluebunch wheatgrass, black sagebrush, Idaho fescue)	298
Pine Savannah	Limber pine/Rocky Mountain juniper	295
Low Shrub	Black sagebrush/bluebunch wheatgrass	159
Conifer Forest	Douglas-fir/Rocky Mountain juniper	96
Grassland	Bluebunch wheatgrass/Sandberg bluegrass	12
Disturbance Types	Historical Placer/Dredge Tailing	0.1
	Grassland Reclamation	2
TOTAL		**1,313**

[1] Dominant community types within the Study Area. Phases of each dominant type and mapping complexes within each type have been combined for brevity. Specific community type phases and mapping complexes are presented in Scow (2005, 2006).

Shrub and tree re-establishment is typically one of the most difficult aspects of reclamation in the arid and semi-arid west, and lengthy time horizons (*e.g.*, 10 to 20 years) are frequently required before woody plant density and canopy cover are similar to adjacent or baseline conditions (Roundy *et al.* 1993).

Even though Graymont's proposed reclamation methods include planting up to 400 shrubs and/or trees per acre, woody plant density on reclaimed sites would not be similar to baseline conditions for several decades. The generally shallow slopes and deeper soil proposed would tend to favor other plant species in competition with mountain mahogany. Shrubs and trees have been established on about 60 acres of reclamation, but reproduction from these plants has probably not occurred (Scow 2008). The slow establishment of shrubs (especially mountain mahogany) on reclaimed areas results in long-term impacts to wildlife through slow re-establishment of browse species (see *Terrestrial Wildlife* section in this chapter). No indirect impacts to vegetation communities are anticipated.

Overall range condition within the reclaimed areas would be initially very Early Seral as native species become established. Once native perennial grasses have established to the levels measured in 2003 and 2007, range condition would likely be considered Mid Seral to Late Seral, similar to baseline conditions (Scow 2007b). No indirect impacts to range condition are anticipated except as noted under *Invasive, Non-native Species* (*Noxious Weeds*).

Special Status Plant Species

Nineteen of 23 sword townsendia populations in the Dolomite Claims Area would potentially be removed by mine activities. Forty-three occurrences of the species are documented in Montana (MTNHP 2007). Most populations occur in southwestern Montana in Beaverhead County or in the Beartooth Mountains of Carbon County. Populations within and near the Study Area represent the northernmost known extent of this species in Montana. Removal of these populations would not likely lead to the demise of the species or elimination of the species from the state.

A single population of rushy milkvetch was identified in the Study Area and could be affected by proposed mine expansion. The MTNHP considers the plant globally secure, but at risk within Montana. BLM has the capability to affect the conservation status of the species through management on land affected by BLM-authorized actions.

Invasive, Non-native Species (Noxious Weeds)

Noxious weeds are relatively limited in the Study Area, particularly within the South Claims Area (Scow 2005, 2006). Noxious weeds are more common in areas surrounding the Study Area, but have invaded portions of the current mine operations and are controlled on an annual basis. Control of noxious weeds in the proposed mine expansion areas would continue in accordance with Graymont's Weed Management Plan (Graymont 2007b). After reclamation has been completed and active weed control and management has ended by Graymont, the Project area would be vulnerable to noxious weed invasion from uncontrolled sources located in adjacent areas.

Noxious weed control using chemicals not only kills weeds but can also affect native plants surrounding the weeds. This is an unavoidable impact of a noxious weed control program. As noxious weeds increase over the long-term, more native plant species would be lost. Reclaimed plant communities would be less diverse than pre-mine native plant communities. This would be an unavoidable impact of disturbance and the presence of aggressive introduced species in the area.

Wetlands

Relatively small, ephemeral non-wetland Waters of the U.S. may be disturbed by the Proposed Action. The current jurisdictional status of these drainages is unknown following the 2006 U.S. Supreme Court decision "*Rapanos v. U.S.*" A Section 404 permit may be required to allow fill of these drainages if they are determined to be jurisdictional by subsequent legal proceedings.

Alternative A – Modified Pit Backfill

Impacts on vegetation resources from implementation of Alternative A would be similar to those described for the Proposed Action. Modified pit backfill methods would be used to enhance establishment of mountain mahogany and other browse species on steep slopes to support wildlife.

No Action

Under the No Action Alternative, the proposed mine expansion would not be authorized. Predicted impacts to vegetation in the mine expansion area would not occur. Existing permitted mining operations would continue for approximately 15 years disturbing a total of 757 acres in the North Claims Area. Establishment and reproduction of mountain mahogany would be limited because the shallow slopes and soil thickness in the approved reclamation plan tend to favor other plant species in competition with mountain mahogany.

POTENTIAL MONITORING AND MITIGATION MEASURES

The population of lesser rushy milkvetch could be monitored every 5 years to ensure that weed control activities or mine construction activities have not disturbed the population.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Assuming that reclamation activities result in the ultimate (*i.e.,* within at least 50 years) replacement of vegetation communities with similar structural characteristics to those removed by mining, no irreversible commitments of vegetation structural habitat would occur. As structural characteristics of reclaimed areas develop (*e.g.* bunchgrasses develop mature swards, shrubs develop mature canopies, trees develop longer branches and snags), grass and shrub productivity would eventually lead to a plant community that could provide winter browse for mule deer.

The diversity of native plant species would be reduced relative to the existing undisturbed communities. This impact would be long-term and would be considered irreversible, since reclamation would not reestablish vegetation communities similar in species diversity to those that occurred pre-mining.

Some sword townsendia populations within the Dolomite Claims Area would not be irreversibly lost, since they have been observed colonizing disturbed areas, especially abandoned roads where limestone gravel is present (Westech 1993).

RESIDUAL EFFECTS

Residual effects on vegetation resources would include potential for continued noxious weed invasion from adjacent areas outside the mine site and spread within the Study Area. Loss of diverse native plant communities in reclaimed areas would be an adverse effect.

TERRESTRIAL WILDLIFE

AFFECTED ENVIRONMENT

The Study Area for wildlife lies between Old Woman's Grave Road on the east, Mud Springs Road on the west, Indian Creek to the north, and Crow Creek on the south, and encompasses the Indian Creek Mine as depicted on **Figure 3-1.**

The Study Area is characterized by steep terrain consisting of dry limestone ridges and valleys with dominant plants, including bluebunch wheatgrass and other bunch grasses, black sagebrush, Rocky Mountain juniper, rubber rabbitbrush, curl-leaf mountain mahogany, limber pine, and Douglas-fir.

Current land uses include military training, limestone mining, livestock grazing, and wildlife habitat. The most substantial changes to wildlife habitat in recent years are from mining and wildfire caused by military exercises.

Wildlife Habitats

Wildlife habitats are defined by multiple vegetation community types. Acreages for vegetation community types may differ from wildlife habitats.

Woodland Habitats

Woodland habitats occur on dry rocky slopes and are dominated by limber pine, Rocky Mountain juniper, and Douglas-fir. Woodland habitats comprise a total of about 1,000 acres in the South Claims and Dolomite Claims areas.

Woodlands occupy a transition area between the drier grassland and shrub habitats and the cooler, moister conifer habitats at higher elevations and are important big game winter range and year-round habitat for other species. This habitat can be especially important for wolves and mountain lions, when elk or deer, their primary prey, are present.

Rocky Mountain juniper occurs with Douglas-fir at higher elevations extending into lower riparian areas along Indian Creek, forming nearly pure stands on some sites. Juniper berries are an important food for small mammals and birds, especially waxwings and provide important nesting habitat for a variety of birds including chipping sparrow, robins, song sparrows, and sharp-shinned hawks (Scher 2002).

Limber pine communities grow on some of the driest sites capable of supporting trees, generally on shallow, rocky soil derived from limestone. On the driest sites, bluebunch wheatgrass is a dominant understory species, and Idaho fescue becomes dominant with increasing moisture (Pfister *et al.* 1977). The foliage of limber pine is largely unpalatable as a browse species for wildlife; however, its large high-energy seeds are an important food for birds and small mammals. Clark's nutcracker cache seeds from limber pine, which are often found and eaten by bears.

Woodlands provide habitat for a variety of birds, small mammals, and big game animals including elk, mule deer, bighorn sheep, white-tailed deer, coyote, bobcat, mountain lion, black bear, yellow-pine chipmunk, red squirrel, striped skunk, sharp-shinned hawk, Cooper's hawk, blue grouse, hairy and downy woodpeckers, mourning dove, finches, jays, Clark's nutcracker, nuthatches, mountain bluebird, chickadees, northern flicker, and Townsend's solitaire.

Curl-leaf Mountain Mahogany

Curl-leaf mountain mahogany habitats occupy 768 acres on dry limestone ridges within the South Claims and Dolomite Claims areas.

Mountain mahogany is an evergreen shrub that is an important winter range browse species for mule deer. It is one of the few species that meet the protein requirements for wintering deer and is heavily favored by bighorn sheep in summer. Utilization of mountain mahogany by mule deer in the Study Area exceeds 50 percent (Graymont 2007a). Relatively small populations of Wyoming big sagebrush, rubber and green rabbitbrush, and juniper are present in mountain mahogany habitats. Bluebunch wheatgrass dominates the undergrowth and needle-and-thread is present in varying amounts.

Sagebrush Habitats

Sagebrush habitats occupy 117 acres in the proposed Project area and provide important winter range for antelope, elk, mule deer, and bighorn sheep. Brewer's sparrow, a sensitive species, nests in sagebrush habitats on portions of the Study Area. Other species include coyote, badger, red fox, prairie falcon, western rattlesnake, and ground squirrels.

Sagebrush habitats in the Study Area are dominated by black sagebrush, rubber rabbitbrush, skunkbush sumac, and a diversity of understory species including bluebunch wheatgrass, prairie junegrass, and fringed sage. Black sagebrush and low sagebrush form the driest shrubland types occurring in western Montana (Mueggler and Stewart 1980), usually growing on south and west exposures, on dry, rocky soil. Low sagebrush communities usually do not form extensive landscape-level stands, but are usually part of larger black sagebrush mosaics. Grasses, such as bluebunch wheatgrass, prairie junegrass, and Sandberg bluegrass dominate the undergrowth. Non-native annual grasses, such as cheatgrass and Japanese brome, are also present. Black sagebrush can be an important browse species for mule deer and pronghorn antelope; however, browse utilization studies conducted by Geomatrix (2008) in the vicinity of the proposed mine expansion found little use of this species by ungulates.

Grassland Habitats

Grassland habitats occupy about 29 acres of the South Claims and Dolomite Claims areas on the driest sites. These communities are common on the lower slopes and valley floors. Some of the common grass species are needle-and-thread, western wheatgrass, prairie junegrass, Sandberg bluegrass, bluebunch wheatgrass, and Idaho fescue. Grasslands provide habitat for meadowlarks, prairie falcons, horned larks, mice, voles, and other small mammals. Elk also rely on grasslands for forage throughout the year.

Riparian and Wetland Habitats

Wetland and riparian habitats are present along Indian Creek. These habitats were subject to placer mining in the late 1800s and many of the native species that occurred in these habitats have not re-established. Wetland/riparian areas comprise about 1 percent of the Study Area and provide important watering sites for a variety of birds and wildlife. They are the most productive areas within the watershed and can be critical habitat during specific stages of the lifecycle of wildlife species that rely on them. These areas are also important travel corridors.

Riparian vegetation includes cottonwoods, willows, grasses, and sedges. Wetlands commonly have a diversity of herbaceous vegetation such as sedges, rushes, grasses, and moss. Wildlife species that use wetland and riparian habitats include: white-tailed deer, mink, coyotes, and a variety of small mammals such as skunks, shrews, mice, and voles. Bats are attracted to water in riparian areas and at seeps and springs for feeding and drinking. Wetland/riparian habitats support the highest densities and diversity of breeding birds such as

flycatchers, warblers, and other migratory birds. These sites have been invaded by many introduced species such as spotted knapweed, dandelion, yellow sweetclover, and Kentucky bluegrass.

Wildlife Corridors

Wildlife travel corridors are a vital component of habitat for a variety of species. Corridors are travel routes used by wildlife to allow them to disperse to new core areas and allow for seasonal movements between summer and winter ranges for species such as elk and deer. Corridors are also important for movement of young animals dispersing from their place of birth to establish new territories and home ranges and may also be used for daily movements from loafing to foraging areas.

Specific movement corridors have not been identified in the Study Area, but they likely are present along Indian Creek and to areas that link the higher elevation Elkhorn Mountains with ridges and valleys within and to the east of the Study Area. Mule deer that winter within and east of the mine area likely move seasonally over a broad east-west corridor over the broken topography between the Elkhorn Mountains and Old Woman's Grave Road.

Big Game Animals

Mule Deer

In seasonally harsh environments, like western and central Montana, mule deer tend to migrate between seasonal ranges (Mackie *et al.* 1998). Winter range is associated with areas accumulating minimal snow and tends to occur at low elevation on south and west-facing slopes and wind-blown ridges. Winter range is particularly important for maintaining healthy mule deer populations because the scarcity of high quality forage, cold temperatures, and increased energy demand associated with winter tends to stress populations.

The area west of Old Woman's Grave Road is the most important mule deer winter range associated with the Elkhorn Mountains. In most years, about half of all mule deer counted on winter ranges around the Elkhorn Mountains are observed in the Limestone Hills. When local mule deer numbers are at their peak, over 1,000 mule deer may be present in the Limestone Hills (MTARNG/BLM 2007). Most of this use is associated with limestone hogback ridges and accompanying mountain mahogany/shrub habitats west of Old Woman's Grave Road (Westech 1999). Approximately 2,446 acres of mountain mahogany habitat are located in the Limestone Hills of which approximately 768 acres occur within the South Claims and Dolomite Claims areas.

Mule deer generally browse year-round favoring species such as mountain mahogany, sagebrush, and deciduous shrubs. Forbs and herbaceous plants become an important part of their diet in late spring and summer, while shrubs are critical in fall and winter.

Elk

Elk are generalists exhibiting a wide habitat tolerance and are adapted to habitat transitional areas needing forested habitat for thermal and hiding cover and grasslands and shrublands for favored foraging habitat. Elk migrate seasonally between winter and summer ranges with snow accumulation being the factor influencing migration. Wintering grounds are commonly located within foothill areas with south-southwest exposures and windblown ridges. Grassland and shrubland habitats are typically used as winter range.

The elk population in the Elkhorn Management Unit has been relatively stable since 1992 and typically fluctuates around 2,000 animals (Montana Fish, Wildlife & Parks 2004). Elk are primarily in the Study Area during winter, but a few individuals may be present in all seasons

(MTARNG/BLM 2007). Although large concentrations of elk winter adjacent to the Limestone Hills, few are present in the South Claims and Dolomite Claims portions of the Study Area because grassland–dominated communities and forage are limited. In most winters, 20 to 50 elk are present in the Limestone Hills (Westech 1999).

Bighorn Sheep

Bighorn sheep typically use areas with cliffs, mountain slopes, or rolling foothills. Winter habitat generally occurs on open slopes or ridges where grass is available. Grass and shrubs are common food sources during winter, while grass, sedges, and forbs are heavily used in spring and summer. Winter range is the limiting factor for management of healthy bighorn populations.

Bighorn sheep were transplanted into the Crow Creek drainage during the winter of 1996, 1997, and 2000 and had successfully established ranges in the Crow Creek and Indian Creek drainages (MTARNG/BLM 2007). During winter 2007-2008 bighorn sheep in the area contracted pneumonia resulting in a loss of approximately 95 percent of the herd. A FWP aerial survey in March 2008 revealed 19 bighorn sheep remaining from a population estimated at 220 animals (Carlson 2008).

Some sheep are present in the Study Area year-round. Wintering bighorn sheep may occur anywhere in the area, but are most often associated with limestone ridges and their associated mountain mahogany/shrub habitats (MTARNG/BLM 2007).

An October 1997 Memorandum of Understanding (MOU) between MFWP, BLM, and Continental Lime (now Graymont) addressed specific concerns expressed by the company regarding effects of reintroduction of bighorn sheep in the Indian Creek drainage may have on reclamation, liability issues, and future mine expansions. MFWP agreed to respond to reclamation damage complaints in accordance with Guidelines for Big Game Damage Procedures as defined in 87-1-225, MCA. BLM and MFWP further agreed not to use the presence of bighorn sheep to oppose future expansion of mining activities (MFWP/BLM/Continental Lime 1997).

White-Tailed Deer

Few white-tailed deer are present in the Study Area year-round. White-tailed deer occur throughout Montana and are adapted to a variety of habitats (Foresman 2001). Riparian cover, which is limited in the Study Area, appears to influence the abundance of white-tailed deer (Mackie *et al.* 1998). White-tailed deer prefer grasses and forbs during spring and early summer and then switch to new-growth leaves and twigs of small trees and shrubs.

Pronghorn

A few pronghorn are present in the Study Area from spring to fall (Westech 1999). Pronghorn are found within open sagebrush or grassland areas, which are limited within the Study Area. Sagebrush grasslands located outside of the Study Area are the preferred winter habitat as browse is a critical food source during this period.

Black Bear

Black bears are periodically present in the Study Area, but habitat is limited (MTARNG/BLM 2007). Black bears use a variety of habitats depending on seasonal variation in diet and availability of food. Black bears are omnivorous; however, a major portion of their diet consists of berries, fruits, grasses, sedges, and inner bark. The entire Study Area is black bear habitat; however, they tend to prefer dense forested areas, riparian areas, open slopes, and mountain meadows (Foresman 2001).

Mountain Lion

Mountain lions are present in the Study Area in small numbers usually when their favored prey species (deer, elk, and bighorn sheep) are most abundant on winter ranges. They use a variety of vegetation types, depending on prey availability, cover and preference for areas with minimal human disturbance. Mountain lions typically prefer mountainous and foothill areas.

Birds

The Study Area provides habitat for a variety of raptors (eagles, hawks, falcons, and owls). Species documented in the Study Area include the red-tailed hawk, American kestrel, great horned owl, Cooper's hawk, prairie falcon, and golden eagle (Butts 1993).

Native blue grouse and the non-native gray partridge have been observed but are uncommon in the Study Area (MTARNG/BLM 2007). Most other avian species recorded in the Study Area are common (including the turkey vulture) and typical of grassland, dry shrub, and dry forest habitats (Butts 1993).

Small Mammals

Small mammals present in the Study Area include deer mice, voles, ground and pine squirrels, chipmunks, bats, yellow-bellied marmot, white-tailed jackrabbit, cottontail rabbit, bushy-tailed wood rat, and porcupine.

Reptiles and Amphibians

No amphibians have been recorded in the Study Area, but habitat may be present for the spotted frog and western toad. Reptiles reported for the proposed Project Area are bull snake, common garter snake, western rattlesnake, and western yellow-bellied racer.

Special Status Wildlife Species

BLM special-status species are species proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the Endangered Species Act (ESA); those listed by the state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each State Director as sensitive. BLM sensitive species typically are species that occur on BLM-administered land for which BLM has the capability to affect the conservation status of the species through management. BLM policy is to provide sensitive species with the same level of protection as is provided for candidate species in BLM Manual 6840.06 C; that is, to ensure that actions authorized, funded, or carried out do not contribute to the need for the species to become listed.

The Montana Natural Heritage Program ranks species of conservation concern in Montana. The ranks are determined jointly by biologists from the Program and Montana Fish, Wildlife and Parks. Sensitive species with potential to occur in the vicinity of the Study Area or have suitable habitat are shown in **Table 3-14.**

DIRECT AND INDIRECT IMPACTS

Proposed Action

The Proposed Action would result in direct loss of woodlands, mountain mahogany, sagebrush, and grassland habitats (**Table 3-15**). Loss of these habitats would reduce availability of forage, security, and breeding cover for wildlife inhabiting the area. Individuals of all species dependent on these disturbed sites would be killed or displaced. Displaced animals may be incorporated into adjacent populations, depending on variables such as species behavior, density, and habitat quality. Adjacent populations may experience increased

mortality, decreased reproductive rates, or other compensatory or additive responses as a result of increased interaction with displaced animals.

With mine development, there would be a loss of habitat until reclamation is successful. The capacity of the Study Area to support wildlife would be reduced until suitable habitat (including mountain mahogany, other shrubs, and trees) has re-established. Initially, vegetation on reclaimed areas would likely be dominated by grasses, with low densities of native forbs, shrubs, and trees. Sagebrush and other shrubs, typically, are difficult to re-establish on mined land and areas burned by wildfire (Vicklund *et al.* 2004; Schuman and Booth 1998). Because shrubs are important forage for mule deer, bighorn sheep, and other wildlife species, low rates or slow re-establishment of these plant species on reclaimed sites would reduce the capacity of the Study Area to support species with affinities for shrub habitat (*e.g.*, mule deer, Brewer's sparrow, and bighorn sheep).

TABLE 3-14
Special Status Wildlife Species with Potential to Occur in the Study Area

Common/Scientific Name and State Rank	Habitat/Occurrence in the Proposed Project Area
Threatened and Endangered Species	
Gray wolf (*Canis lupus)* Nonessential Experimental Population (S3)	Wolves have not been documented in the Study Area. As wolves continue to expand in Montana, the Study Area with its high concentration of wintering big game animals may be attractive as a foraging or denning area. The gray wolf was determined to be recovered and de-listed under the Endangered Species Act (ESA). However, U.S. Federal Court issued a preliminary injunction on July 18, 2008 that immediately provided ESA protection to gray wolves in the Northern Rocky Mountains, including Montana.
Sensitive Mammal Species	
Wolverine (*Gulo gulo*) (S3)	Habitat in the Study Area is marginal for wolverines and none have been recorded; however, wolverines may be transient in the Study Area, attracted to winter-killed big game.
Fringed myotis (*Myotis thysanodes*) (S3)	Variety of habitats from low to mid-elevation grass, woodland, and desert regions, up to and including spruce-fir forests. The fringed myotis has not been documented in the Study Area.
Long-eared myotis (*Myotis evotis*) (S3)	Associated with forested stands containing old-growth characteristics, but found in habitats characterized by shrubland and juniper. Long-eared myotis have been documented in the Study Area at Mud Springs (Butts 2005).
Preble's shrew (*Sorex preblei*) (S3)	Sagebrush, grassland, and moist habitats. Preble's shrew has not been documented in the Study Area or surrounding counties.
Townsend's big-eared bat (*Plecotis townsendii*) (S2)	Roosts and hibernates in caves and mines; forages over open areas with wetlands and riparian communities. Species has been documented in the Study Area, but lack of surface water sources may limit its widespread use by bats (Butts 1993). No hibernacula or roosts that support large numbers of bats are known to occur within the Study Area (Butts 2005).
Sensitive Bird Species	
Black-backed woodpecker (*Picoides arcticus*) (S2)	Foraging and nesting habitats in conifer forests that have insect infestations associated with fire and disease. Black-backed woodpeckers are not known to be present in the Study Area and habitat is marginal.
Brewer's sparrow (*Spizella breweri*) (S2)	Shortgrass prairie with scattered or abundant sagebrush, or other arid shrub habitats. These sparrows have not been documented in the Study Area (Butts 1993).
Burrowing owl (*Athene cunicularia*) (S2)	Prairie grasslands and shrublands often in prairie dog or ground squirrel burrows. This species has not been documented in the Study Area and habitat may not be suitable because of the steep, rocky terrain.
Ferruginous hawk (*Buteo regalis*) (S3)	Grassland and shrublands in rolling foothills and middle elevation plateaus. They have not been observed in the Study Area.
Golden eagle (*Aquila chrysaetos*)	Prefers open habitats and nests on cliffs or large trees. Golden eagles have been observed in the Study Area (Butts 1993).

TABLE 3-14
Special Status Wildlife Species with Potential to Occur in the Study Area

Common/Scientific Name and State Rank	Habitat/Occurrence in the Proposed Project Area
Loggerhead shrike (*Lanius ludovicianus*) (S2)	Open shrub and grassland habitats. This species has not been observed in the Study Area.
Mountain plover (*Charadrius montanus*) (S2)	Arid shortgrass prairie, often in association with prairie dog colonies. Mountain plovers have not been documented in the Study Area and habitat is not suitable.
Northern goshawk (*Accipiter gentilis*) (S3)	Nests in mature to old-growth conifer and aspen forest. Goshawks have not been observed in the Study Area and habitat is not suitable for nesting. Goshawks occupying higher conifer habitats in the Elkhorn Mountains might be transient foragers in the Study Area.
Prairie falcon (*Falco mexicanus*)	Nest almost exclusively on cliffs and hunt in grassland and prairie habitats. Prairie falcons breed throughout Montana, which is near the northern edge of their winter range. They have been observed near the Study Area, but nesting has not been documented (Butts 1993).
Peregrine falcon (*Falco peregrinus anatum*) (S2)	Nests on ledges and cliffs, often near water with prevalent prey base (birds). The peregrine falcon has not been documented in the Study Area.
Sage thrasher (*Oreoscoptes montanus*) (S3)	Limited almost entirely to semi-dry regions and communities containing extensive sagebrush. Sage thrashers have not been documented in the Study Area.
Swainson's hawk (*Buteo swainsoni*) (S3)	Nests in trees, often in riparian areas. These hawks have not been observed in the Study Area.
Sensitive Reptiles and Amphibians	
Boreal/Western toad (*Bufo boreas*) (S2)	Uses a variety of habitats including low elevation beaver ponds, reservoirs, streams, marshes, lake shores, potholes, wet meadows, and marshes, to high elevation ponds, fens, and tarns at or near treeline. While still widespread in western Montana, surveys suggest that populations may be declining (Maxell *et al.* 2003). Boreal toads have not been documented in the Study Area.

S2 = At risk because of limited and/or declining numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation within the state.
S3 = Potentially at risk because of limited and/or declining numbers, range, and/or habitat even though it may be abundant in some areas.

TABLE 3-15
Habitats Affected by Proposed Action

Habitat	Acres Affected by Proposed Action
Woodlands	752
Mountain Mahogany	451
Sagebrush	96
Grassland	14
Riparian/wetland	0.1
TOTAL[1]	**1,313**

Reclamation under the Proposed Action would be similar to the No Action alternative (see *Reclamation Plan* section of *Existing Operations* in Chapter 2).The reclamation plan for the proposed Project specifies that revegetation of disturbed areas would include planting seedlings of various species of shrubs and trees at densities ranging from 50 to 400 plants per acre. Approximately 680 acres of habitat would be revegetated with mountain mahogany seedlings at a density of 200 plants per acre, as replacement for mountain mahogany habitat disturbed by mining (Graymont 2007a). In addition to grasses and forbs listed in the *Reclamation Plan* section of Chapter 2, other species of tree and shrub seedlings used in revegetation of disturbed areas would include juniper (100 plants/acre), Douglas-fir (130 plants/acre), yucca (75 plants/acre), and limber pine (25 plants/acre).

Experimental seeding of shrubs was conducted on reclaimed areas during spring 2007. The following species were seeded: black sagebrush (0.5 lb. PLS/acre), yucca (2 lbs PLS/acre), skunkbush sumac (4 lbs PLS/acre), and rubber rabbitbrush (1 lb. PLS/acre). Two additional species, mountain mahogany and golden currant, would be included in the seed mix in 2008.

Reclamation monitoring studies conducted at the Indian Creek Mine show that shrub densities on reclaimed areas ranged from 90 plants per acre in 2002 to 405 plants per acre in 2007 with the most abundant species in 2007 being rubber rabbitbrush (314 plants/acre), mountain mahogany (71 plants/acre), and wax currant (20 plants/acre).

Shrub densities, canopy cover values, and biomass production are lower for reclaimed sites than for shrub communities on sites not affected by mining. The proposed planting density of 50 to 400 plants per acre is less than the woody plant densities in shrub communities on undisturbed sites. The capacity of reclaimed areas to provide forage for mule deer and bighorn sheep would be lower than for undisturbed shrub communities.

Species that would experience impacts from loss of shrub habitats include mule deer, Brewer's sparrow, and bighorn sheep. These species depend on sagebrush, mountain mahogany, and other shrubs for food and cover, especially in winter.

The amount of winter range determines the capacity of habitat to support mule deer. Because winter poses nutritional and thermal stress to animals, it becomes the population limiting factor. Removal of 451 acres of mountain mahogany habitat (18 percent of mountain mahogany in the Limestone Hills) as a result of the Proposed Action would have potential to reduce the capacity of the Study Area and adjacent Elkhorn Mountains to support mule deer. The extent of reduction would depend on availability of winter forage including mountain mahogany and other browse species favored by mule deer (*e.g.*, sagebrush, juniper, winterfat, rabbitbrush, and skunkbush sumac). Loss of 18 percent of mountain mahogany habitat would likely result in reduced carrying capacity of mule deer winter range in the Limestone Hills until reclaimed sites develop vegetation characteristics comparable to pre-mining conditions.

Under the Proposed Action, 1,252 acres of bighorn sheep winter range would be disturbed. Like mule deer, bighorn sheep are dependent on shrubs such as mountain mahogany for winter forage. Reductions in the winter forage base could reduce the capacity of the range to support bighorn sheep, if the range is currently at its maximum carrying capacity. The population goal is 250 animals, indicating that the capacity of the range to support bighorn sheep has not been reached; therefore, implementation of the Proposed Action may not reduce the existing population but it may affect achieving the population goal of 250 animals. During winter 2007-2008 bighorn sheep in the area contracted pneumonia resulting in a loss of approximately 95 percent of the herd. A FWP aerial survey in March 2008 revealed 19 bighorn sheep remaining from a population estimated at 220 animals (Carlson 2008).

Re-establishment of browse species important to mule deer (*e.g.*, mountain mahogany, sagebrush, rubber rabbitbrush, and juniper), on reclaimed land, would restore the capacity of the range to support mule deer and bighorn sheep affected by mining operations. In addition to mountain mahogany, several browse species (e.g., winterfat, skunkbush sumac) would invade the reclaimed mine site, which would increase the carrying capacity of the mule deer winter range. Capacity of the winter range to support

mule deer would therefore increase as browse species become established. Decades could be required to establish shrub cover on reclaimed land with forage values comparable to pre-mining conditions.

During spring and early summer, when newly planted grasses and forbs on reclaimed areas are succulent and rapidly growing, mule deer, bighorn sheep, rabbits, and small mammals would be attracted to reclaimed areas because of the seasonably abundant forage. During late summer, fall, and winter reclaimed areas would become desiccated and provide little forage or cover for most wildlife species until shrubs re-establish. Availability of adequate shrub-dominated habitat in winter is important to survival of mule deer and bighorn sheep.

Mule deer using the Study Area for year-round and wintering habitat would be displaced by proposed mine development. Migration of mule deer through the Study Area likely would be impeded by the mine and ancillary facilities; however, mule deer would not be entirely prevented from migratory movements.

Small mammals, snakes, and insects could be killed by construction activities and vehicle traffic. Small mammals and snakes seek cover underground, and removal of soil and rock could result in direct mortality.

Raptors, coyotes, and other predators could experience a reduced prey base due to a reduction in available habitat until successful reclamation is achieved; however, reclaimed land typically is invaded by small mammals, often within 1 to 2 years following the start of reclamation (Hingten and Clark 1984a, 1984b). Populations of small mammals on reclaimed land could provide a prey base for raptors, even during early stages of reclamation.

Noise levels associated with the Proposed Action would increase in areas that were previously distant from mining activity, displacing some animals an unknown distance from the noise source. Some individuals would likely abandon habitat near high levels of noise and human disturbance; whereas, others would become accustomed to noise and associated human activity and resume their use of otherwise unaffected habitat.

Migratory birds are present in the Study Area and present in areas outside the area in suitable habitat. Proposed expansion of the Indian Creek Mine would affect individuals nesting or foraging in disturbed habitats but would not affect the viability of populations of species not directly affected by areas of disturbance. None of the existing facilities located at the Indian Creek Mine or those proposed would attract migratory birds.

Migratory birds could experience losses of foraging and nesting habitats. If UXO clearance or mine construction were to take place in the nesting and brood-rearing period, young birds could be killed and nests destroyed. Killing or destroying migratory birds would violate the Migratory Bird Treaty Act.

Bats would experience reduced habitat quality through removal of foraging habitat and fractured rock faces for roosting. Bats would experience a loss of roosting habitat (*e.g.*, trees and fractured rock faces) and foraging areas over upland and wetland habitats removed by proposed mine development. Few bats have been recorded in the Study Area, probably because of the limited water sources (Butts 2005).

Alternative A – Modified Pit Backfill

Impacts on terrestrial wildlife from implementation of Alternative A would be similar to those described for the Proposed Action. Configurations of modified pit backfill would establish varied slope angles that create

landscape areas conducive to establishment of a diverse habitat, including mountain mahogany, to support wildlife. Overburden combined with reject rock fragments (sand- to boulder-size) would form a growth medium conducive to planting or seeding mountain mahogany and other browse species preferred by mule deer and bighorn sheep. Browse species for mule deer and bighorn sheep would be enhanced by limited competition from other species on steep slopes having rocky limestone-dominated growth media.

Depending on the specific method employed to treat steep slopes under Alternative A, access to browse species established on steep slopes may not be available for certain wildlife species (*e.g.*, mule deer). Other types of wildlife (*e.g.*, bighorn sheep, deer mice, marmots, chipmunks) would find habitat in steep slope areas similar to the Proposed Action.

Materials placed at angle of repose may continue to move in response to gravity until stable slope configurations are achieved. Plantings and seedings of vegetation on these slopes may not survive because of slope movement until such time as slope stability would allow growth.

No Action Alternative

Under the No Action Alternative, the proposed mine expansion would not be approved and therefore, potential impacts to wildlife resulting from the Proposed Action would not occur. Existing permitted mining operations would continue for approximately 15 years disturbing and reclaiming a total of 757 acres. The potential for successful establishment and reproduction of mountain mahogany would be limited.

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures for terrestrial wildlife have been identified by BLM or DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

No irreversible or irretrievable commitment of wildlife resources would result from the Proposed Action. Reestablishment of mountain mahogany to pre-mine conditions could require decades to achieve. Control of noxious weeds is important to ensure that weeds do not out-compete desired plant communities on reclaimed areas.

RESIDUAL EFFECTS

No residual effects on wildlife resources are expected to result from implementation of the Proposed Action. Reclamation activities would eventually restore areas disturbed by mining and processing operations resulting in reestablishment of wildlife habitat.

LAND USE, ACCESS, AND TRANSPORTATION

AFFECTED ENVIRONMENT

The Study Area for land use and access includes the area lying between Mud Springs Road on the west and Old Woman's Grave Road on the east. The area includes public land administered by BLM, the LHTA used by the MTARNG, and state land as shown on **Figure 3-1**.

Land Use

Limestone Hills Training Area

The Indian Creek Mine and proposed life-of-mine expansion are located within a right-of-way issued by BLM to the MTARNG for the LHTA. The LHTA has been used by the MTARNG from the 1950s to the present. In 1984, BLM granted MTARNG a 30-year "non-exclusive non-possessory right-of-way" to use federal land within the LHTA for constructing and maintaining certain improvements and to conduct military training exercises under specific limited terms and conditions. The right-of-way agreement expires in March 2014. In order to continue use of this area, the U.S. Army on behalf of the MTARNG must apply to withdraw federal land in the LHTA in accordance with the Engle Act of 1958, which requires an Act of Congress for military withdrawals encompassing more than 5,000 acres. The MTARNG began the proposed withdrawal process in 2003.

A Memorandum of Agreement between MTARNG, Graymont, and BLM sets forth the policies and procedures agreed to by MTARNG regarding military training exercises; UXO clearance, exploration, mining, and reclamation activities conducted by Graymont; and administration of public land by BLM to allow joint and compatible use of the LHTA. The LHTA is used for military exercises approximately 140 days per year within a 6.5-month training period beginning mid-April through November each year. The LHTA is not used for military training exercises during the 5.5-month period beginning in December through mid-April. The non-training use period is currently in effect, as requested by FWP, to protect big game on the winter range.

Other Existing Rights-of-Way

The proposed Dolomite Claims Area encompasses a portion of two existing linear rights-of-way (ROW) authorizations. One ROW was issued to the BLM (MTM-19584), as an access road through the area. The other ROW was issued to NorthWestern Energy (MTM-60926), for a powerline buried along existing roads (**Figure 3-1**). The powerline is used to support LHTA range facilities. Except for the above mentioned authorizations in the Dolomite Claims Area, no other ROW or land use permits within the area would be affected by the Proposed Action.

Recreation

Recreation in the Study Area is managed by BLM under the Elkhorn Mountains Travel Management Plan (BLM 1995). The Study Area is designated in the Elkhorn Mountains travel management plan as category "B," defined as an area closed to off-road motorized traffic yearlong, but open to road-use yearlong with periodic designated road closures from April 15 to November 30. Public access to withdrawn land west of Old Woman's Grave Road is allowed with prior permission and a MTARNG-approved escort due to risk of encountering military training activities (**Figure 3-1**).

Livestock Grazing

Grazing by sheep, cattle, and horses has occurred in the Study Area since the late 1800s associated with early mining and settlement. Settlers and ranch families often established a claim for land around a spring where a homestead would be built, and cattle and horses would graze on surrounding unclaimed public domain areas. In 1934, under the *Taylor*

Grazing Act, unclaimed federal land, such as occurs in the Study Area, was put under management of the Department of the Interior. Livestock grazing continues on this federal land under a permit system regulated by BLM.

The current grazing permit system recognizes priority in occupancy and allows grazing permits for specific parcels to remain with individuals and ranches as long as operators meet permit conditions. Most permits are renewable and valid for a period of 10 years. Preference for grazing allotments is given to operators engaged in the livestock business that own or control land suitable as base property. Permits and associated allotment management plans describe allowable livestock class, intensity, duration, timing of grazing, and range improvements that may be installed. Grazing allotments within the Study Area are shown on **Figure 3-7**.

Access

The Indian Creek Mine lies within an area bordered by four public roads: Indian Creek Road on the north, Crow Creek Road on the south, Mud Springs Road on the west, and Old Woman's Grave Road on the east. Public access to the Indian Creek Mine area is restricted for safety and security reasons. Most of the Project area lies within the MTARNG LHTA, which is closed to nonmilitary use at all times west of Old Woman's Grave Road.

Transportation

U.S. Highway 12/287 is an asphalt two-lane highway located about 4 miles east of the Indian Creek Mine. Highway 12/287 provides access to the mine site at the intersection with Indian Creek Road. In addition to Indian Creek Road, Old Woman's Grave Road and Mud Springs Road are Broadwater County improved roads open to year-long motorized travel where not otherwise restricted.

Montana Rail Link, a commercial rail carrier, runs parallel to U.S. Highway 12/287 in a north-south direction. Coal and petroleum coke used at the Indian Creek Mine and lime products produced by Graymont are transported to and from the load-out facility located on a rail siding west of the main rail line north of the Indian Creek Road.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Limestone Hills Training Area

Expansion of mine operations into the South Claims and Dolomite Claims areas could have an impact on the "nonexclusive, nonpossessory" military use of the LHTA. The currently approved Memorandum of Agreement between Graymont, BLM, and MTARNG contains a map showing no conflict between the areas proposed for mining by Graymont and the Surface Danger Zones identified by MTARNG and agreed to by BLM. Subsequent to execution of the Memorandum of Agreement, MTARNG has published other maps indicating that implementation of the Proposed Action would affect live-fire training exercises at five weapon system Surface Danger Zones located within the proposed mine expansion area. Military regulations do not allow MTARNG to conduct live-fire operations when personnel are within the bounds of a Surface Danger Zone for a respective weapon system.

The MTARNG has expressed its view that the proposed mining operations in the South Claims Area would conflict with the MTARNG training program (Putnam 2006), notwithstanding the limited area of Surface Danger Zones as depicted in the currently approved Memorandum of Agreement. Unless the right-of-way is allowed to expire in 2014, the level of impact mining operations in the South Claims Area would have on MTARNG training will

ultimately be resolved by Congress before Graymont's operations reach the South Claims Area.

Most of the South Claims Area has potential to have been contaminated with UXO. The Right-of-Way and Memorandum of Agreement between BLM, Graymont, and MTARNG require MTARNG to remove UXO from the area. The preferred alternative in the Legislative EIS for *Land Withdrawal in the Limestone Hills* (MTARNG/BLM 2007) "….calls for the Army to clear claims of unexploded ordnance within the current mine permit area by 2008." The Army has previously been able to clear about 25 acres per year. However, that rate of clearance has increased with an additional 84 acres released in early 2008. MTARNG currently estimates that UXO clearance in the existing mine permit area (North Claims Area) will be completed by 2010, if funding remains available at current levels. Expansion of mine operations into the South Claims and Dolomite Claims areas would increase the area requiring UXO remediation by about 1,300 acres. At the present time, MTARNG is unable to provide an estimate of the time and effort necessary to provide UXO clearance in these areas.

Livestock Grazing

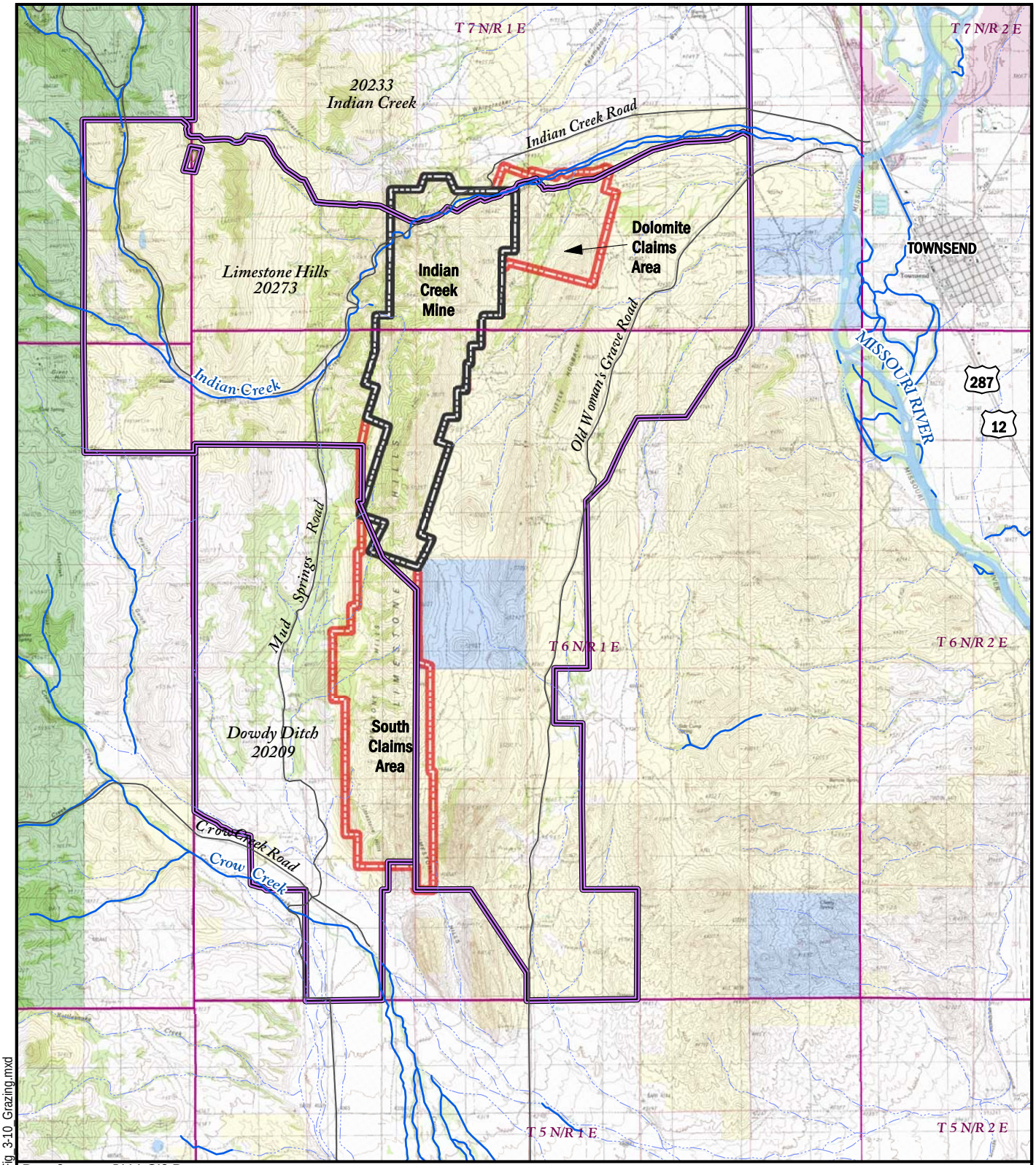
Grazing allotments affected by proposed mine expansion into the South Claims and Dolomite Claims areas are listed in **Table 3-16**. According to the BLM MRB Survey and Allotment Tabulation Record, mine expansion would result in loss of carrying capacity on 524 acres of the Limestone Hills Grazing Allotment, 775 acres of the Dowdy Ditch Allotment, and about 11 acres in the Indian Creek Allotment. These records are available at the BLM Butte Field Office.

Grazing on mine-related disturbance areas would be lost until revegetation and forage production are comparable to adjacent land. Steep slopes, lack of water, and sparse vegetation have limited livestock grazing in the proposed mine expansion areas. Revegetation of disturbed areas with reduced slopes may attract some livestock to the area for brief periods, but lack of water generally inhibits livestock from wandering too far from water sources. If necessary, temporary fences would be installed to prevent grazing on newly seeded areas. Temporary fencing may also be installed in the Dolomite Claims Area near the National Guard Well to preclude cattle from wandering into active mine areas. If mine dewatering activities affect the National Guard Well, Graymont would make arrangements to provide water for livestock.

TABLE 3-16
Grazing Allotment Summary

Allotment	Number of Livestock	Grazing Season	Total AUMs	Total Acreage	Area Affected by Mine Disturbance	
					South Claims Area	Dolomite Claims Area
Dowdy Ditch North & South No. 20209	20 cattle	May 1 – June 15	30	5,078	772	0
Limestone Hills No. 20273	494 cattle	May 15 – Sept. 30	1,870	14,085	42	314
Indian Creek No. 20233	212 cattle	May 15 – Oct. 15	344	9,761	0	11

Source: BLM 2007.
Note: AUM – animal unit month (approximately 780 pounds of forage (dry weight).



Data Source: BLM GIS Data

N

0 Miles 1.5

Grazing Allotments
Townships
Existing Operating Permit Boundary
Proposed Operating Permit Boundary

Land Ownership
State of Montana
Bureau of Land Management
Bureau of Reclamation
Forest Service

U.S. Department of the Interior
Bureau of Land Management
Butte Field Office
Butte, Montana

GRAZING ALLOTMENTS
Indian Creek Mine Expansion - Environmental Impact Statement
Broadwater County, Montana

FIGURE
3-7

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Recreation

The South Claims and Dolomite Claims areas lie within a portion of the LHTA closed to public access without an escort approved by the MTARNG (**Figure 3-1**). Recreational use and public access in this area are restricted for safety and security reasons. Continued closure of the South Claims and Dolomite Claims areas would have no affect on recreation as areas with unrestricted access adjacent to the area remain available for dispersed recreational use.

Access

Access into active mine areas is restricted for safety and security purposes. The South Claims and Dolomite Claims areas lie within a portion of the LHTA closed to public access without an escort approved by the MTARNG.

Transportation

Implementation of the Proposed Action would have no effect on transportation in the Study Area. Mine related traffic on Indian Creek Road would likely remain at current levels throughout the life-of-mine.

Alternative A – Modified Pit Backfill

Impacts on land use, access, and transportation from implementation of Alternative A would be similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, expansion of the Indian Creek Mine into the South Claims and Dolomite Claims areas would not be authorized. Potential effects to land use, access, and transportation associated with the Proposed Action would not occur.

Existing permitted mining operations would continue for approximately 15 years. UXO clearance would continue and is estimated to be completed in the North Claims Area by 2010. Carrying capacities on grazing allotments would likely remain at current levels. The current mine permit area lies within a portion of the LHTA closed to public access without an escort approved by the MTARNG. Recreational use and public access would remain restricted for safety and security reasons.

POTENTIAL MONITORING AND MITIGATION MEASURES

No potential monitoring or mitigation measures for land use, access, and transportation have been identified by BLM or DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Grazing on mine-related disturbance areas would be lost until revegetation and forage production are comparable to pre-mining levels associated with adjacent land. No irreversible or irretrievable impacts to recreation, access, or transportation are expected as a result of the Proposed Action.

RESIDUAL EFFECTS

No residual effects to land use, access, and transportation would result from implementation of the Proposed Action. With the exception of mine pits and rock faces, reclamation of disturbed areas would restore grazing on areas previously supporting livestock.

NOISE

AFFECTED ENVIRONMENT

Noise is generally defined as unwanted sound and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels heard by humans and animals are dependent on several variables, including distance between the source and receiver, altitude, temperature, humidity, wind speed, terrain, and vegetation. Human and animal perception of noise is affected by intensity, frequency, pitch, and duration, as well as the auditory system and physiology of the animal. Noise can influence humans or wildlife by interfering with normal activities or diminishing the quality of the environment. Response to noise is subjective, and therefore, the perception of noise can vary from person to person or among animals.

Noise levels are quantified using units of decibels (dB). Humans typically have reduced hearing sensitivity at low frequencies compared with their response at high frequencies. The "A-weighting" of noise levels, or A-weighted decibels (dBA), closely correlates to the frequency response of normal human hearing (250 to 4,000 hertz). By using A-weighted noise levels in an environmental study, a person's response to noise can typically be assessed. Because decibels are logarithmic values, the combined noise level of two 50 dBA noise sources would be 53 dBA, not 100 dBA.

Different A-weighted metrics can be used to describe and quantify noise levels. The equivalent noise level, L_{eq}, during a certain time period uses a single number to describe the constantly fluctuating instantaneous ambient noise levels at a receptor location during a period of time, and accounts for all noises and quiet periods that occur during that time period.

The day-night average noise level, L_{dn}, is a single number descriptor that represents the constantly varying sound level during a continuous 24-hour period. The L_{dn} can be determined using 24 consecutive one–hour L_{eq} noise levels, or estimated using measured L_{eq} noise levels during shorter time periods. The L_{dn} includes a 10 decibel penalty that is added to noises that occur during the nighttime hours between 10:00 p.m. and 7:00 a.m., to account for people's higher sensitivity to noise at night when the background noise level is typically low. Because it represents the average noise level during a 24-hour period, the L_{dn} is not effective for describing individual noise events, such as a single blast.

The 90th percentile-exceeded noise level, L_{90}, is a metric that indicates the single noise level that is exceeded during 90 percent of a measurement period, although the actual instantaneous noise levels fluctuate continuously. The L_{90} noise level is typically considered the ambient noise level and is often near the low end of the instantaneous noise levels during a measurement period. It does not typically include the influence of discrete noises of short duration, such as car doors closing, bird chirps, dog barks, or car horns. If a continuously operating piece of equipment is audible at a measurement location, typically it is the noise created by the equipment that determines the L_{90} of a measurement period even though other noise sources may be briefly audible and occasionally louder than the equipment during the same measurement period.

Comparing the L_{eq} noise levels of a noise source to L_{90} (ambient) noise levels at a listener location helps approximate whether a noise source would be audible. In general, if the L_{eq} value is less than the L_{90}, then the noise would rarely be heard, if at all. If the L_{eq} is up to 10 dBA higher than the L_{90}, then the noise would

be audible sometimes, and if the L_{eq} is more than 10 dBA higher than the L_{90}, then the noise would be heard often (Menge 2005).

Large amplitude impulsive sounds, such as blasting and large caliber weapons noise (larger than 20 millimeter [mm]) are commonly defined using the un-weighted instantaneous peak noise level, L_{pk}. L_{pk} represents the highest instantaneous noise level during a certain time period, and the units of L_{pk} are unweighted peak decibels (dBP).

Noise Guidelines

No state or county regulations exist to govern environmental noise. Federal noise guidelines apply to noise that would be generated by the Proposed Action under the Noise Control Act of 1972. Under this act, EPA developed acceptable noise levels under various conditions that would protect public health and welfare with an adequate margin of safety. The EPA identified outdoor L_{dn} noise levels less than or equal to 55 dBA are sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use (EPA 1979). Although the EPA guideline is not an enforceable regulation, it is a commonly accepted target noise level for environmental noise studies.

The Montana Department of Transportation (MDT) determines traffic noise impacts based on the noise levels generated by peak-hour traffic. The MDT criteria state that traffic noise impacts occur if predicted 1-hour $L_{eq}(h)$ traffic noise levels are 66 dBA or greater at a residential property during the peak traffic hour (MDT 2001).

No regulations exist to limit the blasting noise produced by the Proposed Action, but the U.S. Army has determined an approximate level associated with human annoyance to blast noise. In general, L_{pk} 115 dBP at a listener location represents the threshold of annoyance for people, and below this level, there is a low risk of noise complaints (USACHPPM 2005).

Existing Noise Sources

The ambient noise at a receptor location in a given environment is the all-encompassing sound associated with that environment and is due to the combination of noise sources from many directions, near and far, including the noise source of interest. In an outdoor environment, noise levels decrease as the distance increases between the source and receptor. Noise levels typically decrease by approximately 6 dBA each time the distance between the source and receptor is doubled, depending on the characteristics of the source and the conditions over the path the noise travels. The reduction in noise levels can be increased if a solid barrier, such as a man-made wall, a building, or natural topography, is located between the source and receptor.

The Indian Creek Mine is located in a rugged rural area, approximately 4 miles west of Townsend off of Indian Creek Road. The mine has been operating since 1981. The mine uses standard open pit and quarry mining practices. Noise sources associated with the limestone quarry and processing plant include drilling, blasting, loading, hauling, and ore processing. Noise is primarily generated by heavy equipment (*i.e.*, haul trucks, front end loaders, rotary drills, bulldozers, or graders) in the quarry, and ore processing equipment at the plant site (*i.e.*, conveyors, crushers, a kiln, or process fans) (Graymont 2007a).

Blasting at the mine occurs 1 day per week at 4:00 p.m. Although a total of approximately 9,400 pounds of ANFO explosive is used for each blast, the total blast uses smaller sequenced charges of 125 pounds per delay placed in 24-foot-deep holes (Graymont 2007c).

Graymont's rail terminal and loadout facility are located at the intersection of Indian Creek Road and U.S. Highway 287. Noise sources at these facilities include haul truck engines and dumping when filling rail cars (Graymont 2007a).

Other noise sources in the mine area include intermittent impulsive noise from weapons and explosives used at the LHTA, the railroad, wind-generated noise through grass and trees, flowing water near Indian Creek, wildlife, aircraft flying overhead, and vehicles traveling on roads (BSA 2007).

The Study Area is located within the LHTA used by the MTARNG for weapons training. Weapons and equipment used at the LHTA include 60 mm and 81 mm mortars, 120 mm tanks (M1A1 Abrams Battle Tank and M2A2 Bradley Fighting Vehicle), and smaller weapons such as rifles and machine guns. Operational data for LHTA indicate that training using small and large weapons occurs during the daytime and nighttime hours from April through November (USACHPPM 2003).

The Proposed Action boundary is within the LHTA, providing a buffer for mine-related noise. Residences are located within 1 to 3 miles of the Study Area: one residence located approximately 1.1 miles west of the existing plant site on Indian Creek Road, several existing residences and a new subdivision located approximately 2.8 miles east of the existing plant off Desert Road, and five residences located off of Crow Creek Road between the south boundary of the Southern Claims Area and Toma Road (**Figure 3-8**). Residents and mine workers, as well as wildlife that live, forage, and pass through the mine area, are the primary noise-sensitive receptors (BSA 2007).

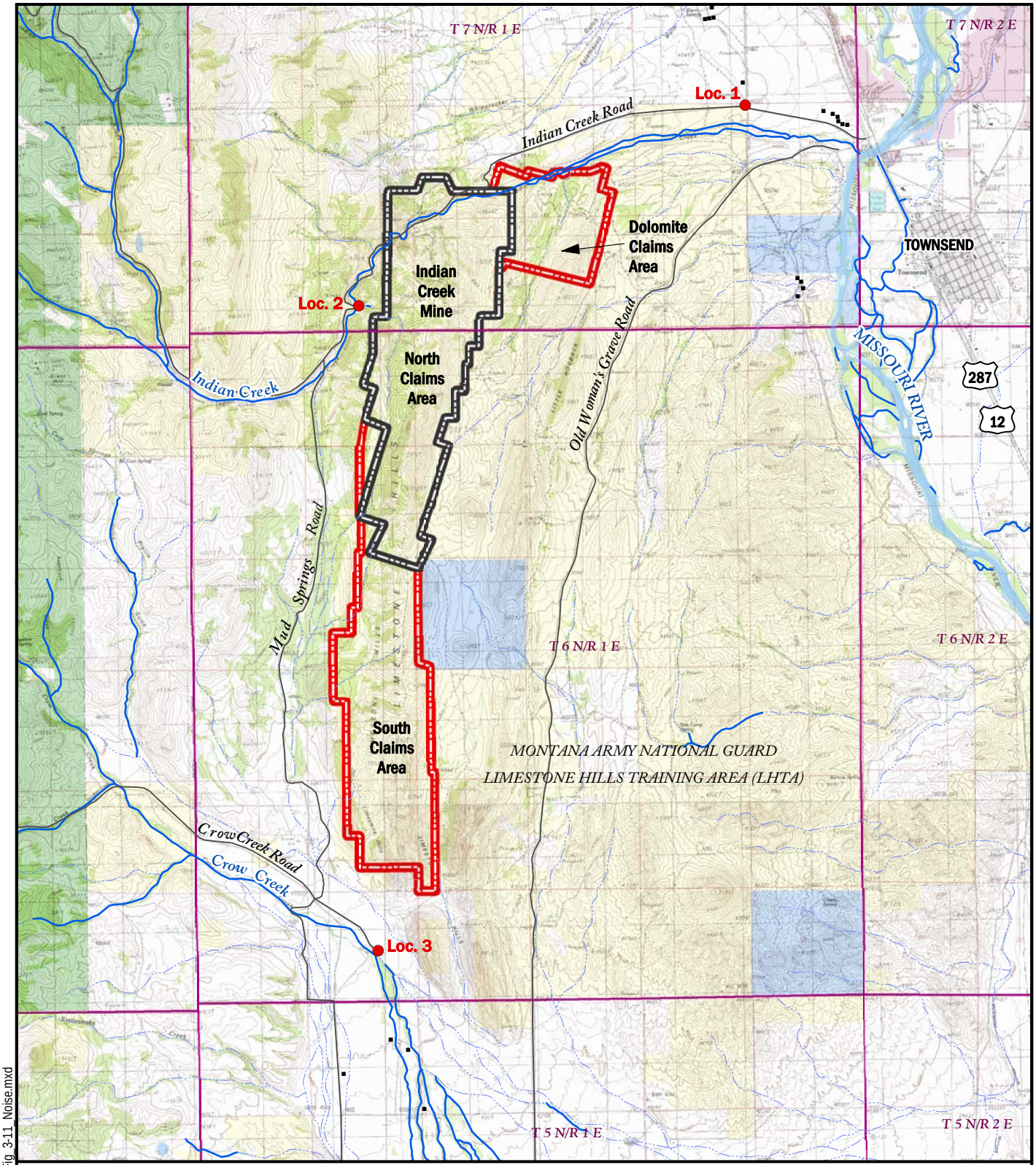
Existing Noise Levels

Ambient noise level measurements were conducted at three representative locations (**Figure 3-8**) within 1 to 3 miles of the Study Area boundary to determine the L_{90} at each location. Measured data were used to estimate the existing L_{dn} at each location. In general, the ambient noise at each location was due to natural sounds, such as birds, insects, and wind in trees or grasses, except at Location 2 where mine plant equipment and haul trucks were audible but faint. **Table 3-17** summarizes the measured ambient noise levels (BSA 2007). The measured L_{90} and estimated L_{dn} levels are typical for sparsely populated, rural locations (Harris 1998). The estimated noise levels are less than the EPA recommended L_{dn} 55 dBA guideline (EPA 1979).

TABLE 3-17
Ambient Noise Level Measurements at Representative Locations

Location	Noise Sources During Measurements	L_{90} (dBA)	L_{dn} (dBA)
1	Dominant noise sources included wind in grass, insects, and vehicles on Indian Creek Road. Mine plant was not audible.	27	34
2	Dominant noise sources included wind in trees and insects. Steady drone from mine plant audible but faint. Haul trucks occasionally visible and audible from ridge approx. 0.9 mile east.	30	33
3	Dominant noise sources insects, birds, wind in trees, and water flowing in creek. Mine was not audible.	24	27

Note: See **Figure 3-8** for measurement locations. L_{90} = 90th percentile-exceeded noise level; L_{dn} = day-night average noise level; dBA = A-weighted decibels.
Source: BSA 2007.



Data Source: Big Sky Acoustic, 2007

N

0 Miles 1.5

Loc. 1 Noise Monitoring Location

Residences

Existing Operating Permit Boundary

Proposed Operating Permit Boundary

Townships

Land Ownership

State of Montana

Bureau of Land Management

Bureau of Reclamation

Forest Service

U.S. Department of the Interior
Bureau of Land Management
Butte Field Office
Butte, Montana

NOISE MONITORING LOCATIONS
Indian Creek Mine Expansion - Environmental Impact Statement
Broadwater County, Montana

FIGURE 3-8

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Impulsive noises from blasting at the mine and from large weapons used at the LHTA are probably audible within several miles of the mine facilities and can vary due to atmospheric conditions at the time of blast including wind speed and direction, temperature, and relative humidity. The L_{pk} noise level due to blasting at the mine quarry was estimated based on the weight of explosive per delay and the distance to the listener (Fidel 1983). Mine blast noise was compared to noise created by artillery used at the LHTA at various distances. For reference, a 60 mm mortar firing is L_{pk} 185 dBP at 2 feet, and an 81 mm mortar firing is L_{pk} 179 dBP at 3 feet (USACHPPM 2007). A 120 mm tank firing is L_{pk} 120 dBP at 2,000 meters (6,560 feet) (USACHPPM 2003). **Table 3-18** is intended to provide a general comparison of mine blasting to noise from mortars and tanks at the same distances. As shown in the table, blasting from the mine is less than the L_{pk} 115 dBP blast annoyance criteria (USACHPPM 2005) within 0.5 mile of the blast location. Mortars exceed the criteria between approximately 1 to 1.5 miles, and the tank exceeds the criteria within approximately 2 to 2.5 miles from the firing location. Although blasts from both the mine and the LHTA are audible for several miles and can vary due to atmospheric conditions, the large weapons used at the LHTA appear to be more likely to cause annoyance at greater distances than blasting at the mine. Although not measured, local area residents claim that noise generated by the railroad located adjacent to U.S. Highway 12/287 creates a greater sustained level of noise than mining operations at the Indian Creek Mine (BSA 2007).

Noise produced by diesel-powered equipment used at the mine is typically 85 dBA at a distance of 50 feet (FTA 1995). The mine or rail facility equipment could be audible at distances up to approximately 1 mile away, depending on shielding provided by surrounding terrain or an open pit, as well as the locations of the equipment, listeners, and the level of other noise sources (BSA 2007).

Haul trucks and employee vehicles access the mine and rail facility along Indian Creek Road. The haul trucks to the rail facility operate 24 hours a day. Graymont employs 48 people at the plant and processing facility. Quarry operations such as drilling, blasting, loading, and hauling are contracted (Graymont 2007a). The speed limit on Indian Creek Road is 35 miles per hour (mph) between US Highway 287 and Desert Road, and 45 mph west of Desert Road.

TABLE 3-18
Estimated Blast Peak (L_{pk}) Noise Levels vs. Distance

Distance	Mine Blast	LHTA 60 mm Mortar (dBP)	LHTA 81 mm Mortar (dBP)	LHTA 120 mm Tank (dBP)
0.5 mile	112	123	121	128
1 mile	107	117	115	122
1.5 miles	104	113	111	118
2 miles	102	111	109	116
2.5 miles	101	109	107	114
3 miles	100	107	105	112

Source: BSA 2007. Note: mm = millimeter; dBP = unweighted peak decibels.

The closest residences to Indian Creek Road are approximately 135 feet from the road east of Desert Road and approximately 300 feet west of Desert Road. Assuming that all 48 cars and approximately 4 haul trucks travel Indian Creek Road during the same hour, estimated noise 135 feet from Indian Creek Road east of Desert Road is approximately L_{eq}(h) 48 dBA, and the estimated noise at 300 fee from Indian Creek Road west of Desert Road is approximately L_{eq}(h) 45 dBA (FHWA 1998). Estimated traffic noise levels are less than MDT's L_{eq}(h) 66 dBA impact criterion (MDT 2001).

DIRECT AND INDIRECT IMPACTS

Proposed Action

Under the Proposed Action, mining would expand into the South Claims and Dolomite Claims areas. Project equipment used for construction, mining, and reclamation activities would include drill rigs, end-dump trucks, dozers, front-end loaders, and other standard construction and earth moving equipment (Graymont 2007a).

Impacts from noise were predicted at various distances from the activities for general information, and at specific locations that represent existing residences. Noise level calculations included the estimated effects of distance, ground attenuation, and attenuation resulting from air absorption per international standards. Although the calculations conservatively assume that atmospheric conditions are favorable for noise propagation, the estimated noise levels can vary due to atmospheric conditions and should be considered average noise levels (ISO 1996).

Mining and quarry operations would continue in the same manner using similar equipment as the current operations. A new crusher would be constructed in the South Claims Area (Graymont 2007a). Noise sources include diesel-powered earth-moving equipment that can typically generate intermittent noise levels of 85 dBA at a distance of 50 feet from the equipment (FTA 1995). Equipment noise can vary considerably depending on age, condition, manufacturer, use during a time period, and a changing distance from the equipment to a listener location. The existing crusher is L_{eq} 63 dBA at approximately 820 feet from the crusher (BSA 2007). Blasting using 125 pounds of ANFO per delay would continue to be used in the South Claims and Dolomite Claims areas (Graymont 2007c). The number of haul trucks and employee vehicles traveling along Indian Creek Road is expected to remain similar to the current volume (Graymont 2007a).

Estimated noise levels are summarized in **Table 3-19**. Estimated noise levels assume a direct line of sight between the receiver and the noise source(s). If the line of sight is blocked due to terrain or the depth of a quarry, the estimated noise level would be reduced by 6 dBA or more due to shielding. Noise levels due to heavy equipment operating during mining operations, haul trucks transporting limestone to the plant facility, and reclamation are predicted to be L_{dn} 49 dBA at 0.25 mile from the Project area (**Table 3-19**), which is less than the EPA guideline of L_{dn} 55 dBA, and the predicted L_{dn} 36 dBA at 1 mile from heavy equipment would be considered typical for sparsely populated, rural locations (Harris 1998). The predicted L_{dn} 31 dBA at 0.5 mile from the crusher (**Table 3-19**) would be considered typical for sparsely populated, rural locations (Harris 1998). The predicted peak blasting noise level for the mine is predicted to be less than the U.S. Army guideline for human annoyance of L_{pk} 115 dBP between 0.25 and 0.5 mile of the blast (**Table 3-19**).

TABLE 3-19
Estimated Noise Levels at Various Distances and Representative Residence Locations from Source(s)

Proposed Action	Equipment / Noise Source(s)	Noise Level at Receiver		
		¼ mile	½ mile	1 mile
Construction, quarry operations, overburden disposal, and reclamation	Four pieces of earth moving equipment operating simultaneously, such as end-dump trucks, bulldozers, front-end loaders, and graders operating continuously for 12 hours during daytime.	L_{eq} 52 dBA L_{dn} 49 dBA	L_{eq} 46 dBA L_{dn} 43 dBA	L_{eq} 39 dBA L_{dn} 36 dBA
Operations — • Crusher	Crusher operating continuously for 12 hours during daytime.	L_{eq} 50 dBA L_{dn} 47 dBA	L_{eq} 34 dBA L_{dn} 31 dBA	L_{eq} 9 dBA L_{dn} 6 dBA
Operations — • Quarry	Blasting – 125 pounds of ammonium-nitrate fuel oil (ANFO) per delay, once per week at 4:00 p.m.	L_{pk} 117 dBP	L_{pk} 112 dBP	L_{pk} 107 dBP[1]

Estimated Noise Levels at Representative Residence Locations from Source(s)

Proposed Action	Equipment / Noise Source(s)	Noise Level at Receiver		
		Location 1	Location 2	Location 3
Construction, quarry operations, overburden disposal, and reclamation	Four pieces of earth moving equipment operating simultaneously, such as end-dump trucks, bulldozers, front-end loaders, graders, etc. operating continuously 12 hours during the daytime.	L_{eq} 35 dBA L_{dn} 33 dBA	L_{eq} 33 dBA L_{dn} 30 dBA	L_{eq} 41 dBA L_{dn} 38 dBA
Operations — • Crusher	New South Claims Area crusher operating continuously 12 hours during the daytime.	L_{eq} <10 dBA L_{dn} <10 dBA	L_{eq} <10 dBA L_{dn} <10 dBA	L_{eq} <10 dBA L_{dn} <10 dBA
Operations — • Quarry	Blasting – 125 pounds of ANFO per delay, once per week at 4:00 p.m.	L_{pk} 105 dBP	L_{pk} 102 dBP	L_{pk} 109 dBP[1]

[1] Blast noise potentially audible for several miles.
L_{eq} = equivalent noise level; L_{dn} = day-night average noise level; L_{pk} = peak noise level; dBA = A-weighted decibels; dBP = unweighted peak decibels. Shading indicates exceedance of US Army guideline of 115 dBP.

Note: Estimated construction and blasting noise levels at Locations 1 and 2 based on operations near the closest Dolomite Claims Area boundary. Estimated construction and blasting noise levels at Location 3 based on operations near the closest South Claims Area boundary. See **Figure 3-8** for locations.

Estimated noise level (per activity) at three existing residences near the claims area boundaries are shown in **Table 3-19** (**Figure 3-8**). The estimated levels assume a direct line of sight between the receiver and the closest claims area boundary. If the line of sight is blocked due to terrain or depth of the quarry, the estimated noise levels would be reduced by 6 dBA or more due to shielding. The L_{dn} noise level at the receiver location would be L_{dn} 38 dBA or less, which is below the EPA guideline of L_{dn} 55 dBA and considered typical for sparsely populated, rural locations (Harris 1998). Noise level at receiver from the new crusher would be less than L_{dn} 10 dBA. The predicted L_{pk} levels at the representative residence locations are predicted to be L_{pk} 109 dBP or lower, which is less than the L_{pk} 115 dBP annoyance criterion.

Comparing the L_{eq} noise levels to measured L_{90} (ambient) levels at a location helps approximate whether a noise source would be audible. **Table 3-19** compares the predicted L_{eq} noise levels with measured L_{90} noise levels at several representative locations. Noise from earth-

moving equipment is predicted to be audible intermittently at Locations 1 and 2, and audible often at Location 3 and at 1 mile from equipment. The predicted noise level at Location 3 is based on equipment being located near the closest point of the South Claims Area boundary to Location 3, and therefore, the predicted equipment noise level would be less when the equipment is located further north of the boundary or shielded by natural terrain. Comparison of L_{eq} and L_{90} noise levels indicates that mining equipment would be audible at all representative locations. Noise levels between approximately 25 and 40 dBA, such as the predicted L_{eq} levels associated with the Proposed Action, are typically considered "faint", if at all audible (Egan 1988).

Alternative A – Modified Pit Backfill

Impacts from noise due to implementation of Alternative A would be the same as those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, existing sources of noise associated with ongoing mining operations would continue at current levels (**Table 3-17**) and for the time period that operations would occur under approved operating permits.

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures for noise have been identified by BLM or DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

No irreversible or irretrievable commitment of resources would result from the creation of noise associated with the Proposed Action.

RESIDUAL EFFECTS

No residual effects would result from noise created during implementation of the Proposed Action. Noise levels would return to ambient conditions in the Project area once mining operations cease.

VISUAL RESOURCES

AFFECTED ENVIRONMENT

The Study Area for visual resources includes all land areas from which the proposed mine expansion would be visible. This includes the area lying east, west and northwest of Townsend, north and northeast of Radersburg, and the eastern slopes of the Elkhorn Mountains.

Landscape of the Study Area is characterized by the Limestone Hills on the east flank of the Elkhorn Mountains. The Limestone Hills include prominent exposed ridges and cliffs with intervening valleys formed by intense folding and subsequent erosion of steeply dipping bedrock units. Elevations in the area rise to over 5700 feet above mean sea level.

Vegetation in the Study Area consists primarily of shrub-dominated upland types of mountain mahogany and Rocky Mountain juniper communities. Rocky Mountain juniper is conspicuous in several shrub- and tree-dominated stands and dominates the visual aspect of many stands. Mountain mahogany stands dominate the crests and upper slopes of limestone ridges, together with limber pine savannah. Natural vegetation patterns are disturbed by active mining operations, wildfires, and reclaimed mine sites. Dominant vegetation colors are gray, gray-green, and olive green. Soil and rock are exposed in numerous areas where vegetative cover is sparse or has been disturbed

by mining activities. Soil color ranges from chalky off-white to beige. Disturbed areas exhibit a wider range of color including chalky white, gray, dark gray, reddish brown, and buff.

Color hues of disturbed areas are stronger than those of undisturbed areas and exhibit greater variation. These colors contrast with surrounding soil and vegetation. Excavated areas vary in color from chalky off-white, gray, and beige contrasting with the gray-green and olive green vegetation.

The existing mine disturbance creates moderate to strong contrasts with horizontal lines, smooth surfaces, blocky and pyramidal forms, and more vivid colors from disturbed soil and rock. Existing disturbances at the Indian Creek Mine consist of exploration roads, drill pads, quarries, and overburden disposal areas creating contrasts with the forms, lines, and colors of the undisturbed landscape.

Visual Resource Inventory

A Visual Resource Inventory was performed by Resource Management Associates, Inc. in 2006. The inventory was conducted in accordance with BLM Visual Resource Management (VRM) objectives. BLM developed the VRM system to classify visual resources based on scenic quality, visual sensitivity, and visual distance zones. These values determine management guidelines and class objectives for specific areas. VRM objectives are shown in **Table 3-20.** The Indian Creek Mine site is located within a VRM Class IV area (BLM 1984).

DIRECT AND INDIRECT IMPACTS

Proposed Action

The Indian Creek Road provides access to the Project site from U.S. Highway12/287. The Southeastern view of the proposed mine expansion in the Dolomite Claims Area would be viewed by travelers on U.S. Highway 12/287 and by Graymont workers and supply haulers going to and from the mine on Indian Creek Road. Mining operations in the South Claims Area would not be visible from U.S Highway 12/287 or the Indian Creek Road. Partial views of the South Claims Area operations would be visible from the Mud Springs Road along the western boundary. A small portion of the South Claims Area operations would be visible to residents of Radersburg looking north-northwest (Resource Management Associates 2006b).

TABLE 3-20
Visual Resource Management Objectives

Class	Objective
I	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
II	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
III	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
IV	The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Source: BLM 2003.

Results of the Visual Resource Management Inventory and contrast ratings indicate that the proposed mine expansion would not exceed visual management objectives for these areas (Resource Management Associates 2006b). The contrast rating for the South Claims Area is "moderate", which corresponds to the Visual Resource Class IV. As the South Claims Area has been determined to be a Visual Resource Class IV, the rating of moderate contrast is acceptable under this area's management objective. Contrast rating for the Dolomite Claims Area is moderate matching the Visual Resource Class IV established for this area (BLM 1984).

The South Claims Area is remote with little public viewing and proposed mine activities would not destroy the landscape's essential form using the VRM methodology. The Dolomite Claims Area is visible to many sections of the public; however, the land around this area has limited public access and existing mine operations are visible in the vicinity (Resource Management Associates 2006b)

Alternative A – Modified Pit Backfill

Implementation of the modified pit backfill methods described under Alternative A in Chapter 2 would reduce the visual effect of highwalls and/or establish varied slope angles to create post-mining landscape more natural in appearance. Use of visually compatible growth media would be emphasized in reclaimed areas visible from public roads. Placement of overburden or cast blasting benches would eliminate the flat terrace features (pit benches) of pit highwalls by breaking up the surface of the benches. The resultant visual element would resemble natural cliff faces or talus slopes.

Establishing vegetation species that are similar to adjacent undisturbed areas would further reduce visual impacts from various locations along public roads in the Project area. Color and texture of vegetation established on various locations along slopes over time would result in visually blending the reclaimed slope areas with adjacent undisturbed areas.

No Action Alternative

Under the No Action Alternative, no visual impacts would occur beyond those created by existing mine operations. Existing mining operations in the North Claims Area will be visible from the Indian Creek Road and U.S. Highway 12/287 for approximately 15 years. Visual impacts will be reduced once reclamation is complete.

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures for visual resources have been identified by BLM and DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irretrievable commitment of visual resources would occur during construction and active mine operations until reclamation is successful. Impacts on visual resources would be reduced through implementation of reclamation measures that reestablish the vegetation mosaic and visual elements associated with vegetation. Rock faces and talus slopes would represent an irreversible commitment of visual resources compared to the pre-mining landscape, but would resemble natural rock faces in the area.

RESIDUAL EFFECTS

Following successful reclamation, weak contrasts in form and line would remain. Straight lines associated with reclaimed slopes of overburden piles and roads would be weakened by color and texture of revegetation

to blend with surrounding landscape. Rock faces would remain visible after reclamation as weak contrast associated with straight lines and color.

SOCIAL AND ECONOMIC RESOURCES

AFFECTED ENVIRONMENT

Broadwater County is the geographical area in which the direct and indirect socioeconomic effects of the Proposed Action and the No Action Alternative are likely to occur. The Proposed Action includes a life-of-mine expansion of limestone and dolomite mining operations at the Indian Creek Mine located approximately 4 miles west of Townsend, Montana. The proposed expansion would encompass approximately 1,940 acres of public land administered by BLM and represents approximately 35 more years of mine production at current rates (Graymont 2007a). Graymont produces calcium oxide (quicklime or lime), hydrated lime, and lime products at the Mine. Broadwater County is the Study Area because the mine and the majority of its employees are located within its boundaries.

Demographics

The county seat and only incorporated city in Broadwater County is Townsend. Other unincorporated towns include Radersburg, Toston, and Winston (NACO 2007). In 2006, the U.S. Census Bureau estimated the population of Broadwater County at 4,572, a 4.3 percent increase since the 2000 census. Townsend had an estimated population of 1,974 in 2006 (U.S. Census Bureau 2007). Sixteen subdivisions totaling 429 lots currently under construction or planned in Broadwater County could increase the population by up to 30 percent (BCBP 2003). These subdivisions are located between Townsend and Helena and primarily serve as bedroom communities for Helena.

Historically, Montana has been one of slowest growing states in the Union. The population is not expected to exceed 1 million until 2015, growing at a rate of approximately 1 percent per year from the 2000 census estimates. Broadwater County is projected to grow at a rate of 1.7 percent almost twice as quickly as the state as a whole between 2000 and 2015 (NPA Data Services, Inc. 2004.).

The median age in Broadwater County was 41.3 in 2000, an increase of 14 percent from 1990 (U.S. Census Bureau 2001). The 2000 census reported 2,002 housing units in Broadwater County with 1,752 households and predicted the number of housing units would increase to 2,030 by 2005. There were 2.47 persons per household, and the median value of owner-occupied housing was $85,500 in 2000.

Infrastructure

Townsend lies approximately 4 miles east of the Indian Creek Mine and has a full complement of residential, commercial, industrial, and community services. The surrounding area is rural with farms and ranches engaged in livestock and crop production.

In 2008, Townsend public schools served 709 students with one elementary school and one high school (Greatschools 2008). Community services include municipal water, sewer, and trash collection; health services; law enforcement from the County Sheriff's office; and a volunteer fire department.

Employment

According to the Economic Profile System, the fastest growing categories under Services and Professional are services which include health, business, legal, engineering, and management services (19 percent of total employment in 2000). Retail trade accounted for 12 percent of total employment in 2000. The majority of the

growth in government employment has been in state and local government. Broadwater County economic activities supported 2,098 full- and part-time jobs in 2000, an increase of 1,031 since 1970, an almost 100 percent increase (**Table 3-21**). Over the last 30 years, job growth in Broadwater County has outpaced that of the state and the nation (Sonoran Institute 2003).

In Broadwater County, the mining industry employed 110 people in 2000, which accounted for 5 percent of total employment and 13 percent of earnings in 2000 (**Table 3-22**).

The Indian Creek Mine is one of Broadwater County's 10 largest private employers and is classified as a basic industry. "Basic industries" are those business and government activities which bring outside income into an area economy. By paying salaries and making purchases with non-local money, Graymont's mine provides a foundation for state and local county economic development by:

- Direct and indirect employment;
- Purchases of goods and services;
- Capital improvements; and
- Property and Net Proceeds Taxes.

TABLE 3-21
Employment by Industry Changes from 1970 to 2000, Broadwater County

	1970	Percent of Total	2000	Percent of Total	New Employment	Percent Change 1970-2000
Total Employment	1,067		2,098		1,031	97
Farm and Agricultural Services[1]	372	34.9	386	18.4	14	4
Farm	360	33.7	324	15.4	-36	-10
Ag. Services	12	1.1	62	3.0	50	417
Mining	19	1.8	89	4.2	70	368
Manufacturing (incl. forest products)	98	9.2	368	17.5	270	276
Services and professional	388	36.4	867	41.3	479	123
Transportation and Public Utilities	26	2.4	80	3.8	54	208
Wholesale Trade	7	0.7	56	2.7	49	700
Retail Trade	179	16.8	245	11.7	66	37
Finance, Insurance, & Real Estate	31	2.9	96	4.6	65	210
Services (Health, Legal, Business, Others)	145	13.6	390	18.6	245	169
Construction	27	2.5	123	5.9	96	356
Government	163	15.3	265	12.6	102	63

[1] Agricultural services include soil preparation services, crop services, forestry services, such as reforestation services, and fishing, hunting, and trapping. Manufacturing includes paper, lumber and wood products manufacturing.
Source: Sonoran Institute 2003.

TABLE 3-22
Mining Industry Employment and Earnings in Broadwater County, 2000

	Employment	Earnings
Mining Production	90	$4,900,000
Mining Processing	20	800,000
Total Mining Industry	**110**	**$5,700,000**
Percent of Total Employment and Earnings in County	5	13

Source: BCBP 2003.

Since its startup in the early 1980s under the management of Continental Lime Company (now Graymont), the Indian Creek Mine has evolved into an important contributor to the Broadwater County/Townsend economic base. In 2003, the Mine employed 36 people with an annual salary and hourly payroll of $1.16 million and purchases of $2.67 million in goods and services from Montana vendors (Chorney 2004).

In 2005, Graymont employed 27 workers directly and contracted 11 other jobs through Quarry Services, accounting for 43 percent of mining jobs in Broadwater County and 0.2 percent of total employment in the county. In addition, Graymont paid approximately $196,000 in property taxes in 2004, about $47,500 in net proceeds tax, and approximately $11,000 to the state Resource Indemnity Trust Tax in 2003 (BCPB 2003; Chorney 2004; Brown 2005).

In 2007, Graymont employed 48 persons and operated the plant on a 24-hour, 7-days-per-week schedule. The quarry contractor operates a 10-hour shift per day for four days. Annual payroll at the Plant is approximately $1.65 million. The quarry contractor payroll is about $800,000.

Unemployment rates in Broadwater County have been relatively stable since 2000 at a rate similar to that of the State of Montana (**Table 3-23**). This indicates a relative economic stability for the county, particularly as the unemployment rate for the United States has increased since 2003.

TABLE 3-23
Annual Unemployment Rates, 2000-2005 for Broadwater County and State of Montana

	2000	2001	2002	2003	2004	2005
Broadwater County	4.7	5.5	4.0	4.9	3.9*	3.7*
State of Montana	5.0	4.6	4.6	4.7	4.3*	4.0*

Source: US Department of Labor 2004; *Source: Montana Department of Labor and Industry 2005.

Income

Personal Income is defined as all income received by individuals from all sources: income from work (labor income or earnings); income from non-labor sources such as income from savings and investments (investment income); and income from outside sources, such as social security or Medicare (transfer payment income). In 2003, total personal income in Broadwater County increased 19.5 percent from $77 million to $92 million. Rate of growth for Montana during the same period was 22 percent (**Table 3-24**). Broadwater County had higher growth in non-labor sources, dividends, interest, rent, and personal current transfer receipts than the State of Montana.

TABLE 3-24
Personal Income by Type, 1993-2003, for Broadwater County and State of Montana (in millions of 2003 dollars)

Category	Broadwater County			Montana		
	1993	2003	Percent Change	1993	2003	Percent Change
Total Personal Income	77	92	19.5	19,115	23,327	22
Labor Sources	45	52	16	12,011	15,076	26
Non-Labor Sources	31	40	29	7,104	8,251	16
Dividends, interest and rent	17	19	12	3,963	4,359	10
Personal current transfer receipts	14	21	50	3,142	3,892	24

Source: Sonoran Institute 2007.

Almost 43 percent of total personal income in Broadwater County is derived from Non-Labor sources, including 22 percent from investment income and 21 percent from transfer payment income (**Table 3-25**). The percentage of non-labor personal income reflects the 32 percent of the population in 2000 that was 65 years of age or older and no longer in the labor force. Travel and recreation employment account for 3 percent of personal income in Broadwater County (BCPB 2003). Income from wages and salaries is lower in Broadwater County than for the state as a whole: in 2004, the state average earnings per job were estimated at $30,878, while Broadwater County average earnings per job were approximately $22,432 (Fedstats 2007).

TABLE 3-25
Income by Type, 2000, Broadwater County and State of Montana (in millions of 2000 dollars)

	2000 Broadwater County	Percent of Total	2000 State of Montana	Percent of Total
Labor Income				
Wage and Salary Income	30	36	9,987	49
Other Labor Income	4	5	1,306	6
Proprietor's Income	10	12	2,014	10
Non-Labor Income				
Investment Income	19	22	4,623	23
Transfer Payment Income	17	21	3,275	16

Source: Sonoran Institute 2003.

Median household income and personal income per capita are commonly used to evaluate the relationship within a community or county with regard to personal income (**Table 3-26**). Broadwater County outpaced the State of Montana's growth between 1999 and 2004 in median household income but was outpaced by the State of Montana in personal income per capita for that same period.

TABLE 3-26
Median Household and Personal Income, 1989, 1999, and 2004 for Broadwater County and Montana

	1989[1]	1999[2]	Percent Change 1989-1999	2004[3]	Percent Change 1999-2004
Median Household					
Broadwater County	$20,257	$32,689	61.3	$35,899	9.8
State of Montana	$22,988	$33,024	43.7	$35,574	7.2
Personal Income Per Capita					
Broadwater County	$10,125	$16,237	60.4	$22,782	40.3
State of Montana	$11,213	$17,151	52.8	$27,657	61.3

Sources: [1] US Census 1997; [2] US Census 2001; [3] US Census Bureau 2007.

Government and Public Finance

In fiscal year (FY) 2005-2006, Broadwater County had a budget of $7,263,072. The two primary sources of local government revenues in Montana are intergovernmental transfers (funds passed through from federal and state governments, such as grants-in-aid and payments in lieu of taxes (PILT) for publicly owned land for forgone property tax revenues) and local taxes and assessment. In fiscal year 2006, BLM paid $369,374 (5.1 percent of the budget) to Broadwater County for compensation for BLM and other federal land within the county (Tomeo 2007).

In 2000, mining ranked fourth in the value of taxable income, with Utilities, Residential, and Agriculture in the first, second, and third ranking, respectively (**Table 3-27**).

TABLE 3-27
Major Classes of Taxable Valuation, Broadwater County, 2000

Type of Property Value (Tax Rate)	Taxable Value	Percent of Taxable Value	Assessed
Utilities (12%)	$3,122,000	30%	$28,029,000
Residential (3.6%)	2,690,000	26%	75,057,000
Agriculture (3-3.6%)	1,450,000	14%	42,663,000
Mining	811,000	8%	22,455,000
Commercial/Industrial (3.6%)	626,000	6%	17,696,000
Railroad (4.27%)	614,000	6%	13,641,000
Telecommunications (6%)	579,000	6%	9,651,000
Other	371,000	4%	38,214,000
Total	**$10,254,000**	**100%**	**$224,716,000**

Source: BCBP 2003.

In FY 2006, Broadwater County collected $3.5 million in property tax revenues; Graymont paid over $77,200 of those taxes for its Indian Creek property (Nelson 2007). Net Proceeds Tax is a tax classification in which proceeds from non-metal mining production are taxed. Graymont is the only contributor to Net Proceeds Tax in Broadwater County (BCBP 2003) Between 2003 and 2006, Graymont's net proceeds revenues increased by almost 60 percent, while the County tax revenues increased 18 percent (**Table 3-28**).

TABLE 3-28
Estimated Property Tax Receivables Fiscal Year 2003 for Broadwater County

Type of Property Tax	Property Tax Amount FY 2003[1]	Property Tax Amount FY 2006[2]
Real Estate Property Tax	$2,780,156	$3,502,371
Mobile Home Tax	90,530	96,556
Personal Property Tax	91,429	66,918
Net Proceeds (Graymont)	48,490	77,217
Utilities	1,550,571	1,641,811
Total	**$4,561,175**	**$5,384,873**

Sources: [1] Gillespie 2004; [2] Nelson 2007.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Mining and Mineral Production

Implementation of the Proposed Action would allow mining and lime processing operations at the Indian Creek Mine to continue at current production rates for approximately 50 years, including 15 years of currently permitted life-of-mine.

Direct Employment and Income

The current direct employment and income trend would continue for an additional 35 years (50 years total) subject to market conditions. Implementation of the Proposed Action would generate a payroll in excess of $82 million over the life-of-mine in 2007 dollars.

Indirect Employment and Spending

The current employment trend would continue during the 50-year expansion period. Indirect payroll amount over the expansion period would be approximately $40 million in 2007 dollars.

Given the average annual wage in Broadwater County for 2004 of $22,432, the inferred annual payroll for this indirect work force is approximately $1,435,648. These indirect workers (retail employees, teachers, and service workers) in Broadwater County would have a stable and longer employment horizon in conjunction with the proposed life-of-mine expansion period. Extrapolated combined annual wages of this group considered over the additional 35 year life-of-mine is estimated to be $71.7 million in 2007 dollars.

In 2005, 25 of 27 Graymont employees lived in Broadwater County (MTARNG/BLM 2007), and it is reasonable to assume the ratio is similar among the 2007 workforce and that many of the contract workers also live in the county and would continue to do so as a result of the life-of-mine expansion.

Graymont would continue to purchase goods and services in Montana throughout the life-of-mine period. In 2003, Graymont spent

$2,675,526 on purchases from Montana vendors. This spending also creates employment and income although the effects are not quantifiable. In 2005, a combined amount of $5.1 million was spent on contracted services and purchases from Montana vendors (Chorney 2007).

At the 2003 expenditure rate, the life-of-mine expansion (35 years) would result in expenditures with Montana vendors in excess of $133 million (2003 dollars). Employment associated with these expenditures would likely remain at current levels over the period.

Tax and Fee Distributions

In 2004, Graymont contributed $14,918 to the Resource Indemnity Trust Tax fund. Extended tax distribution over the life-of-mine period would include nearly $750,000 to the Resource Indemnity Trust Tax fund in 2004 dollars. In addition, Graymont paid $146,379 in income tax to the state in 2004. Extended over the life-of-mine, about $7.3 million in income tax would be paid to the state.

In 2003, Graymont paid Broadwater County $195,808 in property taxes as well as $47,490 in annual net proceeds in 2004 (Brown 2005). This amount is derived from the taxable value of Graymont's lime operations in the tax year (BCPB 2003). In 2006, Graymont paid approximately $77,200 in Net Proceeds Tax to Broadwater County. In 2005, Graymont was the only contributor to Net Proceeds Tax revenue for Broadwater County (BCPB 2003). The life-of-mine expansion would maintain the income generated from the Net Proceeds Tax, which could exceed $9.7 million in property taxes in 2003 dollars and over $3.8 million in Net Proceeds Tax in 2006 dollars. Streams of federal and state income tax revenues would be extended as derived from personal income tax paid by workers at the facility throughout the life-of-mine.

Alternative A – Modified Pit Backfill

Impacts to social and economic resources from implementation of Alternative A would be the same as those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, mining and lime production would continue at the Indian Creek Mine for approximately 15 years. Graymont would continue to employ a staff commensurate with the current rate of production and subcontractors to provide the goods and services necessary to support the mining operation over the 15-year period. At the end of mining and production operations employees would be transferred to other Graymont operations or provided a separation package at termination. A cascading employment reduction effect may also occur with downstream jobs potentially effecting as many as 96 indirect jobs in the regional economy. The net effect to regional employment would continue downward in the absence of mine spending on goods and services Graymont purchases from Montana vendors.

With mining operations coming to a close at the end of the current operating period, the State of Montana would lose contributions to the Resource Indemnity Trust Tax fund and the taxable income generated by mine operations. In addition, Broadwater County would lose a portion of property taxes derived from the mine as well as revenue derived from annual net proceeds.

The effect on tax receipts for local and state government for the remaining 15 years of mine life under the No Action Alternative and for the Proposed Action are shown in **Table 3-29.**

TABLE 3-29
Alternative Comparison of Tax Contributions
Indian Creek Mine

Tax	No Action (Life-of-Mine15 years)	Proposed Action (Life-of-Mine 35 years)	Total
Property Tax	2.9 million	6.8 million	9.7 million
Net Proceeds	1.1 million	2.7	3.8 million
Resource Indemnity Trust	.225 million	.525 million	.75 million
State Income Tax	2.2 million	5.1 million	7.3 million

Source: BCPB 2003; Brown 2005.

POTENTIAL MONITORING AND MITIGATION MEASURES

No monitoring or mitigation measures for social and economical resources have been identified by BLM or DEQ.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

No irreversible or irretrievable commitment of socioeconomic resources is expected to occur as a result of the Proposed Action.

RESIDUAL EFFECTS

No residual effects to social or economic resources are expected to occur.

CULTURAL RESOURCES

AFFECTED ENVIRONMENT

The Study Area for cultural resources encompasses proposed mine development in the South Claims and Dolomite Claims areas of the Indian Creek Mine. Cultural resources are considered archaeological, historic, or architectural properties, buildings, structures, objects, and districts, as well as properties of traditional cultural importance to living communities. Cultural properties can be prehistoric, historic, or both prehistoric and historic in age. Historic properties are those cultural properties which meet both the criteria for significance and for integrity established by the Secretary of the Interior and are therefore eligible for listing on the National Register of Historic Places.

Previous Surveys and Studies

In 1979, Montana State University conducted a cultural and paleontological resource inventory of the MTARNG LHTA, which included the Study Area. That survey resulted in identification and documentation of 87 historic and prehistoric cultural properties, of which 15 were within the Study Area (Davis *et al.* 1980). Since the 1979 inventory, an additional five cultural properties have been identified and recorded within the Study Area.

A bibliographic search of records by the Montana State Historic Preservation Office (SHPO) identified references to eight subsequent cultural resource studies conducted at locations within the Study Area. These subsequent studies were conducted at an inventory level investigation; no excavations were performed. The studies were conducted in response to development activities within the Study Area. Collectively, these datasets indicate the Study Area has been examined for cultural resources; information concerning the character of those resources has been collected; and additional inventory work is unlikely to identify cultural resource properties differing substantially from those already known.

Native American Cultural Resources

Archaeologists working on the northwestern plains have found evidence of human occupation extending over 11,000 years. Archaeological material from various sites characterized by distinctive tool types and geographic and/or temporal distributions are the basis for defining cultural complexes. Cultural complexes in the northern plains have largely been defined and identified on the basis of similar diagnostic projectile point forms and/or ceramics found in various assemblages (**Figure 3-9**). The cultural periods and their general defining characteristics are described below.

Early Prehistoric Period.

Dating from ca. 11,000 to 8,000 radiocarbon years before present (BP), this period contains a number of archaeological complexes some of which are characterized by projectile point styles presumably designed for use on heavy throwing or stabbing spears. The primary Early Prehistoric Period complexes and phases presently identified in Montana include Clovis, Goshen, Folsom, Agate Basin, Hell Gap, Alberta-Cody, and the early part of Plains/Mountain.

Middle Prehistoric Period

The period from ca. 8000 to 1300 BP is characterized by projectile point types presumably designed for use with a spear thrower or atlatl. Evidence of stone boiling in the form of water fractured fire cracked rock is abundant throughout the Middle Prehistoric period. Water fractured fire cracked rocks (FCR) are stones which have been heated to high temperatures and then dropped into a water filled container and fractured.

Water fractured rock is interpreted as a food processing or food preparation technique (stone boiling) used for such activities as rendering grease from bone pieces, or cooking meat and other foodstuffs. The presence of fractured rock at a prehistoric site reflects a campsite where a range of domestic cultural activities occurred.

Pottery also appears during the latter part of the Middle Prehistoric period within some cultural complexes. Middle Prehistoric Period complexes or phases characterized by side-notched projectile point forms include Mummy Cave, Oxbow, Sandy Creek, and Besant. Complexes characterized by lanceolate, stemmed, or corner notched forms include the latter part of Plains/Mountain, McKean, and Pelican Lake.

Late Prehistoric Period

The period from ca. 400 BP to proto historic/historic times is characterized by projectile points intended for use with the bow and arrow. Point forms include a variety of un-notched, stemmed and notched forms. Bison hunting remained the primary subsistence activity in the plains of central and northern Montana, and a diversified hunting and gathering economy characterized groups in southern and western Montana. Communal bison kills, which involved coordinated efforts by groups of hunters driving a number of animals over cliffs, into corrals, or other natural traps, are present throughout the archaeological record, but reach a peak in both number and magnitude during the Late Prehistoric period.

Proto-historic/Historic Periods

In the northwest plains, the Proto-historic Period is usually defined as the time between arrival of the horse and/or manufactured trade goods on the northern plains but before arrival of white traders/explorers. The Proto-historic Period was of relatively short duration for Native American groups of Montana. Depending upon the authority cited, the Proto-historic Period may have lasted for no more than 100 years beginning early in the 18th Century with its end, and the beginning of the Historic

Period, marked by the Lewis and Clark expedition passing through the area in the first years of the 19th Century. Historically, the Study Area was primarily occupied by Salish speaking groups such as the Flathead (Kroeber 1939; Kehoe 1992).

Native American Cultural Properties within the Study Area

To date 15 Native American cultural resource properties have been identified and documented within the Study Area. These sites are classified as lithic scatter and are largely characterized by pieces of chipped stone. One site is associated with a tipi ring. Lithic scatter sites presumably reflect locations where chipped stone tool production was the primary or only activity taking place. Occasionally cores and complete or broken stone tools may also be present.

Existing documentation is not clear whether any of these properties has been excavated or shovel tested. Time diagnostic projectile point forms suggest Middle Prehistoric use at one site and Late Prehistoric use at one site. The age and cultural association of the remaining sites are indeterminate.

The National Register of Historic Places' eligibility for all Native American cultural properties within the Study Area is identified by the Montana State Historic Preservation Office (2007) as undetermined or unresolved.

Historic Euro-American Cultural Properties within the Study Area

Non-Indian settlement within the Study Area began in 1866 with the discovery of placer gold deposits in the Indian Creek drainage. The northern margin of the Study Area is located within the Park-Indian Creek Mining District (aka Hassel districts). Mining of placer gold deposits within the Indian Creek drainage started in 1866, with lode deposits subsequently identified upstream that were initially mined in 1875. Placer mining was hampered by seasonal availability of water. A dam and associated ditches and flume were constructed in the 1870s to control the flow of water in order to extend the placer season. After the turn of the century, mining within the district was reduced, but limited hardrock mining continued into the Depression Era. Beginning around 1940, gravel on lower Indian Creek was reworked using dry land dragline dredges. These operations were closed by Federal order during World War II, but resumed in 1946 and continued until 1950.

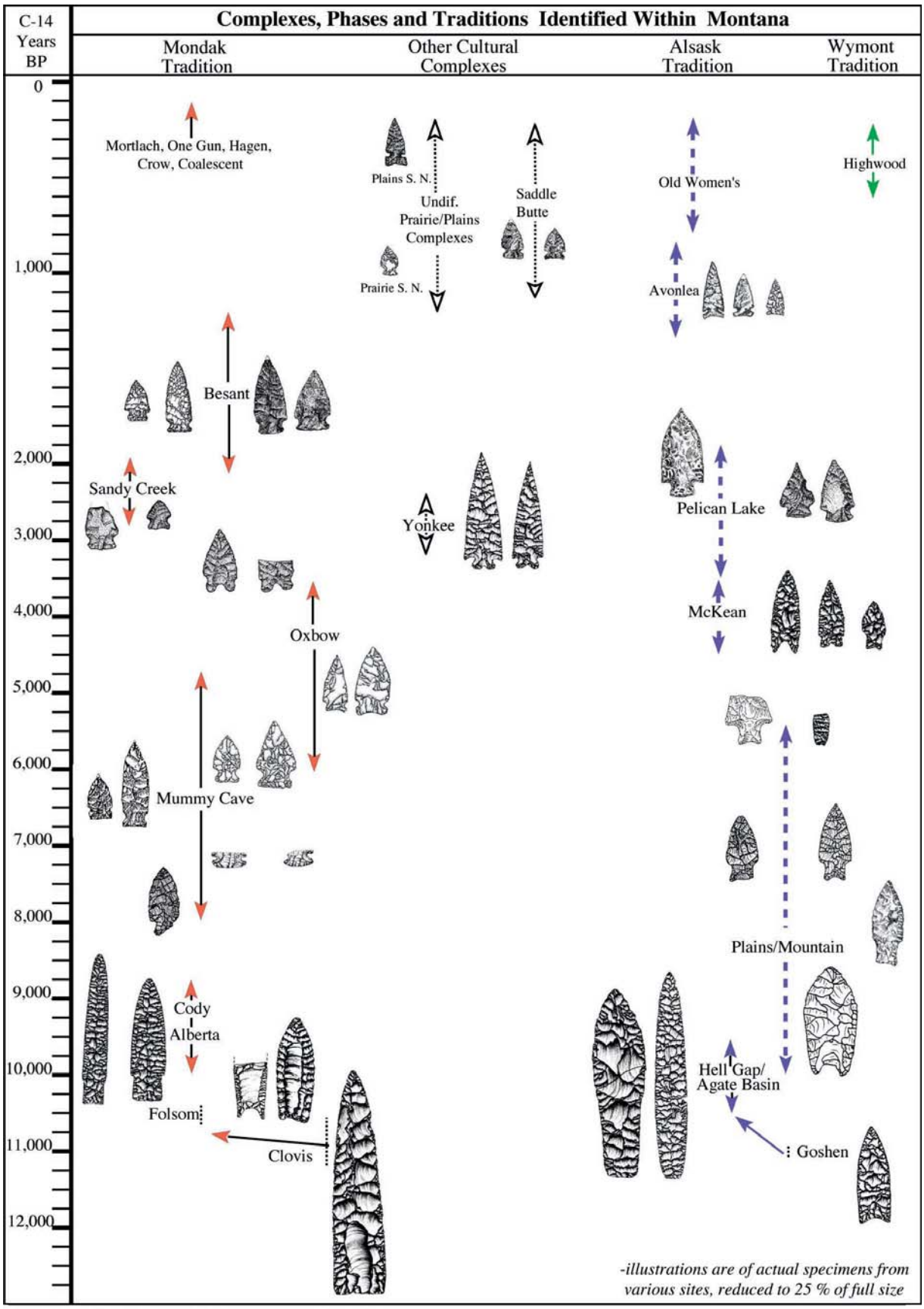
One historic cultural property has been identified within the Study Area. The site consists of an historic building foundation and roadbed segment, which may or may not be mining related. Numerous unassociated prospecting pits are also present in the Study Area and appear to be remnants of gold and silver prospecting that occurred during the late 19th century and again in the Great Depression era of the 20th century.

Historic agricultural settlement within the general Project Area as evidenced by homestead and cash entries was first attempted in the early 1900's and continued into the late 1930's. Most of the public domain within the Study Area was never filed upon and that which was, subsequently was either relinquished or cancelled. No cultural resource properties reflecting historic agricultural settlement have been identified to date within the Project Area.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Analysis of artifacts recovered from site investigations is contained in reports to BLM



Prehistoric Cultural Sequence for Montana

U.S. Department of the Interior Bureau of Land Management Butte Field Office Butte, Montana	CULTURAL SEQUENCE Indian Creek Mine Expansion - Environmental Impact Statement Broadwater County, Montana	FIGURE 3-9

and the State Historic Preservation Office for inclusion in the Statewide Inventory. Documentation of 15 Native American sites and 1 Historic cultural property identified within the Study Area has been completed. The status of these sites for listing on the National Register of Historical Places remains undetermined.

Twelve of the Native American cultural sites (lithic scatter) lie within the proposed disturbance boundary and could be affected by future mine operations. Of these, Graymont has identified four which could potentially be avoided through adjustment to haul routes and/or other mine facilities. Some or all of the remaining eight sites and features could be lost under the Proposed Action. Graymont has indicated that the Historic cultural property lying within the proposed disturbance boundary could likely be avoided.

Some loss to archaeological resources occurs due to mining related disturbance within the Study Area to sites determined not eligible for the National Register. All sites represent nonrenewable pieces of America's prehistoric or historic past. Recordation of these sites preserves a written record of their existence to be used by future researchers interested in understanding Montana's past. Mitigation of cultural resources preserves a picture of the past through scientific archaeological research.

Archaeological sites do not remain intact forever. The paleo-environmental record of Montana exhibits evidence of natural erosive forces that eradicate previous traces of human presence. These erosive forces continue to the present day. As a result, recovery of scientific information from sites within the Study Area reveals knowledge that would otherwise be lost.

Alternative A – Modified Pit Backfill

Impacts to cultural resources from implementation of Alternative A would be the same as those described for the Proposed Action.

No Action Alternative

Potential impacts on cultural resources in the proposed mine expansion area would not occur as a result of the No Action Alternative. Previous EA documents (DEQ 1993, 2001) concluded that cultural resources in the North Claims Area would not be affected by existing permitted mining operations.

POTENTIAL MONITORING AND MITIGATION MEASURES

In accordance with the provisions of the National Historic Preservation Act, eligibility of unresolved or undetermined properties would be formally determined prior to any mining related disturbance. Sites determined as eligible would be mitigated prior to any mining disturbance. In the event new sites are discovered during mining operations, Graymont would notify the BLM authorized officer. Activities that could occur after notification include cessation of mining activity in the area of discovery, verification and preliminary inspection of discovery, and development/implementation of plans to avoid or mitigate the site. Mitigation measures would be developed with BLM and SHPO representatives and may include archival recordation of the site(s).

BLM and SHPO are currently considering excavation and further documentation at five sites within Graymont's Indian Creek Mine

operations. One site lies within the currently permitted North Claims Area; one site lies outside the proposed mine expansion disturbance boundary; three sites lie within the proposed mine expansion disturbance boundary, one of which has been identified by Graymont as potentially avoidable.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Implementation of the Proposed Action could result in loss of up to twelve known Native American cultural properties and one Historic cultural property. Loss of these features would constitute an irreversible commitment of a resource.

RESIDUAL EFFECTS

No residual effects to cultural resources are expected to result from implementation of the Proposed Action.